Envisioning Transhuman Communication Research:
Speculative Human Augmentation Technologies and Fictional Abstracts

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ABSTRACT
Throughout human history, communication has evolved and diversified through various means, from natural languages to modern forms like video and virtual reality. Now, a paradigm shift, transhumanism, is proposing the integration of machines and computers into the human body to augment individuals physically, sensorily, cognitively, and emotionally. In this pictorial, we examine "How can we approach the design of transhuman technologies for communication?" and "How might future research examine their impact on communication?" For this, we conducted co-speculation workshops to identify design opportunities, and based on them, created fictional abstracts envisioning future research. Our work contributes a set of design speculations and a range of thought-provoking research ideas that will foster discussions about probable pitfalls and benefits of transhuman technologies in the future of communication.

CSS Concepts
•**Human-centered computing→HCI theory, concepts and models;User models;Interaction design theory,concepts and paradigms;Ubiquitous and mobile computing theory, concepts and paradigms**

INTRODUCTION
Communication has been an essential aspect of human existence, serving the need for cooperation and coordination among humans and pre-human animals. This development has led to the evolution of complex means of communication, including natural languages, art forms, and writing systems, and has been extensively studied, i.e., [14, 24, 31, 35]. These works highlight human communication as a complex process in which meaning-making takes place within a multifaceted realm based on situated communication experiences (i.e. the communicative intentions and interpretative choices and the structural properties of the communication medium -as outlined by Eco [15] and McLuhan [31]). In this regard, communication media such as images, video, telecommunications, virtual reality, and face-to-face interactions provide diverse and unique communication experiences. However, the emergence of transhumanism as a philosophical and technological movement introduces a novel perspective on communication, the integration of machines and computers into the human body will augment individuals physically, sensorily, cognitively, and emotionally [6, 33].

The prevailing view on transhumanism emphasizes human augmentation leading to improved unity, immediacy, and efficiency, but this approach risks sacrificing diversity and plurality for homogenized "perfected" transhumans [23, 32]. In contrast, communication theorists advocate for the value of imperfection and diversity in enriching cultures through multiple perspectives and semiotic materials [17, 28]. To broaden our understanding of transhuman communication, we draw on Haraway's concept of "cyborgs," challenging traditional notions of identity and embodiment [19]. From this perspective, we argue that Human Augmentation Technologies (HATs) hold significant potential to reshape and diversify future communication.

The idea of human-computer integration [38] has sparked explorations into diverse communication experiences through physical and sensory augmentations, involving implantable and prosthetic technologies for social play [34], expressive and social use of artificial limbs [11, 43], and social communication through robotic limb systems [44], as well as social implications of cognitive augmentations such as cloning and/or fusion of multiple beings [22]. However, these examples are constrained

by current technological limitations. A comprehensive and critical examination is essential to understand the communicative landscape in transhuman societies and fully harness the integration of technology and bodies.

In this work, we use speculative design and fictional abstracts as methods to explore the wider communicative possibilities enabled by HATs. Speculative design challenges norms by envisioning artifacts and contexts for plural and alternative societies [13], while fictional abstracts go beyond utilitarian considerations, delving into complex human experiences and the societal impact [4, 5, 27]. Transhumanism has been explored in speculative design (SD) approaches, (i.e. [9, 10, 20, 40]), showing how SD can move away from techno-solutionism in transhuman technology development. Instead, it allows envisioning diverse everyday experiences, from smart cities for transhumans [40] to exploring the impact on children's development [10]. To expand these on exploring transhuman technologies for communication and examining their impact, we conducted co-speculation workshops [12] with participants experienced in communication technology and fiction creation. Through reflexive thematic analysis [7, 8], we identified four themes that provided HAT speculations for communication experiences. Based on these themes, we created five fictional abstracts, illustrating diverse research scenarios of transhuman communication experiences. Figure 1 provides an overview of our research methodology.

Our work contributes a set of design speculations and thought-provoking research ideas that foster discussions about the probable pitfalls and benefits of transhuman technologies in communication. By doing so, we hope to inspire critical conversations and guide the development of transhuman communication technologies in a socially responsible and inclusive manner.
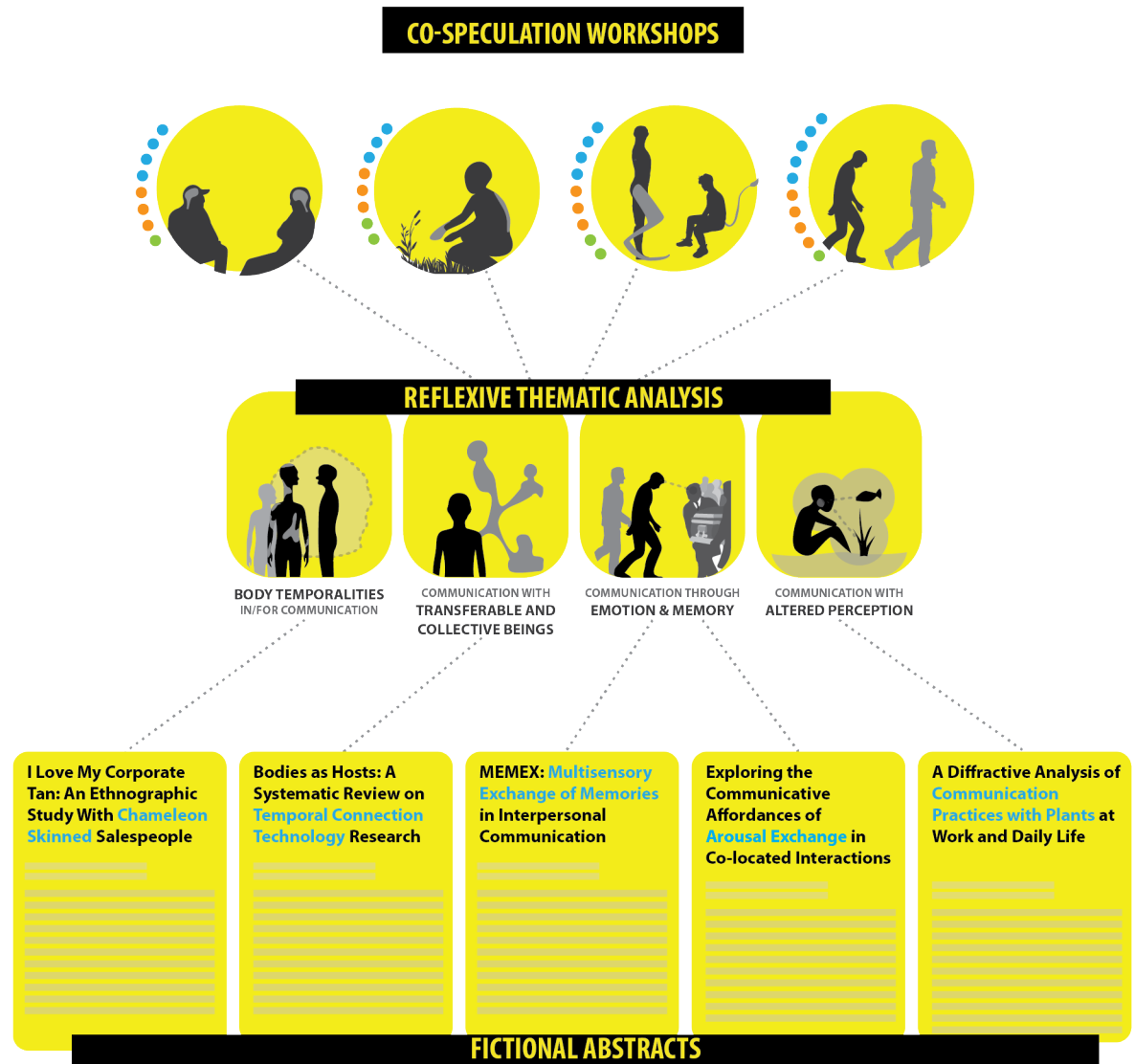
Figure 1: Overview of the research process starting from co-speculation workshops to fictional abstracts.
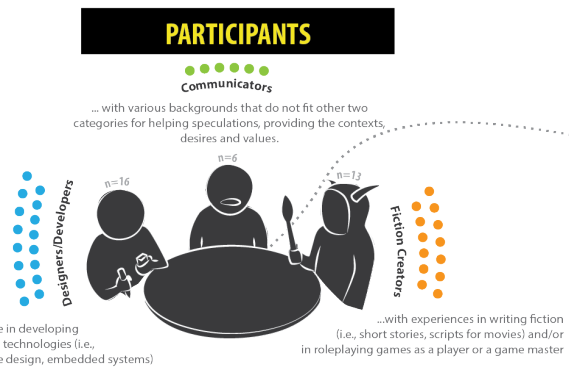
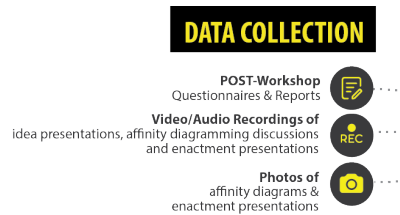**Figure 2:** Summaries of the participant backgrounds by our categorization.

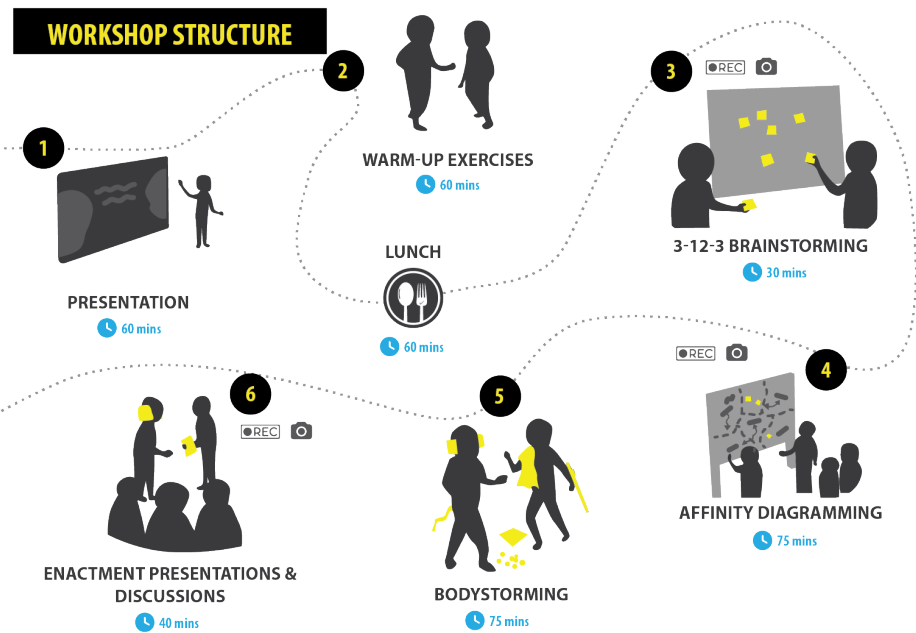**Figure 3:** Data collected from the workshops.

Figure 4: Procedure of the workshops.

CO-SPECULATION WORKSHOPS

Co-speculation, as a participatory approach to speculative design, seeks to engage diverse stakeholders in the co-creation of future concepts [41]. In our work, we utilized co-speculation by conducting four thematic workshops [12, 25] aimed at deeply engaging participants in exploring particular aspects of HAT (physical, sensorial, cognitive, and emotional [6, 33]) as starting points.

The workshops were conducted as part of a course on "Speculative Design for Transhuman Communication Technologies" at Tampere University (Finland), open to students and external participants. The call for participation was spread through various channels, and interested individuals filled out a pre-application form, providing details about their background and interest in the subject. The authors selected 35 participants (11 women, 23 men and 1 preferred not to disclose) by considering their experience in fiction creation, designing and developing technology (Figure 2).

The workshops followed a similar structure with slight variations (Figure 4): (1) an introductory presentation, (2) warm-up activities to encourage creativity [3] and mindful body awareness [21], followed by lunch. After lunch, (3) a brainstorming technique called "3-12-3" [16] is executed for quick expression of ideas. Participants had 3 minutes to generate keywords related to the topic and then 12 minutes to combine those keywords and present their ideas. (4) The affinity diagramming [29] session furthered ideas and encouraged speculations about potential communication experiences. After a break, participants engaged in (5) developing ideas through paper prototyping [39] and body-storming [30] to let them explore and detail ideas bodily, as well as concretizing scenarios. (6) Refined ideas were presented through enactments, and discussions followed.

The data collected (Figure 3) was inductively analyzed by using Reflexive Thematic Analysis (RTA), an iterative method for identifying concepts and developing overarching themes, involving active engagement and reflection with data [7, 8]. Below, we present the steps undertaken throughout the analysis process:

- *Familiarization with the data:* (1) After the workshops, the first three authors came together to note down the observations of the workshop facilitators about the speculated technologies. (2) The 1st author thoroughly reviewed the video and audio recordings of brainstorming presentations, and affinity diagramming discussions and transcribed the parts where participants talked about a speculated technology and scenarios about how they could be utilized. He also took notes for the photos of the affinity diagramming results and videos of enactment presentations from each workshop. Finally, he created a map with flow charts matching data excerpts with workshop phases. (3) He presented the map to the 2nd and 3rd authors. Together, they decided on an inductive data analysis strategy to identify differences and similarities in speculated technologies.

- *Generation of initial codes:* (4) The 1st author created initial codes for identified speculated technologies and did a first round of coding. He also prepared a document with data excerpts and initial codes associated with them to share with the other authors.

- *Reviewing themes:* (5) The 3rd and 1st authors met in two meetings and thoroughly reviewed them, discussing and refining the codes where the conflicts

between the two authors emerged. At this stage, the authors also further conceptualized the codes and grouped them into thematic clusters.

- *Defining and naming themes:* (6) The 1st author performed a second round of coding based on the codes defined with the 3rd author.

- *Producing the report:* (7) The first author created a document summarizing the themes, by also

incorporating communication scenarios and descriptions of the speculated technologies from the workshop data. Themes were reviewed and refined by the first four authors for publication.

Figure 5, 6, 7 and 8 present the themes with titles, descriptions, data excerpts, as well as the illustrations created by the 1st author.

THEME #1

BODILY TEMPORALITIES
IN/FOR COMMUNICATION

The first theme of our design speculations explores how transhumans can have control over their bodily temporalities, allowing them to craft and reverse modifications as needed. These speculations delve into the design possibilities of perceiving and utilizing our bodies/minds and the auras around them for communication.

SENSORY

Participants highlighted the posibility of adjusting the height to the conversation partner: *"Oh, let me come to your level!' [transhuman shrinking down to adjust] ... I could imagine it might be rude if I don't adjust to the level [of the conversation partner]"*

(Affinnity Diagramming Session)

SENSORY

Participants considered transforming into a soft couch to *"give a nice and cozy experience to people",* or being a house, so *"I am sheltering and protecting people".*

(Affinnity Diagramming Session)

An emotional screen, a field around the body that amplifies or blocks their emotional expression while crying, was suggested in the affinity diagramming session.

EMOTIONAL

(Affinnity Diagramming Session)

EMOTIONAL

[participants refferring to skin color change] *"My happiness can be pink and yours could be textured"*

(Affinnity Diagramming Session)

Participants highlighted the possibility of distributing a scent that echoes the conversation partner's *"mother's cooking"* to influence the conversation partner

EMOTIONAL

(Affinnity Diagramming Session)

THEME #2

COMMUNICATION WITH
TRANSFERRABLE AND
COLLECTIVE BEINGS

The second theme introduces speculative designs that liberate transhumans from a single physical body. Instead, these designs offer flexible, transferable, and ephemeral ways of existence, allowing transhumans to share their bodies with others and gain profound insights into each others' mental, physical, and emotional states, and even beyond.

In the final presentation of a group, a scenario was enacted where a couple shared an intimate camping experience, and one of them was transferred into the other's body. While trekking together during the trip, the shared body was predominantly controlled by the host. However, the remote partner, accessing the host's perception, noticed an intriguing plant. To communicate their interest, the remote partner moved the host body's arm towards the plant as a sign of curiosity.

(Enactment Presentations)

COGNITIVE

EMOTIONAL

In a discussion about a clone collective scenario, one participant emphasized a possible conflict within the multiple copies of a single transhuman: *"There are so many of me. But then I am perceiving all the different emotions coming from all the copies of myself. I'll need to know how I am actually feeling"*

(Affinnity Diagramming Session)

COMMUNICATION THROUGH
EMOTION & MEMORY

The third theme explores speculative scenarios where transhumans possess the ability to control their own and others' emotions and memories, impacting communication experiences and enabling the exchange of emotions and memories as commodities through tokens, interpersonal connections via touch, and a network of mind exchange.

Participants suggested that, in a funeral context, a transhuman attendee can have the ability to adjust their level of sadness to empathize with the grief of the deceased's loved ones, even if they did not feel as sad themselves.

(Affinnity Diagramming Session)

In a final enactmet presentation, participants demonstrated a scenario where an angry crowd's emotions were suppressed by another group of transhumans (referred to as authority) using an "emotion bomb," a device capable of altering emotions in a specific area.
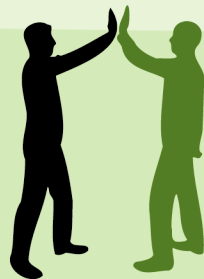
(Enactment Presentations)

Participants discussed the possibility of sending the emotions of a crime victim to the perpetrator, intending to make them understand the impact of their actions by experiencing the victim's emotions.

(Affinnity Diagramming Session)

In a final enactment scenario, participants portrayed two transhumans engaging in a covert memory exchange of a concert by touching their palms together, only to have the exchange interrupted by the police, who enforce the ban on illegal memory exchanges.
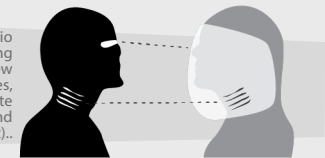
(Enactment Presentations)

COMMUNICATION WITH
ALTERED PERCEPTION

The fourth theme explores speculations on modifying how transhumans sense and perceive the world. It envisions transhumans developing augmentations to mimic the information exchange methods of non-human animals and plants, which are imperceptible to human beings. These augmentations could include technologies in their bodies, such as sending and receiving vibrations for communication or photosynthesizing. Additionally, in this theme, transhumans might have the ability to manipulate their time perception for communication, either slowing it down or speeding it up.

One of the final presentations depicted a future scenario where the Earth's land becomes inhospitable, leading some humans to live underwater. To survive in this new environment, they integrated technology into their bodies, enabling them to breathe underwater and communicate through vibrations (inspired by fish communication) and signaling with lights (similar to the Morse alphabet)..

(Enactment Presentations)
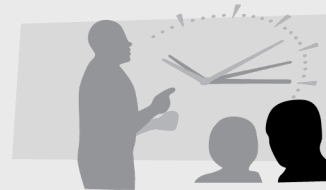
"Ability to manipulate time perception [...] could have a range of applications such as in education or entertainment. In education, by allowing students to slow down the pace of lectures or demonstrations to better understand and absorb the information being presented, and in entertainment, by allowing people to experience fast-paced events or actions in slow motion, which could enhance the viewing experience and make it more immersive.'"

(Reflection Report)

"The potential uses of [photosynthesis] would be similar to sunbathing together that would represent intimacy. [...] there could be class divisions based on access to the resources for photosynthesis."

(Reflection Report)

FICTIONAL ABSTRACTS

In this section, we present the five fictional abstracts illustrating future research, as well as the impact of HATs on society and communication experiences. Each abstract is presented with a title, a set of fictional authors and their affiliations, a summary of the work [10, 45], as well as accompanying figures to detail the designs, utilizations in communication scenarios and how they are considered in the fictional abstracts.

These abstracts were created based on the themes from co-speculation workshops, emphasizing technology speculations and their societal impact. For this, we reviewed speculated technologies and scenarios mentioned in the themes and elaborated on further details about how they might be designed, as well as creating new scenarios to illustrate their use and impact. For instance, "skin color change" and its potential utilization for self-expression were speculated in the workshops.

While creating Abstract 1, authors imagined the use of this augmentation in work contexts and speculated an ethnographic study that reports another potential issue, biolabor (and its abuse). As such, these abstracts illustrate the four pillars of human augmentations (physical, cognitive, sensorial, and emotional [6, 33]) and extend the speculations and discussions based on the workshop data. The first author crafted the abstracts, with inputs from the second, third and fourth authors.

I LOVE MY CORPORATE TAN: AN ETHNOGRAPHIC STUDY WITH CHAMELEON-SKINNED SALESPEOPLE

William Adama, University of Iopolis, Canceron

Skin replacement technology has allowed for the mainstream adoption of synthetic **"chameleon skin" (CS), enabling dynamic changes in color, texture, and transparency** (Figure 6). Despite being initially used and marketed as a form of self-expression, CS's success and the growing mean age of CS owners have extended its contexts of use beyond leisure activities and in different professions. While also reporting discriminatory employer practices coercing "'Chameleon-Skinned" individuals to be compliant with their respective brand colors, recent studies have highlighted the increasing rate of employment of individuals with CS as salespeople, suggesting that the expressive usage of CS can become a professional asset in the field. This study investigates the utilization and experience of CS as a labor tool for sales work within organizations. To achieve this, three-month fieldwork was conducted, involving participant observation and ethnographic interviews with sales representatives possessing CS (N=5) in an organization producing non-alcoholic beverages. Although limited to one organization, the findings suggest that CS is utilized as a part of labor activities by conforming to beauty standards, retaining customer attention and attracting customers (Figure 5). Additionally, CS was used by salespeople to align their appearance with the corporate identity of the organization. However, several individual workers reported that the utilization of CS to meet sales objectives sometimes conflicted with their own desire for self-expression, for example by stating that they felt the corporate dirt was smudged to their skin (P3), an issue that we interpret in the frame of Marx's theory of alienation [36]. In the conclusions, we argue for the necessity of considering biolabor as a key component of contemporary work environments and of expanding legislation and work regulations to protect the rights of augmented workers.

THEME #1

BODILY TEMPORALITIES
IN/FOR COMMUNICATION

"Old customers like it when I add more wrinkles on my skin you know! They feel more confident when I do that. But for others, my bosses ask me to be this perfect person." (P3)
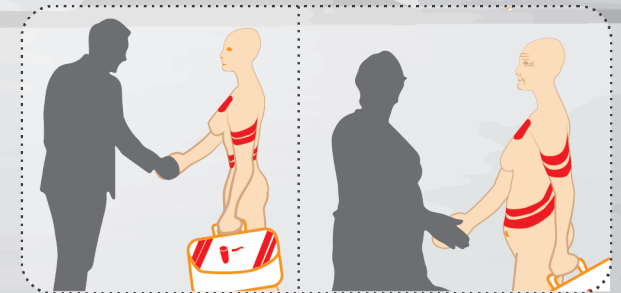

Figure 5: Chameleon-skinned salespeople adjust their appearance depending on the customer and the branding.

Figure 6: A chameleon-skinned salesperson outside of the work context.

Figure 7: Research contexts

Figure 8: Findings from experience evaluations

Figure 9: Modalities used in the studies

BODIES AS HOSTS: A SYSTEMATIC REVIEW ON TEMPORAL CONNECTION TECHNOLOGY RESEARCH

Ashley Madeline Williams, Institute of Body Engineering, Sirona University, Sirona Hannah Shepard, Social Sciences Department, Earth University, Reykjavik, Iceland

Temporal connection technologies (TCT) enable remote individuals to access each other's sensory channels and share control of the host body. While far from being commercialized, scholars have shown significant interest in this technology. We conducted a systematic review of relevant works published between 2063 and 2073 (n=143). The review revealed that a variety of disciplines has engaged TCT from different perspectives, the main ones revolving around technological feasibility, ethical issues and risks, and possibilities for communication. Most research (88 papers) concentrated on technology development and evaluating its effectiveness in transmitting sensations and enabling shared body control in controlled environments. Only 15 studies conducted in-situ evaluations in real-life contexts (Figure 7). The second largest topic tackled ethical issues and potential personal, psychological and societal risks (39 papers), addressing concerns regarding body ownership, consent, temporal dissociation syndrome, lagging and more. Among the implementations, our findings reveal that TCT modalities primarily focus on shared body control, hearing sight, and haptic sensations (Figure 9). Only five studies explored taste and smell sharing. Evaluating TCTs produced mixed results (Figure 8). Many studies assert they could prove beneficial for facilitating collaboration in practical tasks and fostering intimacy through shared sensations and control. However, participants often reported discomfort with their bodies being controlled, difficulties interpreting remote partner-induced body movements, and high cognitive load in multitasking scenarios. Some participants also reported to have felt violated when controlled. Although TCTs showed promise in certain domains, further research is necessary to understand their daily life experiences and the possible physiological, psychological and social consequences of their adoption issues.
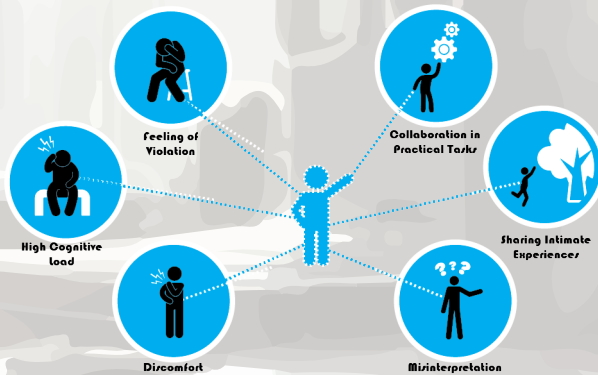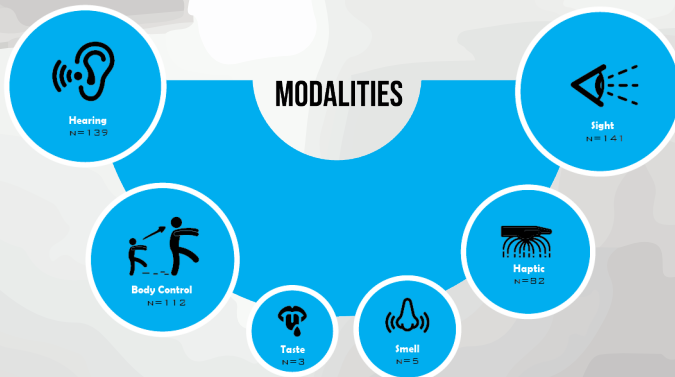
MEMEX: MULTISENSORY EXCHANGE OF MEMORIES IN INTERPERSONAL COMMUNICATION

Karl Agathon, Department of Design, University of Caprica
Sharon Valerii, Department of Design, University of Caprica

While brain implants like NeuroLink enable seamless human-computer interfaces, their application for human-to-human communication remains largely unexplored. The study introduces **"MemExchange," a system combining embedded sensors and brain implants that allow transhumans to record multisensory experiences as memories (Figure 10) and directly exchange them with others (Figure 12)**. An in-situ study involving 11 pairs of individuals utilizing MemExchange for three months was conducted to understand its communicative uses. Participants recorded their experiences and motivations for memory exchange in diaries, and post-interviews were conducted at the end of the study. The findings (Figure 11) suggest that exchanging memories is a complex and time-consuming activity, requiring considerable and continuous effort from both parties. While expressing frustration towards the process, users argued that they would be interested in using this technology with motivations varying from supplementing conversations with anecdotes, sharing individual experiences with the partner, crafting memories for the significant other as a gift to providing instructions about how to accomplish complex tasks. On the other hand, participants claimed that verbal communication is more efficient and easy to perform and that they would use MemExchange only in extraordinary cases. Users also raised concerns regarding ownership and privacy (i.e., sharing intimate memories with third parties), identity (i.e., distinguishing between own and other's memory), as well as disturbance due to oversharing sensations. Overall, this work highlights the complexity of utilizing brain implants for interpersonal communication, suggests that the seamless implementation is critical for wider adoption, and offers valuable insights for further exploration and development of such technologies.

THEME #3
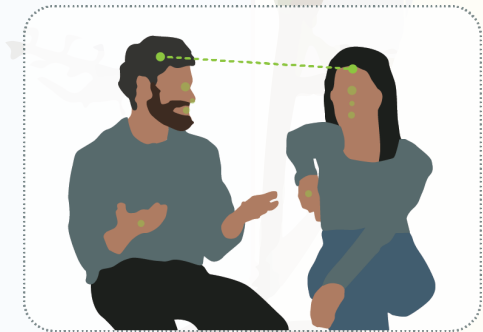
COMMUNICATION THROUGH
EMOTION & MEMORY

Figure 10: A participant sharing the memory of a trip with their partner.
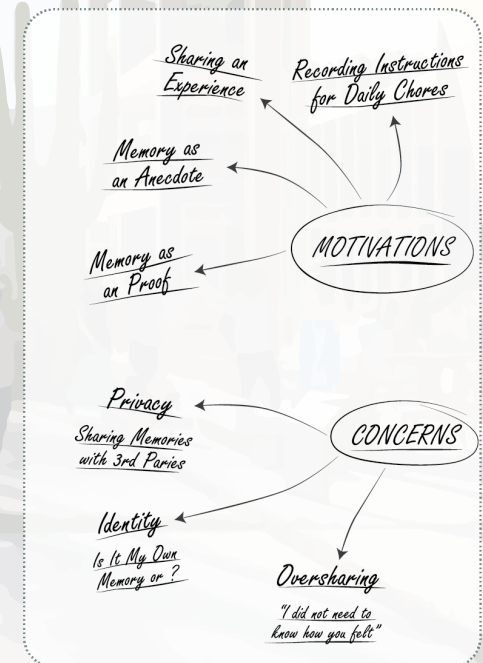
Figure 11: Motivations and concerns for using MemEx in communication.

Figure 12: A participant recording a multisensory memory of a trip to share with their partner.

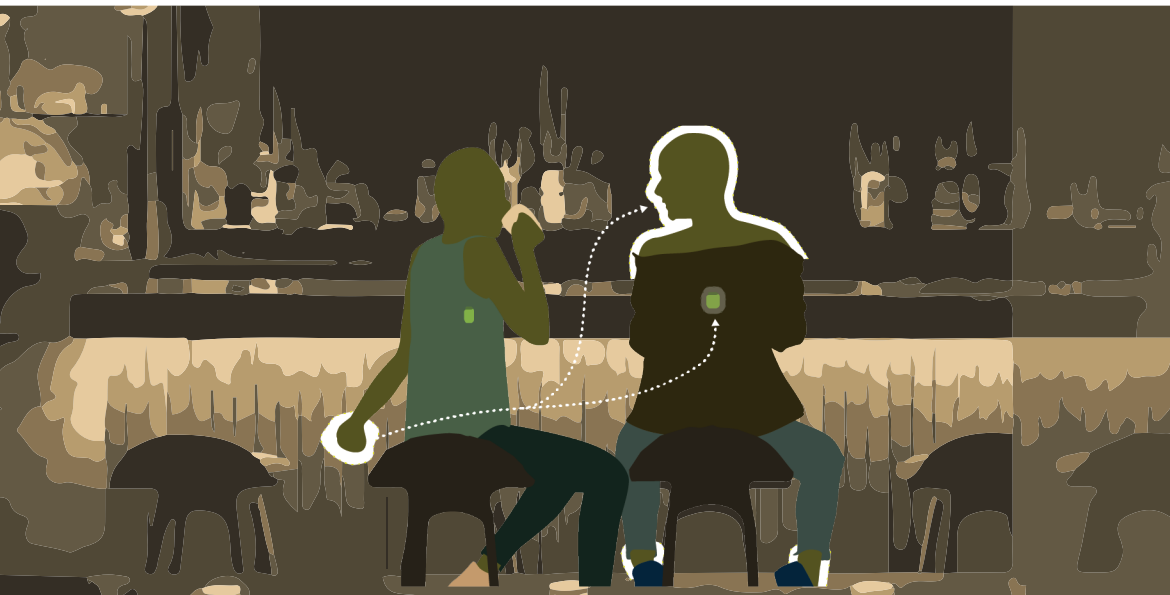**Figure 13:** Speed dating context. One participant sends to another one as a joke with a secret gesture.

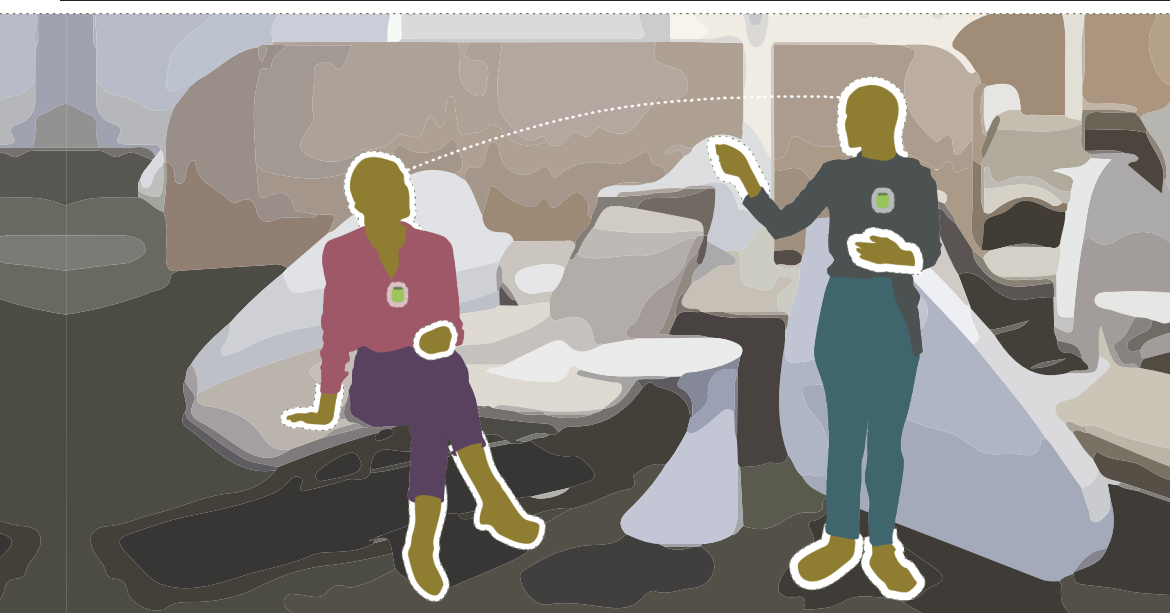**Figure 14:** Brainstorming context. The participant on the left feels the anxious state of the other inmate.

EXPLORING THE COMMUNICATIVE AFFORDANCES OF AROUSAL EXCHANGE IN CO-LOCATED INTERACTIONS

Benezia, Affective Computing Research Group, Noveria University
Karin Chakwas, Institute of Medicine, University of Naran

Arousal Control Technologies (ACT), developed as a result of efforts to link body arousal and emotions in the affective computing field, are trending as one of the most promising communication technologies. ACTs work by stimulating arousal states related to particular emotions in individuals through, i.e., pacemakers to modify heart rate and skin implants for body heat regulations. In the last years, there have been several attempts to use ACT as a method to rehabilitate inmates by making them experience their victims' affective states. Results, however, were mixed: the lack of a critical reflection on the experience was reported by several studies as a major limitation. To overcome this issue, in our study, we developed **a soma interface to exchange arousal states through ACTs for transferring emotions during communication**. Two scenarios were tested with former inmates with ACTs (N=12): automatic arousal transfer during brainstorming (Figure 14) and emotions exchange in speed dating (Figure 13). Post-study interviews confirmed ACTs' ability to build empathy, as participants felt each other's arousal. They also served to enhance conversations by conveying relevant emotions to the topic or expressing engagement through excitement and joy. However, the interpretations of conveyed arousal states varied widely among individuals, suggesting arousal exchange is still an ambiguous form of communication. By highlighting these affordances, our work sheds light on the potential of ACTs in social communication in the context of rehabilitation.

THEME #3

COMMUNICATION THROUGH
EMOTION & MEMORY

A DIFFRACTIVE ANALYSIS OF COMMUNICATION PRACTICES WITH PLANTS AT WORK AND DAILY LIFE

Kai Leng, Technology University of Eden Prime

Plant Communicators, or fytocomm, are sensory augmentations that allow individuals to perceive and produce acoustic and chemical signals to communicate with plants. Fytocomm has quickly become a standard technology in food production focusing on quality and as a means to foster connections with plants by nature-lovers. Previous studies assessed fytocomm by measuring communication efficiency and its impact on plant growth and human well-being, often isolating humans, fytocomms, and plants. In this study we adopt a posthumanist perspective, challenging the notion of predetermined boundaries between plants, humans, and technology, and proposing that these boundaries are enacted within specific material configurations and cultural framings. To understand daily fytocomm experiences better, this study conducts a diffractive analysis of two communication contexts: (1) at work (Figure 16) and (2) in daily life (Figure 15). Data from observations and interviews with farm workers using fytocomm and casual users are analyzed. The analysis reveals that communication blurs the individual identities of humans and plants, making them feel like part of a whole in both contexts. Communication also becomes a survival act, with slightly different meanings for survival in each context, e.g., keeping plants alive and earning a living on the farm, versus maintaining a livable world in daily life. Understanding these entanglements of technology, humans, and non-humans provides a broader perspective on communication experiences between humans and plants in their day-to-day interactions.

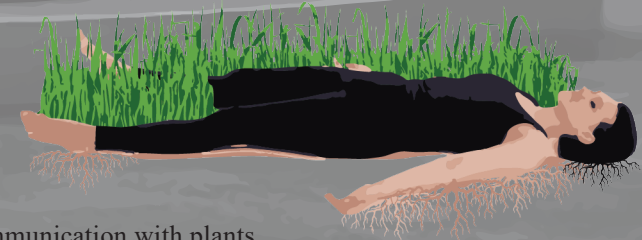**THEME #3**

COMMUNICATION WITH ALTERED PERCEPTION

Figure 15: Leisure time communication with plants.

Figure 16: Communication with plants at work.

REFLECTIONS:
Diversity and Collaboration in Communication

Our themes and abstracts present novel extensions to conventional sign production modes [14], offering the potential for *diversity* in the means of communication and expression. For instance, Theme 1 and Abstract 1 explore crafting body temporalities, augmenting existing communicative strategies like body language, clothing, and perfumes. This aligns with research on prosthetic tails [43], wearable technologies with color-changing capabilities [26], and scent-dispensing devices [2].

On the other hand, the remaining themes and abstracts speculate new and *arguably more ambiguous modalities for communication* through emotions, memories, as well as new sensory abilities borrowed from non-humans. For instance, Abstract 3 signposts the potential for mixed meanings through memory exchange, wherein multisensory memory sharing might lead to disturbances through oversharing while offering a memory as a gift could lead to pleasant exchanges. Abstract 4 emphasizes using emotion exchange for humor and expressing interest. Additionally, Abstract 2 highlights the challenges of interpreting induced movements when a temporal connection is established. Abstract 5 also provides a new means of communication through chemicals and vibrations, as plants use. The inherent ambiguity of these communication forms offers exciting opportunities to diversify communication experiences beyond our current capabilities and practices.

Furthermore, sharing memories and emotions , as well as accessing other human's and non-humans' perceptions can promise *collaborative futures for humans and non-humans*. For instance, by accessing others' perceptions and controlling their body (Abstract 2), transhumans can help each other in complex tasks. Perceiving things from others' perspectives (Abstract 2) and feeling the arousal states of others (Abstract 4) might help individuals build empathy with each other. Similarly, communicating with plants (Abstract 5) might enable collaboration between plants and humans.

Ethics of Transhuman Communication: Autonomy, Ownership, Privacy and Identity

As illustrated in this pictorial, transhuman communication technologies hold the potential to reshape the very fabric of human existence. These technologies, ranging from synthetic skins to augmentation for accessing others' minds and bodies, hold immense promise for augmenting human capabilities and extending the boundaries of what it means to be human. However, with this transformative potential comes a host of ethical considerations that demand careful scrutiny. As these technologies continue to evolve and integrate into our lives, it becomes increasingly vital to explore the ethical implications they entail, from questions of autonomy and consent to issues of ownership, privacy and identity. The majority of workshop speculations and abstracts are based on accessing, influencing and controlling others' minds and bodies for the sake of communication. In this section, we reflect on how these might create ethical challenges ethically.

The ideas about exchanging emotions and memories, as well as controlling others' bodies, bring in *ethical concerns regarding body autonomy*. Abstract 4 mentions the utilization of arousal exchange as a way to rehabilitate people, whereas the workshop speculations highlight that inducing emotions can be used as surveillance technology to calm a group of protestors. Abstract 2 mentions challenges such as discomfort and feeling violated when a body is being controlled by others. Here, researchers should think about how justifiable it is to modify others' bodies for the sake of communication. Is it a violation of others' bodies? Or can it be considered freedom of speech when we modify others' sensations? These are also reminiscences of transhumanism, for instance, "Should children be 'enhanced' with communication technologies without their will?" [1]. We need to acknowledge considerable risks that can threaten the autonomy of individuals through the involuntary alteration of their bodies and minds.

Moreover, HATs bring in other concerns regarding *ownership* and *privacy*, as illustrated in Abstract 3 reporting "sharing intimate memories with third parties" as a concern. Also, in one of the workshops, the exchange of a concert memory between friends was prevented by authority as they did not have the 'right' to share (Theme 3). Based on these, we ask "How would we know who owns the memory when it's exchanged among multiple parties?" or "Do we have the right to second-hand share the memories of others?". While these can be argued to be cases in exchanging videos or images or even verbal descriptions of other's memories, the memory exchange technology and temporal connection technologies propose arguably more intimate modalities such as the sensation of touch, smell and taste to be exchanged between individuals. We need to think about privacy protocols regarding these new means of communication.

Finally, while memories and having control over the body (i.e., having tattoos) are claimed to be highly influential in constructing our identities [36, 37], the speculations enable modifications in them. For instance, Abstract 2 reports temporal dissociation syndrome when bodies are controlled by others, whereas Abstract 3 highlights the challenge of distinguishing the memories of own and others. These suggest that *identity disorders* might be among many other undiscovered psychological problems that can come with alterable minds and bodies and highlight the ethical questions such as should people of the future be allowed to modify others' minds and bodies? How should we prevent the misuse of such technologies modifying others?

Politics of Transhuman Communication: Access, Hierarchies, Commodification and Discrimination

The technologies speculated in this work contain not only the utopias that they can enable (some positive impacts such as pluralistic and collaborative societies summarised in the first section), but also dystopian potentials that they might lead in future societies. In this regard, our work, rather than summarizing prescriptions for the developers of such technologies towards certain directions, provides an ustopian view [46], highlighting

societal and political frictions. In this section, we reflect on some of these frictions with the hope that they might help us answer the question of what kind of a world we want to live in.

As introduced earlier, transhumanism's mainstream focus is on enhancing unity, immediacy, and efficiency through "perfected" transhumans [23, 32]. While our work explores technology's potential to diversify expressions and enhance societal complexities, it raises the critical issue of technology access. This concern has already been addressed in transhuman research, referring to the potential societal gap in access to these technologies [1]. In the context of communication, the issue becomes even more significant. Most communication technologies discussed in the context of this pictorial grant individuals unique communicative abilities, such as emotion-driven (Abstract 4) and memory-based communication (Abstract 3). Access to these technologies determines one's ability to communicate through these means and might define the parts of society they may interact with, possibly resulting in societal divisions. Moreover, technologies, such as accessing others' minds and bodies (Abstract 2), have the potential for some humans to dominate others. For instance, a manager can utilize such technologies for surveilling their workers.

Another issue that the developers of future communication technologies should keep in mind is how such technologies contribute to or diminish *hierarchies within broader society*, one that also includes non-humans. In this regard, Abstract 5, for instance, puts forth two directions on how a technology for communicating with plants might have an impact on the hierarchy between humans and non-humans. As depicted in the abstract, while this technology could enable a connection between humans and plants, possibly diminishing the hierarchy between humans and non-humans, it can also lead to further abuse of non-humans by granting an increased power to control and use them for our economic gains.

The potential for abuse is not limited to non-humans, it can also include (trans)humans with the speculated technologies by the *commodification* of the augmented abilities. In Abstract 1, for instance, this is labeled as biolabor, where the transhumans with skin augmentation are favored as salespeople due to the potential of utilizing skin change abilities to express corporate identities visually. But they are also pressured into using those abilities for their work. Similarly, in Abstract 5, humans commodify their abilities to communicate with plants to earn their living. On one hand, while this commodification can enhance the alienation of workers, the experience of human life as meaningless or the human self as worthless in modern capitalist society [36], as highlighted by Abstract 1, it can also contribute to *discrimination* against transhumans based on these commodification practices. The discriminative practices already exist in workplaces (i.e., beauty standards [18] or lookism in general [42]), yet, Abstract 1 illustrates such discriminative practices can occur based on commodifying abilities, favoring the chameleon-skinned individuals as salespeople. These points illustrate that augmenting human abilities might come with the exploitation of those abilities and might require the production of regulations and policies regarding how these abilities might be used in individual and professional contexts.

CONCLUSION
In this pictorial, we engage with speculative design activities (co-speculation workshops and fictional abstracts) to identify opportunities and pitfalls of designing and using body augmentation technologies for communication. The analysis of co-speculation workshops data enabled us to illustrate how HAT can provide opportunities for (1) crafting bodies during and before communication, (2) temporal or constant connection among transhumans, (3) regulating and exchanging emotions and memories for communication, as well as, (4) communicating with altered perceptions. Based on these themes, we formed five fictional abstracts as a research-oriented stance for demonstrating the potential challenges and benefits of transhuman communication technologies. These abstracts highlight how transhuman communication technologies can yield diverse and collaborative futures, yet raise discussions about probable discriminative practices in labor markets and social, ethical, psychological and political challenges that might emerge from communication technologies allowing access and modifications to our bodies, memories and emotions.

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