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Cyborg Imaginaries: A Computational Grounded Theory of Online Pioneer Community Discussions on Human Augmentation

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1. Introduction

Human Augmentation (HA) technologies, including prosthetics, neurostimulation devices, Brain-Computer Interfaces (BCIs), and microchip implants, are rapidly advancing in both medical and non-medical domains (Barfield et al., 2017; Raisamo et al., 2019). While currently adopted by niche groups (Britton et al., 2017; Seyfried et al., 2023), projections suggest their expansion into the general population (Polaris Market Research, 2023), impacting areas such as work performance (Ho et al., 2022), AI integration (Renz et al., 2024), and beyond-human augmentation (Huberman, 2023). The social and cultural implications of HA technologies, however, remain underexplored.

Following Appadurai's (2013) argument that futures are actively constructed through imagination, anticipation, and aspiration, we explore cyborg imaginaries as future imaginaries (Jasanoff, 2015) enabled by the advances in HA technologies. At this early stage, HA technologies remain largely experimental, making pioneer communities (Hepp, 2016, 2024; Hilgartner, 2015) relevant as spaces where augmentation imaginaries emerge. Among early adopters, transhumanists and biohackers frame HA as a step toward a posthuman evolution, aligning with transhumanist values of technological transcendence (Bostrom, 2005; More, 2013). Biohackers (Lupton, 2016) Quantified-Self practitioners (Yetisen, 2019) and transhumanists engage with HA to enhance human capabilities, focusing respectively on body modification, data-driven self-optimization, and long-term human transformation through technological integration.

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Despite their relevance, these imaginaries remain under-explored in scholarly literature. The study of online spaces, where transhumanist communities predominantly operate (Nabben, 2021), also remains limited (Michael et al., 2010; Niininen et al., 2023).

To address this gap, this study addresses the following research question:

What future imaginaries emerge from online pioneer community discussions on Human Augmentation technologies?

In particular, we use a computational grounded theory methodological approach (Nelson, 2020) to characterize HA-related imaginaries in online pioneer communities.

2. Theoretical Framework

This study situates Human Augmentation within the broader process of digitalization, understood as a co-evolutionary socio-technical transformation characterized by datafication, algorithmization, and platformization (Latzer, 2022). Augmentation technologies such as wearables, neurostimulation devices, Brain-Computer Interfaces (BCIs), and microchip implants extend this transformation to the human body, a process described as the platformization of the body (Pedersen, 2020), which results in increasing cyborgization (Greguric, 2021). Two key drivers underpin digitalization: (1) the belief in technologically controllable human evolution, and (2) implicit religiosity, where technology offers meaning, moral orientation, and transcendent experiences (Latzer, 2022).

The increasing use of augmentation technologies resonates with the transhumanist ideal of overcoming biological limitations through technology (Bostrom, 2005; More, 2013). To analyze how such visions are formed, we draw on the concept of sociotechnical imaginaries (Jasanoff, 2015) as shared and collectively produced visions of desirable futures. However, following Mager and Katzenbach (2021), we understand imaginaries as contested and negotiated in community discourse, rather than collective or institutionally fixed. We use the term “cyborg imaginaries” to describe imagined futures deriving from human-technology integration with augmentation technologies.

3. Related Work

The concept of sociotechnical imaginaries has been widely applied to the study of emerging innovations, including algorithms (Bucher, 2016), AI (Cave et al., 2020; Satori et al., 2023), cryptocurrencies (Jacobetty et al., 2023), and the metaverse (Gorichanaz, 2023). While early research focused on national imaginaries e.g. of nuclear energy (Jasanoff & Kim, 2009), recent work recognizes that imaginaries emerge across populations (Kappeler et al., 2023), communities (Hepp, 2024; Hilgartner, 2015; Lehtiniemi et al., 2019), and specific actors, such as industry stakeholders (Strengers et al., 2022). Online platforms like Reddit and Twitch have proven to be fruitful settings for studying imaginaries (Gutierrez, 2024; Phadke et al., 2021), and computational methods, including topic modeling (Wang et al., 2023), have been used in large-scale data contexts.

4. Methodology

This study applies a Computational Grounded Theory (CGT) approach (Nelson, 2020; Carlsen & Ralund, 2022) to develop an abstract theoretical understanding (Charmaz, 2014) of how cyborg imaginaries are constructed in online pioneer communities. Following a Straussian orientation (Corbin & Strauss, 1990), we keep the definition of imaginaries (Jasanoff, 2015) as sensitizing concept (Bowen, 2006) while remaining open to emergent meaning.

4.1 Data Collection

Table 1. Summary of Analyzed Subreddits

Subreddit	Focus	Members
r/futurology	"A subreddit devoted to the field of Future(s) Studies and evidence-based speculation about the development of humanity, technology, and civilization." (r/Futurology, n.d.)	21M
r/singularity	"Everything pertaining to the technological singularity and related topics, e.g. AI, human enhancement, etc." (r/singularity, n.d.)	3.5M
r/transhumanism	"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. This space is not intended for conspiracies or negative behavior" (r/transhumanism, n.d.)	85k

The dataset consists of discussions from three Reddit communities where pioneer users debate augmentation technologies (See Table 1). Reddit is a community-based online forum where discussions are organized into subreddits centered around shared interests rather than individual posts or fleeting interactions (Medvedev et al., 2019). This characteristic supports in-depth, substantive conversation threads around specific topics based on the subreddit structure (Proferes et al., 2021). While Reddit content is often considered publicly available online data (Proferes et al., 2021), this research was approved through a formal self-assessment at our university. Posts and comments were retrieved with the Python Reddit API Wrapper (PRAW) using search terms such as *"human augmentation," "BCI," "microchip implant,"* and *"cybernetic enhancement."* After removing automated and deleted content, the corpus includes 3,914 posts and 194,089 comments.

4.2 Analytical Process

The analytical process is structured in a multi-step structure (Figure 1). First, BERTopic (Grootendorst, 2022) is used to detect thematic patterns in the corpus. BERTopic employs transformer-based embeddings that capture contextual meaning and allow hierarchical topic clustering, improving thematic coherence compared with traditional models such as LDA (Blei et al., 2003). The BERTopic model produced 101 topics, of which about one-fourth were off-topic (e.g., moderation, generic news). The remaining topics covered a broad range of discussions on human augmentation, including technical aspects, ethical concerns, and speculative futures (Figure 2). As a second

step, representative documents are extracted from the topic model for qualitative coding, allowing for an initial emergence of themes. While themes can emerge from analysis of topics individually, we conceptualize future imaginaries as emerging discursively (Mager & Katzenbach, 2021). Lastly, in order to examine how topics relate, a topic network (Kim et al., 2019) was generated in which nodes represent topics and weighted edges indicate how often they appear within the same discussion. Network centrality metrics (Kim et al., 2019) as well as Louvain community detection (Blondel et al., 2008) on the topic network guided theoretical sampling of relevant discussions. Finally, selected discussions were then analyzed through open, axial, and selective coding. This process enabled the identification of broader conceptual dimensions, leading to the emergence of cyborg imaginaries.

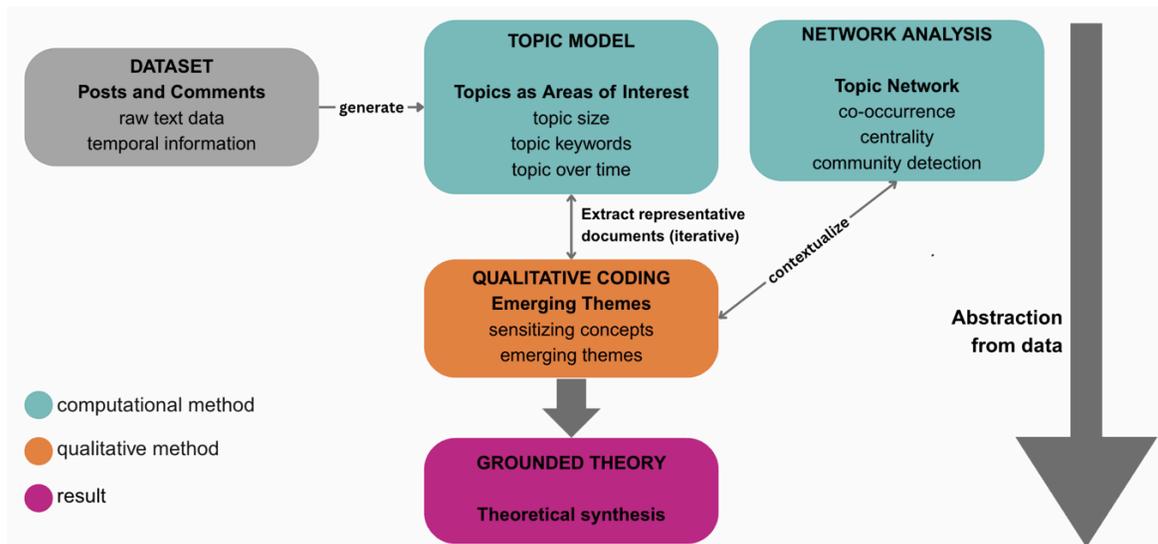


Figure 1. Analytical process combining topic modeling, topic network analysis, qualitative coding, and theorization within a computational grounded theory framework.

5. Results and Discussion

After extensive coding of representative documents and discussions, cyborg imaginaries were found to cluster around two orthogonal dimensions (Figure 3).

Inevitability vs. Contingency. This axis captures whether technological transformation is perceived as an unavoidable step in human evolution or as contingent on human agency and social context. While some participants framed augmentation as inevitable and beyond moral debate, others saw it as elective or dependent on specific innovations, and a few as evitable in a normative sense, something that could or should be limited through ethical and political decisions.

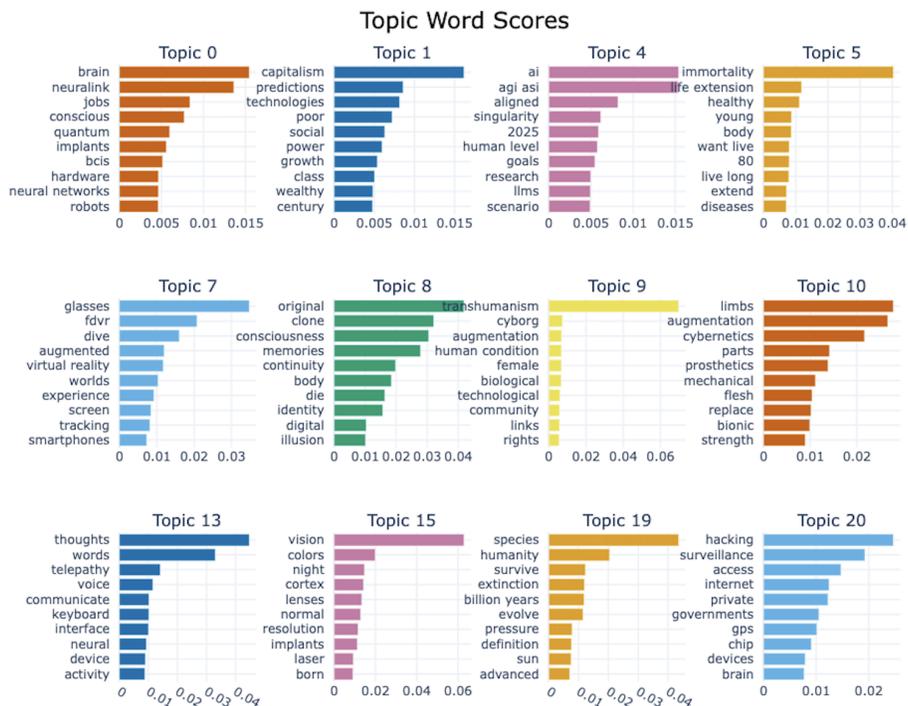


Figure 2. Top relevant 12 topics and keywords.

Apocalyptic vs. Emancipatory. This axis contrasts dystopian imaginaries of dehumanization, surveillance, and technological dependency with emancipatory narratives of human enhancement, extended longevity, and liberation from biological constraints. Whereas apocalyptic visions emphasize loss of autonomy and control, emancipatory ones portray augmentation as a means of self-directed evolution and progress.

Together, these dimensions define contested cyborg imaginaries through which pioneer communities negotiate the desirability, limits, and direction of human augmentation.

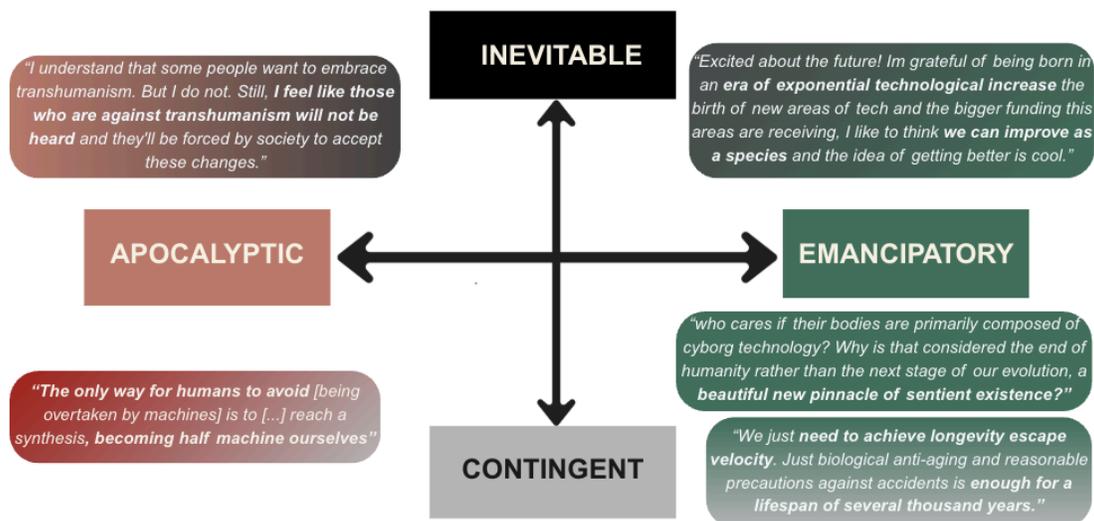


Figure 3. Dimensions of contested cyborg imaginaries with representative quotes.

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