University of Zurich[UZH]

IKMZ – Department of Communication and Media Research

Working Paper – Media Change & Innovation Division

Cyborgization Imaginaries in Online Pioneer Communities: A Computational Grounded Theory Study of Human Augmentation

MEDIA CHANGE and innovation a division of ikmz

Giulia Frascaria, Daniela Jaramillo-Dent, Michael Latzer

November 2026

Abstract

Human Augmentation technologies like wearables, brain-computer interfaces and microchip implants extend human cognitive and physical capacities through direct integration with the body, thereby enabling cyborgization. As these technologies enter early stages of diffusion in society, pioneer communities, particularly transhumanists who advocate for the technological control of human evolution, shape their development through experimentation, debate and speculation. Yet the influential imaginaries emerging from these communities are underexplored, particularly in online spaces where transhumanist communities primarily gather. Drawing on a computational grounded theory analysis of 198,003 posts and comments from transhumanist Reddit communities, we identify and conceptualize three cyborgization imaginaries: Human Enhancement, New Social Order, and Posthuman Horizon. We organize these imaginaries along two axes: utopian versus dystopian, and inevitable versus contingent imaginaries. We further show how the disruptive release of generative Artificial Intelligence has triggered new imaginaries centered on Artificial General Intelligence (AGI) and the technological singularity. Since imaginaries in pioneer communities shape expectations around future governance and design, these findings are relevant for researchers, industry, and regulators.

Keywords: sociotechnical imaginaries; human augmentation; transhumanism; online communities; artificial intelligence; computational grounded theory

PLEASE CITE AS

Frascaria, G., Jaramillo-Dent, D., Latzer, M. (2026). Cyborgization Imaginaries in Online Pioneer Communities: A Computational Grounded Theory Study of Human Augmentation. Working Paper – Media Change & Innovation Division. University of Zurich, Zurich.

CONTACT

Giulia Frascaria, g.frascaria@ikmz.uzh.ch

University of Zurich
IKMZ – Department of Communication and Media Research
Media Change & Innovation Division
Andreasstrasse 15
8050 Zurich

http://www.mediachange.ch

@IKMZmediachange

This research project received funding from the Digital Society Initiative (DSI).

Author's original manuscript – this version has not undergone peer review.

1. Introduction and Background

Cyborgs, understood as 'cybernetic organisms' that merge human biology with technological systems (Clynes & Kline, 1960), are no longer confined to science fiction. An estimated 50,000 individuals worldwide carry subcutaneous microchip implants for convenience purposes (e.g. contactless payment and building access) (Malekos Smith, 2024). In January 2024, Neuralink implanted its first brain-computer interface in a human patient (Neuralink, 2025), with the long-term goal to "connect humans and computers" to mitigate the risk of an AI superintelligence (BBC News, 2024). These applications exemplify the process of cyborgization, understood as the integration of computational systems with the human body to enhance biological functions (Greguric, 2021). Cyborgization marks a stage in digitalization toward transforming the human constitution (Latzer, 2022, 2026; Schütze & Latzer, 2026) and reflects the transhumanist aspiration to enhance human capacities beyond biological limitations through technological means (Bostrom, 2005; More, 2013). Cyborgization is enabled by Human Augmentation (HA) technologies, including wearable devices, microchip implants, and brain-computer interfaces (BCIs), and research and market projections anticipate significant sector growth and rising adoption (Polaris Market Research, 2023; Frascaria et al., 2026b).

While initially developed for medical purposes such as cochlear implants and deep brain stimulation, HA technologies are increasingly used for non-medical augmentation of human capabilities (Frascaria et al., 2026b). They range from external wearables that monitor physiological data to invasive BCI implants that interface directly with the nervous system, with emerging research focusing on cognitive augmentation through integration with Artificial Intelligence (Frascaria et al., 2026b). We understand the development of HA technologies as part of the broader digitalization of societies (Latzer,

2022, 2026), conceptualized as a co-evolutionary, socio-technical process involving three interconnected transformations: the datafication of life domains, the algorithmization of decision-making, and the platformization of markets. This process is shaped by transhumanist ideology, which is characterized by a strong faith in the technical controllability of human evolution (Latzer, 2022, 2026). HA technologies constitute a concrete manifestation of this process, as they enable the platformization of the body (Pedersen, 2020). Empirical studies show that adoption of these technologies in the general population remains limited and is slowed by significant concerns regarding for example cybercrime and privacy violations (Frascaria et al., 2026a, 2026b). Despite the acknowledged risks, groups of early users develop, debate and speculate on augmentation technologies ahead of the general population (Frascaria et al., 2026a).

Early users of augmentation technologies constitute what Hepp (2016) terms pioneer communities, i.e. collectives that engage with emerging technologies at early stages of development, before widespread adoption. These communities play a central role in shaping technological trajectories by producing visions, norms, and expectations that influence how technologies are understood, developed, and eventually adopted by broader populations (Appadurai, 2013; Hilgartner, 2015). In the context of human augmentation, pioneer communities include biohackers who perform experimental body modifications (Lupton, 2016), and Quantified-Self practitioners who systematically self-track and optimize (Yetisen, 2018). Additionally, while material experimentation with augmentation technologies remains concentrated in small local communities (Frascaria et al., 2026b), online platforms have become the primary spaces where transhumanist communities discuss emerging technologies (Bainbridge, 2017).

The discussions taking place in online spaces give rise to sociotechnical imaginaries, understood as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures" (Jasanoff, 2015, p. 4). The concept has subsequently been extended to community-level visions that are multiple, contested, and discursively constructed rather than stable or institutionally fixed (Jasanoff, 2015; Kuchler & Stigson, 2024; Mager & Katzenbach, 2021; Cave et al., 2020). Imaginaries have become a prominent analytical lens for studying emerging technologies including algorithms (Bucher, 2016), AI (Brause et al., 2025; Sartori & Bocca, 2023), cryptocurrencies (Jacobetty & Orton-Johnson, 2023), the metaverse (Gorichanaz, 2023), and quantum technologies (Pöhlmann et al., 2024). These studies exemplify how distinctive imaginaries emerge around novel technologies and influence their material and institutional trajectories. Online platforms have become sites for studying community imaginaries, and a growing body of work developed mixed-methods approaches that combine computational text analysis with qualitative interpretation to reconstruct imaginaries from large-scale online discourse (Andreotta et al., 2019; Phadke et al., 2021; Pöhlmann et al., 2024). Yet despite growing interest in public perceptions of augmentation technologies, a recent systematic review highlights that existing studies have focused on general-public perceptions or on local pioneer community practices, overlooking online spaces (Frascaria et al., 2026b). As a result, little is known about how pioneer communities construct imaginaries of human augmentation technologies in their online discussions.

This gap is consequential because the visions produced in pioneer communities are subsequently taken up by developers, policymakers, and the broader public, shaping research agendas, investment priorities, regulatory frameworks, and public acceptance (Appadurai, 2013; Hilgartner, 2015; Jasanoff, 2015; Mager & Katzenbach, 2021).

Concrete cases show how community discussions can shape the trajectories of the technologies they engage with. Early Internet pioneer communities articulated imaginaries of openness, decentralization, and permissionless innovation that translated into architectural choices such as the end-to-end principle and open protocols, as well as into the institutional arrangements such as the IETF and ICANN that still govern the network today (Turner, 2010; ten Oever, 2021). Coleman (2013) shows how Linux and free software communities cultivated norms of openness and collaboration that continue to shape how open-source software is developed and distributed. Hilgartner (2015) similarly argues that vanguard visions articulated by pioneer communities rendered advances in synthetic biology appealing to wider publics, contributing to the field's success. Recently, Hepp (2026) characterized this dynamic as *quiet futuring*, understood as the less visible but impactful articulation of radical future visions within pioneer communities, which are subsequently disseminated as *loud futuring* by corporate actors and Big Tech. Understanding the imaginaries that emerge from these communities is therefore essential for anticipating how augmentation technologies may be developed, adopted, and governed. To address this gap, this study is thus guided by the following research question:

What imaginaries emerge from online pioneer community discussions on human augmentation technologies?

To answer this question, we focus on Reddit, whose community-based structure supports sustained, topic-specific discussions (Proferes et al., 2021). The study makes three contributions. First, through a computational grounded theory analysis (Carlsen & Ralund, 2022) of approximately 198000 Reddit posts and comments across three relevant

communities, we present a first characterization of the imaginaries that emerge from online community discussions about human augmentation technologies, which we conceptualize as *cyborgization imaginaries*. Second, we highlight the role of Artificial Intelligence in these imaginaries showing how, after the disruptive release of generative AI models, the vision of an upcoming Artificial General Intelligence (AGI) has come to dominate these imaginaries, reframing human-AI integration as a necessary response to an anticipated technological singularity (Kurzweil, 2026). Third, we offer a methodological contribution by combining topic modeling, topic network analysis, and qualitative coding within a computational grounded theory framework for the study of online community discourse (Nelson, 2020; Carlsen & Ralund, 2022) and provide an open-source software tool[1] that supports the proposed approach.

2. Methodology

2.1 Methodological framework and analytical lens

We employ a Computational Grounded Theory (CGT) approach (Nelson, 2020; Carlsen & Ralund, 2022), which extends grounded theory by incorporating computational methods while preserving the interpretive depth required for theory generation. We adopt a Straussian approach (Corbin & Strauss, 2008), using sensitizing concepts drawn from existing literature while remaining open to inductively emerging categories (Charmaz, 2014). The overarching sensitizing concept is that of sociotechnical imaginaries, building on Mager and Katzenbach's (2021) 'future imaginaries' as multiple, contested, and commodified. To operationalize this for discourse analysis, we draw on the

[1] Available at https://figshare.com/s/a2206695081e41fcd62b

Sociotechnical Imaginaries in Public Communication (SIPC) framework (Brause et al., 2025), treating its dimensions as sensitizing concepts.

Table 1. Characteristics of analyzed Subreddits at the time of data collection

Subreddit	**Subreddit description**	**Members**
r/futurology[2]	"A subreddit devoted to the field of Future(s) Studies and evidence-based speculation about the development of humanity, technology, and civilization."	21M
r/singularity[3]	"Everything pertaining to the technological singularity and related topics, e.g. AI, human enhancement, etc."	3.5M
r/transhumanism[4]	"This forum is dedicated to the examination of advanced technologies and their implications for human evolution, encompassing fields such as artificial intelligence, biotechnology, and cybernetics. We promote rigorous, evidence-based discussions regarding the role of technology in enhancing and transforming human capabilities.".	85k

2.2 Data Collection

Reddit was selected because its community-based structure supports sustained, topic-specific discussions, and its semi-anonymous environment encourages discussion of ethically sensitive topics (Proferes et al., 2021). Following the AoIR ethical guidelines

[2] https://www.reddit.com/r/Futurology/

[3] https://www.reddit.com/r/singularity/

[4] https://www.reddit.com/r/transhumanism/

for internet research (Franzke et al., 2020), we paraphrased long excerpts and excluded usernames to avoid identification through reverse search online (Proferes et al., 2021). We collected data from three relevant subreddits in the top 1% of Reddit's communities by member count[5] (Table 1). Using a list of 13 keywords relevant to HA (e.g., *BCI*, *brain-computer*, *cyborg*, *implant*, *microchip*), we retrieved posts and all associated comments through the Reddit API[6]. After deduplication and removal of automoderator content, the final corpus comprises 3,914 posts and 194,089 comments collected between subreddit creation and June 2025. The complete list of keywords and the raw number of posts and comments retrieved per-keyword, per-subreddit are available as supplementary material. For the remainder of this article, the following terms are used to refer to the dataset: a *document* refers to a single post or comment, and a *discussion* (or discussion thread) refers to an individual post together with its associated comments.

2.3 Analytical Process and Techniques

The analytical process combines computational text analysis with qualitative coding within the CGT framework (Carlsen & Ralund, 2022). Computational techniques were used to identify patterns in the corpus and support theoretical sampling, while imaginaries were reconstructed through qualitative analysis. Figure 1 presents the analytical process.

For the computational component, we draw on the Analysis of Topic Model Networks (ANTMN) approach (Walter & Ophir, 2019), combining topic modeling at the document level with topic network analysis at the discussion-thread level. The outputs guide *theoretical sampling*, in which data are selected iteratively based on contribution to

[5] https://subredditstats.com/

[6] https://praw.readthedocs.io/en/stable/

emerging concepts rather than statistical representativeness (Corbin & Strauss, 2008), similarly to Brause et al. (2025, p. 1275), who use topic modeling to "reduce the sample for in-depth analysis while ensuring topical variety". Three criteria were used to assess theoretical relevance: (i) speculative or future-oriented discourse on technology, enhancement, or societal transformation (Mager & Katzenbach, 2021); (ii) strong thematic coherence and interpretability in the topic model; and (iii) co-occurrence of multiple relevant topics within discussion threads in the topic network. Sampling continued until theoretical saturation (Charmaz, 2014).

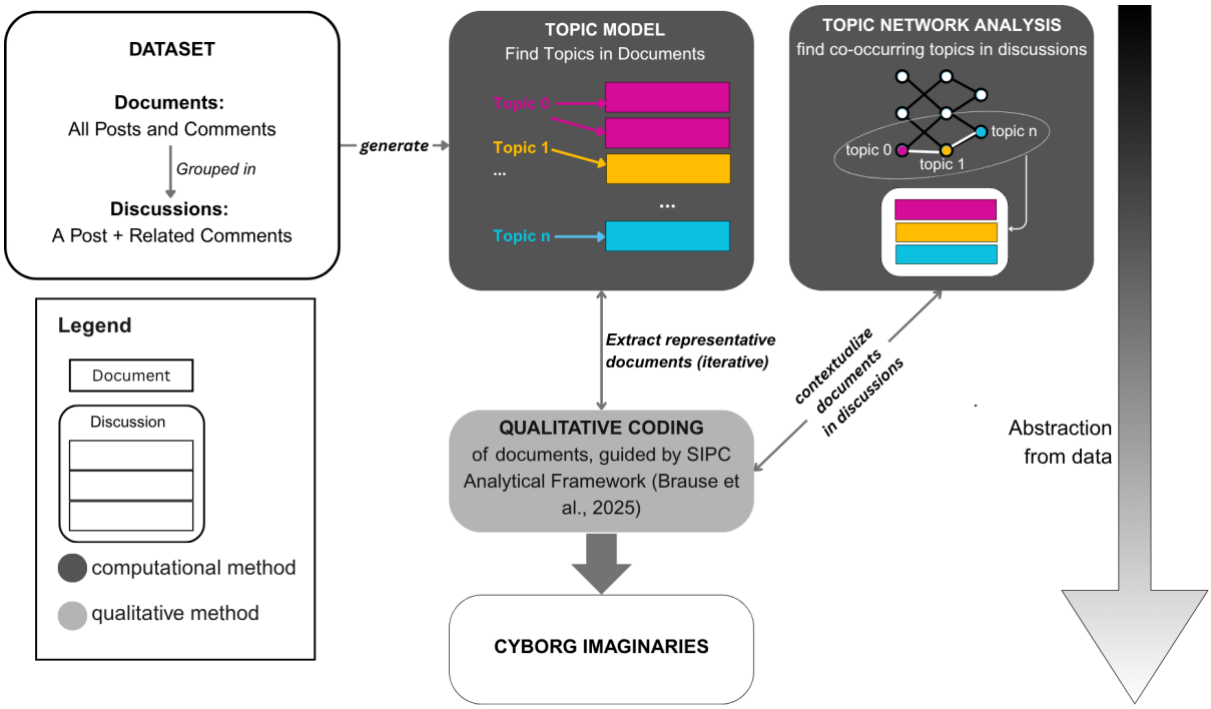


Figure 1. Analytical process combining topic modeling, topic network analysis and qualitative coding to extract cyborgization imaginaries. The units of analysis are indicated. Created by the authors.

We applied BERTopic (Grootendorst, 2022) for topic modeling because it determines the number of topics inductively through clustering, aligning with grounded theory's inductive focus (Baumer et al., 2017). Following Walter and Ophir (2019), we then constructed a topic network in which topics are nodes and edges represent topic co-

occurrence in discussion threads, and applied community detection (Blondel et al., 2008) to identify clusters of frequently co-occurring topics. The resulting topic communities guided the selection of discussion threads for in-depth reading. Full discussion threads identified through the topic network were read in their entirety to contextualize documents within their conversational setting.

Iterative open, axial, and selective coding was performed by the first author at the level of meaning units, understood as segments of text expressing a discrete idea, ranging from a single sentence to a short passage (Corbin & Strauss, 2008), guided by the SIPC sensitizing concept framework. To strengthen interpretive validity, another author engaged in regular review sessions, examining coded excerpts and codebook structure. Disagreements were resolved through discussion and re-engagement with the data.

3. Findings

This section presents the findings of the study. We first summarize the computational results from topic modeling and topic network analysis (Section 3.1). We then present the analytical dimensions identified through qualitative coding, which structure how cyborgization imaginaries are discursively constructed in pioneer community discussions (Section 3.2). Building on these dimensions, Section 3.3 presents the identified cyborgization imaginaries. Section 3.4 highlights the role of generative AI and AGI in reshaping these imaginaries. Section 3.5 organizes imaginaries in a unified conceptual framework.

3.1 Computational Results

The computational phase served two purposes within the CGT framework: identifying topical variety to enable targeted extraction of theoretically relevant material and surfacing topic co-occurrences to identify discussion threads for contextual reading.

Twenty BERTopic models were evaluated based on c_v coherence (Röder et al., 2015) and topic interpretability, varying parameters of the model. The full parameter grid, c_v scores, and configuration logs are available in the code base[7]. The selected model produced 101 topics. After removing non-substantive clusters (e.g., single-word responses, slang) and off-topic clusters unintentionally captured through keyword matching, 78 topics were retained.

An initial round of open coding was performed on representative documents from all 78 retained topics, guided by the sensitizing concepts. This round served to generate initial codes inductively and assess the analytical relevance of each topic against the criteria in Section 2.3. Through this process, 21 topics were identified as analytically relevant. The remaining topics, while related to augmentation technologies, centered on product specifications, news events, or technical troubleshooting and did not yield insights relevant to constructing imaginaries.

A topic co-occurrence network was constructed on the 21 analytically relevant topics, and Louvain community detection (Blondel et al., 2008) identified three topic communities. Discussion threads spanning all three communities were extracted for contextual reading.

[7] Available at https://figshare.com/s/a2206695081e41fcd62b

3.2 Analytical Framework

Building on the topic model and network, qualitative coding was employed to reconstruct the imaginaries emerging from pioneer community discussions on human augmentation. From the 21 analytically relevant topics identified through topic modeling, documents were iteratively sampled based on their theoretical relevance and coded in their entirety. In total, approximately 350 documents were analyzed through open, axial, and selective coding (Corbin & Strauss, 2008), guided by the SIPC sensitizing concepts (Brause et al., 2025). In parallel, 15 discussion threads spanning multiple topic communities in the topic network were read in full to contextualize individual documents within their conversational setting. Through this process, four analytical dimensions (Brause et al., 2025) were identified. Figure 2 provides an overview of these dimensions and their definitions.

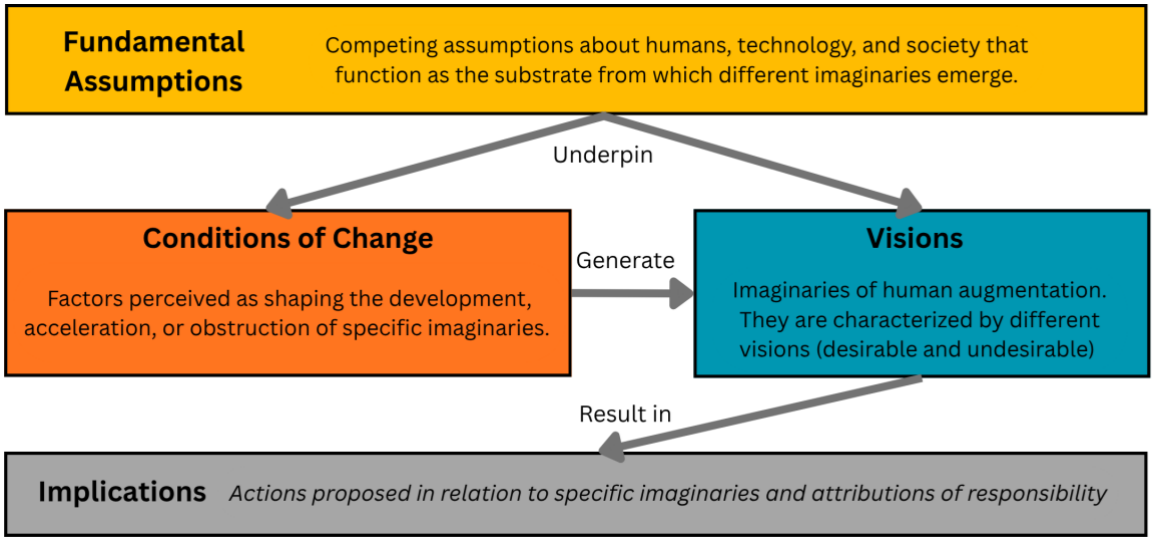


Figure 2. Overview and inter-relationship between analytical dimensions of imaginaries. The dimensions are adapted from Brause et al. (2025). Created by the authors.

3.3 Cyborgization Imaginaries

In this section, we address the research question of this study: ***What imaginaries emerge from online pioneer community discussions on human augmentation technologies?*** We therefore introduce *cyborgization imaginaries* as future imaginaries that emerge from pioneer community discourse on human augmentation technologies, conceived as multiple, contested, and technologically commodified (Mager & Katzenbach, 2021). Based on the analyzed data, three imaginaries emerge, i.e., the (1) Human Enhancement, (2) New Social Order, and (3) Posthuman Horizon imaginary. Aligning with Brause et al. (2025), we show how the first two imaginaries are organized around concrete foundational assumptions and conditions of change and sporadically connect to identifiable governance implications. In contrast, the Posthuman Horizon outlines long-term predictions. We support this section with excerpts from documents and discussions. Following established practices, we report quotes from the corpus verbatim or with slight paraphrasing (*italicized*) and exclude identifying information to preserve anonymity (Andreotta et al., 2019).

3.3.1 The Human Enhancement Imaginary

The Human Enhancement imaginary centers on the augmentation of individual cognitive, physical, and moral capacities through technology. Grounded in transhumanist assumption that biological limitations are solvable through technological integration (Bostrom, 2005; More, 2013), it articulates a predominantly utopian and near- to mid-term outlook through three visions: integration with technology, digital immortality, and moral progress.

Integration with technology aligns directly with the foundational transhumanist value of overcoming biological limitations through technology (Bostrom, 2005). Participants frame technological evolution as the logical next step beyond biological evolution, envisioning physical augmentation that extends sensory perception, cognitive augmentation that expands philosophical and scientific reasoning, and aspirational capabilities such as telekinetic or telepathic abilities (Figure 3, *Vision*). Underpinning this vision is an understanding of the human body as biologically inefficient which positions augmentation as a rational corrective (Figure 3, *Foundational assumptions*).

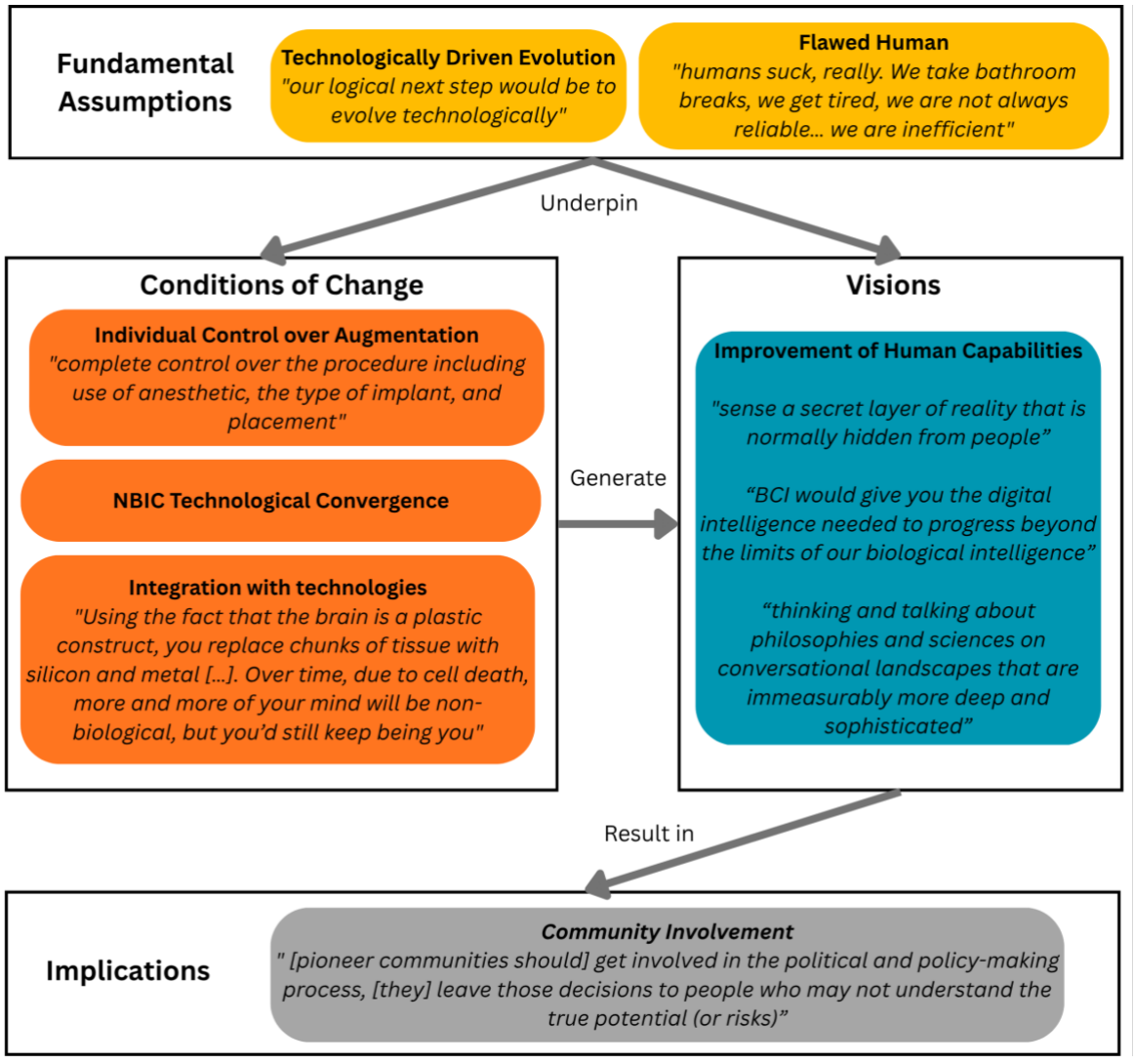


Figure 3. Integration with technology vision. Adapted from Brause et al. (2025). Created by the authors.

The realization of this vision is sustained by technological advancements within the NBIC convergence (Roco & Bainbridge, 2002), including gene editing technologies, DNA nanotechnology, and BCIs, whose use would lead to a gradual assimilation between human biology and technology. (Figure 3, *Conditions of change*). Community discussions negotiate the feasibility of these conditions, debating, for instance, whether biological processes can sustainably power implanted devices (Figure 4).

This vision is grounded in the transhumanist value of bodily autonomy, reflected in personal accounts of experimental augmentation motivated by desire for individual control over procedure and placement (Figure 3, *Conditions of change*). These propositions resonate with ethnographic accounts of biohacker and transhumanist communities (Huberman, 2023; Britton & Semaan, 2017; Seyfried et al., 2023), in which the autonomous and self-directed experimentation is a crucial aspect of the practice, which can also serve as example for the masses and for policymakers (Figure 3, *Implications*).

User 1: Could it be feasible to have a device implanted in your body that would use the nutrients in your blood to generate electricity for powering personal devices?
User 2: Honestly, kinetic energy from walking around could theoretically charge wearable devices.
User 3: I think the human body has a lot of energy. Think about how much power it takes to raise 200 pounds up 50 feet. The average human can climb 5 floors of stairs. They may be winded, but the energy to do it is there.
User 4: It would be difficult to make much power from electrolytes in the blood to power bionic devices as the concentration of electrolytes is quite low. The other problem is the electrolyte levels fluctuate continuously.
User 5: A testament to the efficiency of the human body. We're evolved to harness the energy in our blood in ways we don't bother with for modern electronics. Harnessing the kinetic energy we produce from this energy, as suggested by other comments, is a way of harnessing that biological efficiency down the chain.
User 6: That wouldn't be good for you. The body has energy both stored and readily available for a reason. To just have calories disappear without any work being done would disrupt things.
User 7: Think of smart biological nanobots replacing most computational electronics and communicating with each other wirelessly... There could be swarms of them in the whole biosphere as well as atmosphere and soil. Those could be powered by processes in the body. That is super-scifi but it is basically one of the highest degrees of imaginative fusion between biology and electronics.
User 8: I generally think any device that messes with human body is not ideal for the sole purpose of powering any kind of device other than those essential for regaining and maintaining body functions is unnecessary.

Figure 4. Excerpt from discussion. Created by the authors.

Digital immortality envisions transcending biological existence by transferring the self to a digital substrate. Fundamental assumptions that underpin this vision are contested. On the one hand, a mechanistic conception of the human body and mind emerges as the brain is described through computational metaphors as *"hardware"* built in *"6 layers of neurons"*. This conception resonates with computational theories of mind, in which cognition is understood as information processing that is, in principle, equivalent between biological and digital systems (Rescorla, 2024). On the other hand, this is contrasted with positions that emphasize the irreducible complexity of biological systems, arguing that *"the human brain [...] is a miraculous machine, hard to recreate"* and that *"we have no clue about the mechanism underlying biological intelligence"*. Foundational assumptions about the limits of technology further undercut the aspirational cognitive augmentation

vision, with one participant asserting that *"no sentient and self-directed machine will ever be produced"* using any digital computer. These contestations mirror longstanding debates in cognitive science and philosophy of mind about whether cognition is reducible to computation or whether biological intelligence involves processes that resist formal modeling (Searle, 1980; Von Neumann & Kurzweil, 2012).

In addition to discussions about the technological feasibility of this vision, further fundamental disagreements emerge. Skeptics argue that uploading the mind to a digital substrate means that *"it's a copy and always will be"*, framing an individual's consciousness as bound to its original biological substrate. This debate echoes philosophical arguments about personal identity and the continuity of consciousness (Corabi & Schneider, 2014), and it demonstrates that the most aspirational visions within the Human Enhancement imaginary are contested not only on grounds of technological feasibility but on deeper metaphysical grounds about what constitutes the self.

Moral progress. Augmentation is also envisioned as enabling moral transformation at the individual level, with morality playing a dual role, both motivating technological augmentation and resulting from it. On the one hand, moral obligation functions as a *precondition* for augmentation. Transhumanism is characterized by a belief that enhancing human capacities through technology is a moral obligation aimed at improving humanity (Bostrom, 2005; Latzer, 2026). This is reflected in community discussions as "*the eradication of unnecessary human suffering through biological manipulation should be the prime focus of the transhumanist effort*". On the other hand, moral improvement is imagined as a desirable outcome of technological augmentation, as augmentation technologies are imagined as capable of making individuals more moral. One participant predicts that *"the posthuman that will come… will respect and aid a fellow being, no matter race, gender, or augmentation level"*. This vision departs from foundational

assumptions about the instrumental use of technology to improve the human condition, a core tenet of the transhumanist orientation (Bostrom, 2005), as augmentation is seen as *"a means to improve the condition of mankind". "The possibility and desirability of fundamentally improving the human condition through applied reason"* are highlighted. It is reinforced by egalitarian commitments, as participants articulate that *"transhumanists believe people should be equal and no one left behind because of lack of money or for any unfair reason"*. However, the scope of this moral vision remains contested. Positions range from a narrow focus on individual human enhancement to perspectives that extend augmentation beyond the human, reflected in the claim that *"we could increase the intelligence of animals until they're partners, not subjects"*. This position resonates with critical posthumanist critiques of anthropocentrism (Braidotti, 2016; Haraway, 2020), which argue that privileging the human as the sole subject of moral and technological progress reproduces a hierarchical binary between human and animal life, which augmentation technologies may either reinforce or dissolve.

3.3.2 The New Social Order Imaginary

The New Social Order imaginary envisions large-scale social reorganization driven by augmentation technologies. Grounded in technologically deterministic assumptions about societal change and distrust of institutional and corporate actors, it articulates a predominantly dystopian outlook of near- to mid-term trajectories through four visions: surveillance and forced augmentation, disruption of institutions, automated society, and social entrenchment.

Surveillance and forced augmentation envision augmentation enabling comprehensive social control, where adoption shifts from voluntary to coerced through employment requirements and social pressure. Participants fear that they *"will fall under the watchful*

eye of a […] paranoid Big Brother state" leading to a future in which people are *"chipped at birth and live [their] lives as [tools] for market research, constantly being watched".* Closely linked is an envisioned shift towards coercive adoption of augmentation technologies as *"massive societal pressure to get chipped"* grows, potentially driven by requirements for *"some jobs [that] will start requiring a chip"*.

Societal normalization of the use of augmentation technologies in a variety of contexts emerges as a key enabling mechanism, leading to an incremental reframing of augmentation as beneficial. *"It won't be 'use this chip in you so we can follow you.' It will be 'use this chip in your kid so he'll never get kidnapped, [or] so when you get in a carwreck […], the doctors scan your chip and know all your past surgeries and allergies'".* Cultural forces are expected to erode resistance further, because *"most people in the world won't [care] about Orwellian nightmares if they can watch HD porn in their heads".* Geopolitical competition accelerates this trajectory: *"How will we compete with [China] when their mental asylums contain 80% fewer people than ours, or if they have 50% fewer people on Prozac [...]? If we want to remain competitive, we have to allow such procedures here too!".*

As employment requirements then make augmentation a practical necessity, *"some jobs will start requiring a chip"* so people may *"get one for their livelihood",* and refusal becomes socially costly, making one *"suspicious"* or a *"social outcast",* as it becomes *"impossible to not engage"* with augmentation technologies. This critical orientation departs from foundational assumptions about corporate power, describing a system in which prioritizes *"profits above ALL else",* guaranteeing *"total societal destruction".* This contrasts with accounts that frame transhumanist communities as primarily libertarian or techno-utopian (Hughes, 2004). Instead, it reveals a strand of structural critique that resonates with concerns raised by critics of human enhancement, as for

example Fukuyama (2004) warns that enhancement may undermine the shared human essence grounding equal rights and produce a genetic underclass, while Sandel (2007) argues that the drive to master human nature erodes solidarity. Community discussions explicitly resist this stratification, articulating that augmentation *"should not be coerced"* and that unaugmented individuals should not be *"treated as lesser citizens"*. These concerns resonate with critiques raised by scholars who highlighted the emergence of risks related to augmentation technologies, ranging from increasing inequality to the loss of autonomy, the erosion of meaningful consent as well as eugenics (Fukuyama, 2004; Gebru & Torres, 2024; Sandel, 2007; Allhoff et al., 2011). To mitigate these risks, regulatory efforts show that some states in the USA preemptively banned employers from mandating microchip implants for employees (Malekos Smith, 2024).

Disruption of institutions addresses the disruptive potential of augmentation for existing social institutions, a recurrent concern in foundational transhumanist thought (Bostrom, 2005; Kurzweil, 2026). Figure 5 illustrates how education emerges as one such institutional domain. One participant questions whether schools will survive cognitive augmentation "*once we can download directly into our brains"*, while another contests this premise by distinguishing information access from critical thinking, as *"it's one thing to have all the knowledge in the world in our brains, but quite another to be able to critically assess that information"*. The discourse reveals analogous reasoning related to healthcare (where technologies could transform the physician's role) and governance (where artificial and collective intelligence could restructure policymaking).

User 1: Once we can download directly into our brains, what will happen to schools? The entire traditional education system?
User 2: I don't think we will have any need to download information into our brains. I can see brain/web interfaces which would allow us to instantaneously access any piece of information existing online with just a single thought. Traditional education with a mentor and peers is important because it teaches you how to learn and also to think critically. It's one thing to have all the knowledge in the world in our brains, but quite another to be able to critically assess that information and make creative judgements of it.
User 3: So the education system will remain pretty safe when mind-downloading comes along. That's good. In that case, do you have any idea what could cause the education system as we know it today, to go obsolete?
User 4: My prediction is that schools will just serve as places where you can practice on how to apply your knowledge. It could also serve as a place to learn what you want to learn.
User 5: Let's say guitar mastery takes years. I give it to you in one second. Will the frequency of new ideas overwhelm you? Maybe we're ignoring something temporal here. Are you also prepared for the social consequences of having this knowledge? What will it mean to be so quickly gifted?

Figure 5. Excerpt from discussion. Created by the authors.

Automated society constitutes a contested vision in which advancing mechanization transforms the labor market and social life. The conditions of change driving this vision are technologically deterministic assumptions about progress as autonomous and augmentation as inescapable, reinforced by the belief that *"man is not the master over technology, but rather, subject to it. It is technology that decides what happens"* The anticipated consequence is large-scale human obsolescence: *"it is nothing short of foolish to suggest white collar jobs would be protected as mechanization advances infinitely onward."* This resonates with empirical projections that a substantial share of occupations are susceptible to computerization (Frey & Osborne, 2017). The consequences envisioned are not only economic but existential. Beyond job displacement, automation drives an increasing meaninglessness of life, in case *"every aspiration you have becomes bunk, useless, pointless [because] there is a machine that does each of them for you instead, more efficiently, and of a higher quality, and faster than you ever could"*. Universal Basic Income emerges as a contested governance mechanism. On the one hand some participants frame UBI as redistribution in a post-labor economy (Srnicek & Williams,

2015). However, others interpret it as an instrument of state control, as *"there would be no need for labor [..., and] it is very likely that a UBI would be used as a ball and chain to keep people in line",* anticipating the emergence of new forms of dependency and power asymmetries between corporate and institutional actors and citizens (Kelly, 2023).

Social entrenchment envisions augmentation and longevity technologies as solidifying rather than disrupting concentrations of wealth and power. *"Families already dominate in the modern world. […] But if there's no turnover, if the matriarch or patriarch of these families lives forever and stays in control forever, it magnifies the effect of [wealth] accretion"*. This vision resonates with concerns raised by critics of human enhancement who have highlighted the risks enhancement-based social inequality (Fukuyama, 2002, 2004), and it foregrounds a problematic mechanism, i.e., the suspension of generational turnover, that has received attention in the academic literature on ethical aspects of augmentation technologies (Allhoff et al., 2011).

3.3.3 The Posthuman Horizon Imaginary

The Posthuman Horizon imaginary is articulated through speculative, long-term visions with limited specification of enabling conditions or mechanisms and is suggestive of the underlying long-term transhumanist project of directed species evolution (Bostrom, 2005; More, 2013). Four visions emerge in relation to this imaginary (Figure 6): the hive mind, species differentiation, climate manipulation, and interplanetary expansion.

The *hive mind* envisions the collective integration of human consciousness into a shared network, with utopian framings of a world without corruption or dictators contested by participants who highlight its authoritarian potential. *Species differentiation* envisions augmented and non-augmented humans becoming distinct biological categories, potentially separate species, echoing concerns about a "genetic divide" (Fukuyama, 2004;

Sandel, 2007) derived from technological augmentation. *Climate manipulation* extends the logic of augmentation beyond the human body to the planetary environment, positioning Earth's climate as an object of technological intervention analogous to the biological body. This resonates with the notion of a rising "Transhumanist Anthropocene" (Schütze & Latzer, 2026), characterized by a diminishing sense of urgency surrounding the climate crisis and a growing reliance on techno-solutionist environmental governance. Lastly, the *interplanetary expansion* vision addresses the prospect of interplanetary expansion through cyborgization. The question of whether humans can leave Earth without fundamentally altering their biological form connects directly to the historical origins of the cyborg concept itself, as the term "cyborg" was coined by Clynes and Kline (1960) in the context of space exploration, to describe human-machine systems that would allow astronauts to adapt to extraterrestrial environments. The community discourse revisits this founding question, debating whether space colonization requires a post-biological transformation of the human species or whether biological adaptation and environmental engineering (terraforming) constitute viable alternatives.

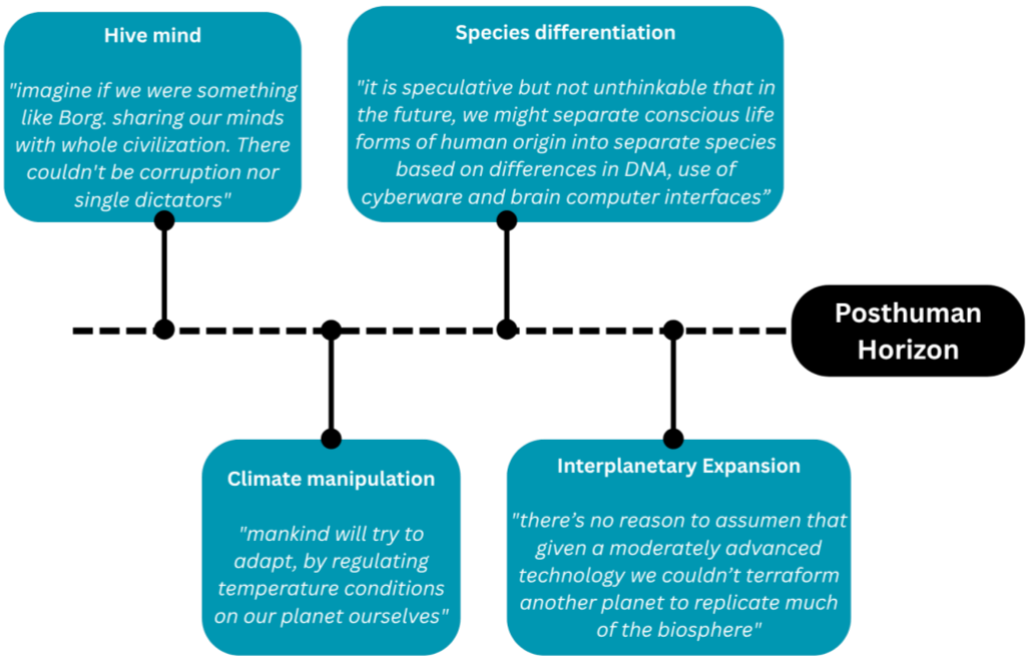


Figure 6. The Posthuman Horizon Imaginary. Created by the authors.

3.4 Generative AI and AGI as Triggers and Horizon of Cyborgization Imaginaries

Generative AI and AGI emerge as key drivers reshaping how augmentation futures are imagined. During the analytical process, we observed a sharp increase in references to AI, BCIs, and the economic consequences of automation, coinciding temporally with the public rollout of large-scale generative AI models in November 2022. AI reshapes cyborgization imaginaries in two ways: as an immediate source of disruption, and as an unknowable event horizon coinciding with the technological singularity (Kurzweil, 2026).

In the immediate future, AI-driven automation extends economic displacement into white-collar professions previously considered secure, with participants anticipating that *"the one percent would use and capitalize on the strength of AI to completely dominate the masses"*. AI also intensifies concerns about surveillance and loss of autonomy, with fears of futures in which people are *"chipped at birth"*, highlighting concerns that

emerged in neuroethical scholarship on mental integrity and cognitive liberty (Ienca & Andorno, 2017). At the same time, AI is imagined as expanding cognitive capacities through direct integration. Rather than remaining external tools, AI systems are imagined as intimate cognitive partners embedded within the self. Participants draw on science fiction, referencing AI companions such as *"Jarvis* (ed. Iron-Man)*, VEGA* (ed. DOOM)*, or Cortana* (ed. Halo)*"* as templates for imagined human-AI integration, consistent with observations that science fiction functions as a shared cultural repertoire through which publics make sense of emerging technologies (Kirby, 2010). In response to these immediate disruptions, the discourse reveals reliance on regulation and institutional safeguards as mechanisms for constraining AI-related risks. Participants trust that *"the threat of lawsuits will ensure that the Genie [ed. AI] stays in the bottle"* and that legal teams may be *"more effective at slowing down and aligning a misaligned AI system"*.

Beyond these short-term changes, the technological singularity, i.e. the hypothesized point at which artificial intelligence surpasses human intelligence and triggers recursive self-improvement (Kurzweil, 2026), functions as an event horizon beyond which current governance mechanisms are perceived as insufficient and the trajectory of technological development becomes unknowable. Discussions describe being *"RIGHT before a runaway hyper exponential intelligence growth"* and anticipate being *"5 years away from AI that can do 90% of the work to self-improve itself"*. Beyond this horizon, augmentation ceases to be elective. It becomes on the one hand a source of comfort, as participants are "*not at all scared of a potential 'tech singularity', because [they] strongly believe humans will merge the technology with [themselves]"*. On the other hand, augmentation becomes a necessity, as *"humans either must adapt alongside machinery, becoming cyborgs of a sort; or perish into oblivion, being able to do absolutely nothing better than a machine can"*.

3.5 Two Axes of Cyborgization Imaginaries

We organize cyborgization imaginaries along two intersecting axes that emerge from how community members construct, evaluate, and contest visions of augmentation futures. We visualize this framework as a futures cone (Voros, 2003), adapting this foresight tool to represent how multiple possible imaginaries fan outward from foundational assumptions, depending on specific conditions of change (Figure 7). The resulting space is organized along axes of *inevitable versus contingent* and *utopian versus dystopian* imaginaries. These axes do not represent discrete categories but define a continuous space in which cyborgization imaginaries evolve and are contested.

The *inevitability-contingency axis* captures whether cyborgization imaginaries are framed as unavoidable outcomes or as dependent on social, political, and technological changes. At the inevitability pole, augmentation is presented as an inescapable consequence of technological momentum, drawing on technologically determinist foundational assumptions reinforced by institutional, market, and geopolitical conditions of change. At the contingency pole, augmentation futures are presented as dependent on individual choices, governance, and individual or collective decision-making.

The *utopia-dystopia axis* differentiates imaginaries by desirability. On the utopian end, cyborgization imaginaries emphasize the expansion of human capacities, collective intelligence, digital immortality, and posthuman moral progress, grounded in foundational assumptions about human perfectibility and the instrumental value of technology. On the dystopian end, imaginaries foreground risks of surveillance, coercion, inequality, and dehumanization.

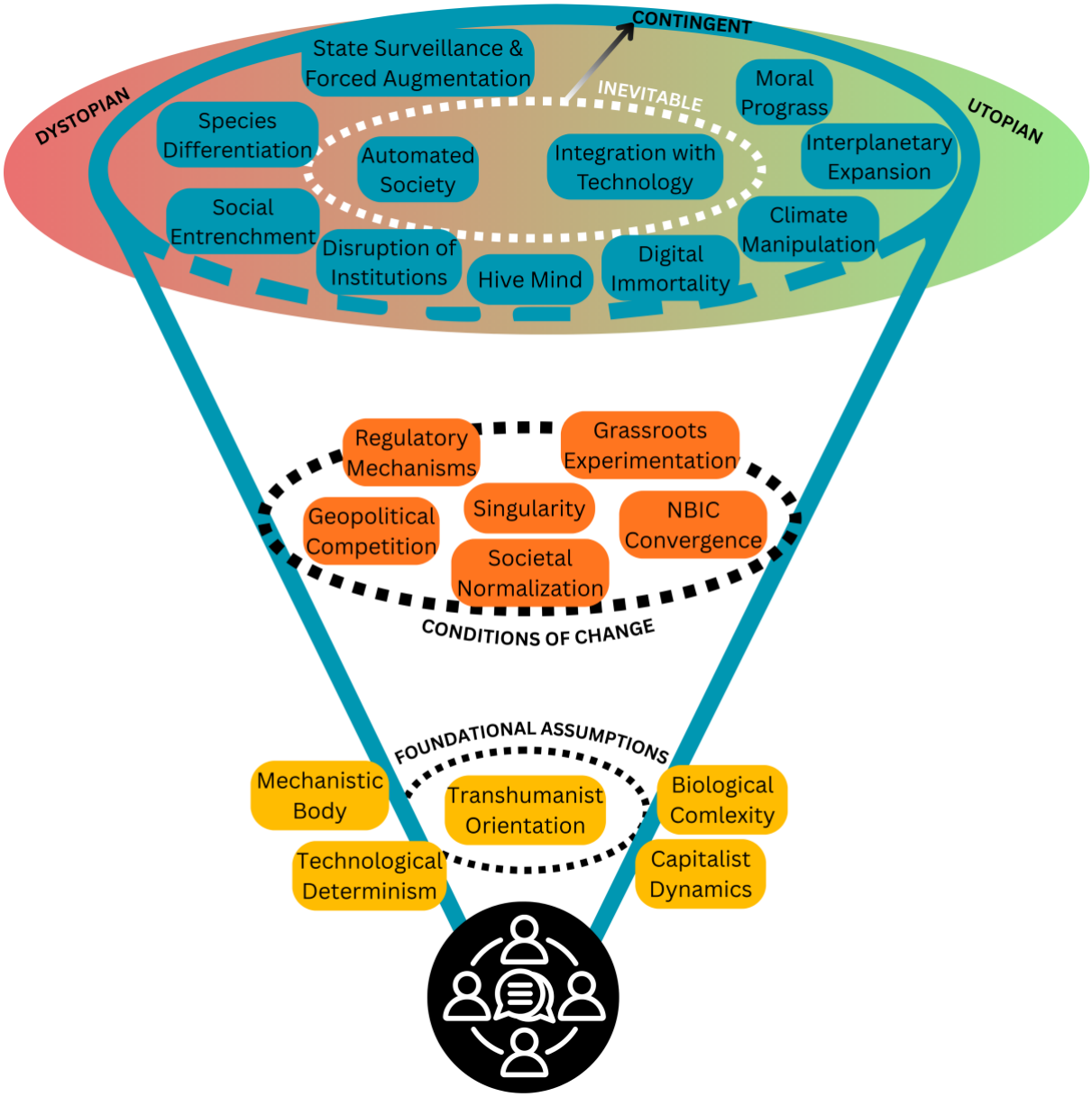


Figure 7. Cyborgization imaginaries represented as a futures cone. Adapted from Voros (2003). Created by the authors.

4. Discussion and Conclusion

This study examined how online pioneer communities construct future visions of human augmentation. Through a CGT analysis of approximately 198,000 Reddit posts and comments, we identified three cyborgization imaginaries (Human Enhancement, New Social Order, and Posthuman Horizon) and organized them along intersecting axes of

utopia-dystopia and inevitability-contingency, with the release of generative AI emerging as a disruptive force that reshapes imaginaries.

Several limitations apply. Our exclusive focus on Reddit and English-language discourse excludes other platforms and non-Anglophone contexts. The keywords used in data collection may miss discussions using alternative vocabularies, and the topic model may obscure discursive nuances. Finally, Reddit communities usually skew toward young, male, Western, and technologically literate participants (Hughes, 2004; Proferes et al., 2021), so perspectives shaped by gender, race, class, and non-Western contexts are underrepresented. Notwithstanding these limitations, this study advances multiple directions for research on the imaginaries of human augmentation technologies.

We provide a theorized characterization of imaginaries in pioneer communities engaging with human augmentation. Empirical work on augmentation adoption has focused on individual decisions, examining either current users in small ethnographic studies of biohacker and grinder communities (Britton & Semaan, 2017; Huberman, 2023; Seyfried et al., 2023) or prospective users in cross-sectional surveys (Frascaria et al., 2026b). We move beyond this to analyze collective meaning-making processes in the online discursive spaces in which transhumanist thought is sustained at scale and highlight that the resulting discourse is not uniformly techno-optimistic: utopian and dystopian visions coexist within the same communities. This adds nuance to the ideologically charged support for augmentation technologies that emerged in prior ethnographic studies (Frascaria et al., 2026b). In particular, a disconnect emerges between the Human Enhancement and New Social Order imaginaries: participants show high trust in what augmentation technologies can do for the individual but high distrust toward their misuse

by institutional actors. This echoes early Internet pioneer communities, whose distrust of centralized infrastructure control shaped imaginaries of openness and decentralization that shaped the Internet's architecture and governance (Turner, 2010; ten Oever, 2021).

We identify a techno-religious characteristic of pioneer community imaginaries, in the context of digitalization. Prior empirical research on augmentation technology adoption identified religious belief as a strong predictor of opposition to augmentation (Frascaria et al., 2026b), but the presence of techno-religious beliefs on the side of transhumanism remained undocumented. Our findings show augmentation technologies linked to aspirational visions (cognitive expansion, digital immortality, moral progress) promising salvation from biological limitation, suffering, and death. On the other hand, dystopian fears of a singularity invoke a mythology of final judgement. Recent scholarship argues that digitalization, driven by a transhumanist belief in technologically controllable human evolution, is giving rise to a form of techno-religion (Latzer, 2026) in which traditional religious promises of omniscience, omnipotence, and eternal life are obtained through, or attributed to, technology. Transhumanism plays a central role in this process, as it provides what Hauskeller (2016) characterizes as a mythology of perfectibility, immortality, and overcoming human limitations through technologies, aligning with the understanding of transhumanism as a secularist faith (Tirosh-Samuelson, 2012). This characterization recently found significant institutional recognition in the first encyclical of Pope Leo XIV (2026, para. 117), in which transhumanism is identified as the underlying narrative accompanying digitalization, including the promise of "a purely technical form of 'salvation'" that (partially) competes with Catholic Church doctrines.

We show that the disruptive release of generative AI has triggered a restructuring of cyborgization imaginaries. Recent empirical research has begun to include AI as part of human augmentation technologies (Frascaria et al., 2026b). Imaginaries scholarship has conceptualized AI either as a tool (Sartori & Bocca, 2023) or as a social actor (Cave et al., 2020). We highlight that in pioneer community discourse AI has a different function, as it is positioned as a superior force, against which augmentation becomes a defense. The anticipated singularity reframes augmentation from elective enhancement to a defensive necessity, shifting the discursive role of AI from artifact or interlocutor to horizon.

Methodologically, we contribute an adaptation of the Analysis of Topic Model Networks (ANTMN) approach (Walter & Ophir, 2019) to online community discussions and release a companion open-source software toolkit. Combining topic modeling and topic-network analysis with qualitative coding within a computational grounded theory framework (Carlsen & Ralund, 2022; Nelson, 2020) this methodological approach and tool support theoretically grounded sampling and interpretive analysis of community discourse at scale.

Lastly, we situate pioneer communities as sites of *quiet futuring* (Hepp, 2026), where radical visions of human augmentation are articulated in advance of broader public uptake. The discourse reveals a strong desire for autonomous, self-directed augmentation, cautious trust in corporate actors to develop aligned AI, and distrust of state actors, whose involvement is associated with surveillance, coercion, and constraint on individual autonomy. For researchers, this invites further investigation of how pioneer-community futuring shapes the development of HA technologies. For developers, the findings suggest

that pioneer-community demand is oriented toward autonomy-preserving, self-directed augmentation rather than top-down initiatives. For policymakers, distrust of state involvement suggests that regulatory frameworks for human augmentation could prioritize the protection of bodily autonomy and neurorights, while constraining coercive adoption.

Acknowledgements

We thank the University of Zurich and the Digital Society Initiative for financing this project.

Disclosure statement

No conflict of interest was reported by the authors.

Data Availability Statement

The dataset is based on publicly available Reddit posts and comments, and an anonymized version of the dataset is available upon request

References

Allhoff, F., Lin, P., & Steinberg, J. (2011). Ethics of Human Enhancement: An Executive Summary. *Science and Engineering Ethics*, *17*(2), 201–212. https://doi.org/10.1007/s11948-009-9191-9

Andreotta, M., Nugroho, R., Hurlstone, M. J., Boschetti, F., Farrell, S., Walker, I., & Paris, C. (2019). Analyzing social media data: A mixed-methods framework combining computational and qualitative text analysis. *Behavior Research Methods*, *51*(4), 1766–1781. https://doi.org/10.3758/s13428-019-01202-8

Appadurai, A. (2013). The Future as Cultural Fact: Essays on the Global Condition. *Rassegna Italiana Di Sociologia*, *4/2013*. https://doi.org/10.1423/76023

Bainbridge, W. S. (2017). TransHumanism: an online network of technoprogressive quasi-religions. In *Dynamic Secularization: Information Technology and the Tension Between Religion and Science* (pp. 209-236). Cham: Springer International Publishing.

Baumer, E. P., Mimno, D., Guha, S., Quan, E., & Gay, G. K. (2017). Comparing grounded theory and topic modeling: Extreme divergence or unlikely convergence?. *Journal of the Association for Information Science and Technology*, *68*(6), 1397-1410.

BBC News. (2024, February 4). *Neuralink: Can Musk's brain technology change the world?* BBC News. https://www.bbc.com/news/health-68169082

Blondel, V. D., Guillaume, J. L., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. *Journal of statistical mechanics: theory and experiment*, *2008*(10). https://doi.org/10.1088/1742-5468/2008/10/P10008

Bostrom, N. (2005). A history of transhumanist thought. *Journal of Evolution and Technology, 14*(1), 1–25.

Braidotti, R. (2016). Posthuman critical theory. In *Critical posthumanism and planetary futures* (pp. 13-32). New Delhi: Springer India.

Brause, S. R., Schäfer, M. S., Katzenbach, C., Mao, Y., Richter, V., & Zeng, J. (2025). Sociotechnical imaginaries and public communication: Analytical framework and empirical illustration using the case of artificial intelligence. *Convergence*, *31*(4), 1267-1287. https://doi.org/10.1177/13548565251338192

Britton, L. M., & Semaan, B. (2017). Manifesting the Cyborg through Techno-Body Modification: From Human-Computer Interaction to Integration. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 2499–2510. https://doi.org/10.1145/3025453.3025629

Bucher, T. (2016). The algorithmic imaginary: exploring the ordinary affects of Facebook algorithms. *Information, Communication & Society*, *20*(1), 30–44. https://doi.org/10.1080/1369118X.2016.1154086

Carlsen, H. B., & Ralund, S. (2022). Computational grounded theory revisited: From computer-led to computer-assisted text analysis. *Big Data & Society*, *9*(1), https://doi.org/10.1177/20539517221080146

Cave, S., Dihal, K., & Dillon, S. (Eds.). (2020). *AI narratives: A history of imaginative thinking about intelligent machines*. Oxford University Press.

Charmaz, K. (2014). Constructing grounded theory.

Clynes, M. E., & Kline, N. S. (1960). Cyborgs and space. *Astronautics*, *14*(9), 26-27.

Coleman, E. G. (2013). *Coding freedom: The ethics and aesthetics of hacking*. Princeton University Press.

Corabi, J., & Schneider, S. (2014). The metaphysics of uploading. *Journal of Consciousness Studies*, *19*.

Corbin, J., & Strauss, A. (2008). Basics of qualitative research (3rd ed.): Techniques and procedures for developing grounded theory. SAGE Publications, Inc., https://doi.org/10.4135/9781452230153

franzke, aline shakti, Bechmann, Anja, Zimmer, Michael, Ess, Charles and the Association of Internet Researchers (2020). Internet Research: Ethical Guidelines 3.0. https://aoir.org/reports/ethics3.pdf

Frascaria, G., Festic, N., & Latzer, M. (2026a). Evolving User Profiles and Adoption of Cyborg Technologies: Evidence from a Repeated Cross-Sectional Study in Switzerland. In *Proceedings of the 2026 CHI Conference on Human Factors in Computing Systems* (pp. 1-13). https://doi.org/10.1145/3772318.3790952

Frascaria, G., Jaramillo-Dent, D., & Latzer, M. (2026b). Adoption of human augmentation technologies for non-medical applications: a systematic review of empirical literature. *International Journal of Human-Computer Interaction*, 1-33. https://doi.org/10.1080/10447318.2026.2625258

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation?. *Technological forecasting and social change*, *114*, 254-280.

Fukuyama, F. (2002). *Our posthuman future. Consequences of the biotechnology revolution*. Farrar, Straus and Giroux.

Fukuyama, F. (2004). *Transhumanism* (Vol. 144, pp. 42–43). Foreign Policy.

Gebru, T., & Torres, É. P. (2024). The TESCREAL bundle: Eugenics and the promise of utopia through artificial general intelligence. *First Monday*.

Greguric, I. (Ed.). (2021). *Philosophical issues of human cyborgization and the necessity of prolegomena on cyborg ethics*. IGI Global.

Gorichanaz, T. (2023). Being at home in the metaverse? Prospectus for a social imaginary. *AI and Ethics*, *3*(2), 647-658.

Grootendorst, M. (2022). BERTopic: Neural topic modeling with a class-based TF-IDF procedure. *arXiv preprint arXiv:2203.05794*.

Haraway, D. J. (2020). *Staying with the trouble: Making kin in the Chthulucene*. Duke University Press.

Hauskeller, M. (2016). *Mythologies of transhumanism* (p. 122). London: Palgrave Macmillan.

Hepp, A. (2016). Pioneer communities: Collective actors in deep mediatisation. *Media, Culture & Society*, *38*(6), 918–933. https://doi.org/10.1177/0163443716664484

Hepp, A. (2026). The imaginative landscape of AI: Locating Silicon Valley's "quiet futuring." *Media, Culture & Society*, 01634437261454515. https://doi.org/10.1177/01634437261454515

Hilgartner, S. (2015). Capturing the Imaginary: Vanguards, visions and the synthetic biology revolution. In *Science and Democracy*. Routledge.

Huberman, J. (2023). Activating the senses: The aesthetics and politics of the transpecies society. *Senses and Society*. Scopus. https://doi.org/10.1080/17458927.2023.2225287

Hughes, J. (2004). *Citizen cyborg: Why democratic societies must respond to the redesigned human of the future*. Basic Books.

Ienca, M., & Andorno, R. (2017). Towards new human rights in the age of neuroscience and neurotechnology. *Life sciences, society and policy*, *13*(1), 5.

Jacobetty, P., & Orton-Johnson, K. (2023). Blockchain imaginaries and their metaphors: Organising principles in decentralised digital technologies. *Social Epistemology*, *37*(1), 1-14.

Jasanoff, S. (2015). One. Future Imperfect: Science, Technology, and the Imaginations of Modernity. In S. Jasanoff & S.-H. Kim (Eds.), *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* (pp. 1–33). University of Chicago Press. https://doi.org/10.7208/9780226276663-001

Kelly, L. (2023). Re-politicising the future of work: Automation anxieties, universal basic income, and the end of techno-optimism. *Journal of Sociology*, *59*(4), 828-843.

Kirby, D. (2010). The future is now: Diegetic prototypes and the role of popular films in generating real-world technological development. *Social studies of science*, *40*(1), 41-70.

Kuchler, M., & Stigson, G. M. (2024). Unravelling the 'collective' in sociotechnical imaginaries: A literature review. *Energy Research & Social Science*, *110*, 103422.

Kurzweil, R. (2026). *The singularity is nearer: When we merge with AI*. Penguin Group.

Latzer, M. (2022). The Digital Trinity—Controllable Human Evolution—Implicit Everyday Religion. *KZfSS Kölner Zeitschrift Für Soziologie Und Sozialpsychologie*, *74*(1), 331–354. https://doi.org/10.1007/s11577-022-00841-8

Latzer, M. (2026). Digitalization, AI and the rise of techno-religion: Transhumanist promises and the challenge to Enlightenment. *Telecommunications Policy*, 103115.

Leo XIV. (2026, May 25). *Magnifica humanitas* [Encyclical letter]. The Holy See. https://www.vatican.va/content/leo-xiv/en/encyclicals/documents/20260515-magnifica-humanitas.html

Lupton, D. (2016). *The quantified self*. John Wiley & Sons.

Mager, A., & Katzenbach, C. (2021). Future imaginaries in the making and governing of digital technology: Multiple, contested, commodified. *New Media & Society*, 23(2), 223-236.

Malekos Smith, Z. L. (2024). *The rise of preemptive bans on human microchip implants*. Carnegie Council for Ethics in International Affairs. https://www.carnegiecouncil.org/media/article/preemptive-bans-human-microchip-implants

More, M. (2013). The philosophy of transhumanism. *The transhumanist reader: Classical and contemporary essays on the science, technology, and philosophy of the human future*, 3-17.

Neuralink. (2025). *Building Safe Implantable Devices*. Neuralink. https://neuralink.com/updates/building-safe-implantable-devices/

Nelson, L. K. (2020). Computational grounded theory: A methodological framework. *Sociological Methods & Research*, *49*(1), 3-42.

Pedersen, I. (2020). *Will the Body Become a Platform? Body Networks, Datafied Bodies, and AI Futures*. https://doi.org/10.7551/mitpress/11564.003.0004

Phadke, S., Samory, M., & Mitra, T. (2021). Characterizing Social Imaginaries and Self-Disclosures of Dissonance in Online Conspiracy Discussion Communities. *Proc. ACM Hum.-Comput. Interact.*, *5*(CSCW2), 468:1-468:35. https://doi.org/10.1145/3479855

Pöhlmann, G., Ma, C., Suter, V., Meckel, M., & Steinacker, L. (2024, September). Exploring Public Discourse on Quantum Technology: Overlooking Societal Implications?. In *2024 IEEE International Conference on Quantum Computing and Engineering (QCE)* (Vol. 2, pp. 77-81). IEEE.

Polaris Market Research. (2023, June 7). Human augmentation market worth $725.29 billion by 2032: Polaris Market Research. https://www.polarismarketresearch.com/press-releases/human-augmentation-market

Proferes, N., Jones, N., Gilbert, S., Fiesler, C., & Zimmer, M. (2021). Studying Reddit: A systematic overview of disciplines, approaches, methods, and ethics. *Social Media+ Society,* 7(2), 20563051211019004.

Rescorla, M. (2024). The computational theory of mind. In E. N. Zalta & U. Nodelman (Eds.), *The Stanford Encyclopedia of Philosophy* (Winter 2024 ed.). Stanford University. https://plato.stanford.edu/entries/computational-mind/

Roco, M. C., & Bainbridge, W. S. (2002). Converging technologies for improving human performance: Integrating from the nanoscale. *Journal of nanoparticle research*, *4*(4), 281-295.

Röder, M., Both, A., & Hinneburg, A. (2015). Exploring the space of topic coherence measures. In *Proceedings of the eighth ACM international conference on Web search and data mining* (pp. 399-408).

Sandel Michael J. (2007). *The Case Against Perfection: Ethics in the Age of Genetic Engineering*. Harvard University Press.

Sartori, L., & Bocca, G. (2023). Minding the gap(s): Public perceptions of AI and socio-technical imaginaries. *AI & SOCIETY*, *38*(2), 443–458. https://doi.org/10.1007/s00146-022-01422-1

Schütze, P., & Latzer, M. (2026): The Transhumanist Anthropocene – From the Climate Crisis to Upgrading Humanity. *The Anthropocene Review*

Searle, J. R. (1980). Minds, brains, and programs. *Behavioral and brain sciences*, *3*(3), 417-424.

Seyfried, G., Youssef, S., & Schmidt, M. (2023). Pioneering neurohackers: Between egocentric human enhancement and altruistic sacrifice. *Frontiers in Neuroscience*, *17*, 1188066.

Srnicek, N., & Williams, A. (2015). *Inventing the future: Postcapitalism and a world without work*. Verso Books.

Ten Oever, N. (2021). "This is not how we imagined it": Technological affordances, economic drivers, and the Internet architecture imaginary. *New Media & Society*, *23*(2), 344-362.

Tirosh-Samuelson, H. (2012). Transhumanism as a secularist faith. *Zygon®*, *47*(4), 710-734.

Turner, F. (2010). *From counterculture to cyberculture: Stewart Brand, the Whole Earth Network, and the rise of digital utopianism*. University of Chicago Press.

Von Neumann, J., & Kurzweil, R. (2012). *The computer and the brain*. Yale university press.

Voros, J. (2003). A generic foresight process framework. *foresight*, *5*(3), 10-21.

Walter, D., & Ophir, Y. (2019). News frame analysis: An inductive mixed-method computational approach. *Communication Methods and Measures*, *13*(4), 248-266.

Yetisen, A. K. (2018). Biohacking. *Trends in biotechnology*, *36*(8), 744-747.