
Social Microbial Prosthesis: Towards Super-Organism Centered Design

Karen El Asmar

Parsons School of Design,
The New School,
New York, NY
elask537@newschool.edu

ABSTRACT

In this paper, I speculate on a future where our need to socialize physically is solely to exchange bacteria. With our biological data being in the hands of private companies and governments and our environments' microbiomes becoming less diverse, our social systems, social identities and social interactions are redefined and reinvented to adapt to this new reality.

In this world, everyone wears a “social microbial prosthesis” that analyzes their microbial composition from their breath and reveals sensitive information on their chest. The microbial prosthesis would be able to give off information not only on the microbial composition but also on the mental and physical health of a person.

This second skin plays a role in controlling communication and interaction between people, where one is able to, by inspecting surrounding people's prosthesis, take careful considerations of who to interact with and who to avoid.

Social Microbial Prosthesis is a critique of the race of private companies and governments to collect our biological data, the role of commercializing such data in shaping and changing our social identities and a response to the loss of microbial diversity in our environments due to our modern lifestyles and surroundings.

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.

CHI'19 Extended Abstracts, May 4–9, 2019, Glasgow, Scotland UK

© 2019 Copyright is held by the owner/author(s).

ACM ISBN 978-1-4503-5971-9/19/05.

<https://doi.org/10.1145/3290607.3312852>

KEYWORDS

Human augmentation; microbial space; social identity; social interaction; critical design; wearable display

1 INTRODUCTION

We are not only humans; we are ecosystems composed of roughly equal amounts of human cells and microbial cells [1]. Ever since this was discovered, microbiome projects, such as the Human Microbiome Project [2], launched worldwide with the goal of understanding the roles and effects that these microorganisms sharing our bodies have on our health and diseases. Discoveries revealed that each person has his or her own unique microbial signature whose composition is directly linked to one's health and predisposition to diseases. These results and discoveries immensely changed our understanding of ourselves, our identities, our agency over our own bodies and how we relate to each other and to the world around us.

Following this discovery, a new hype to regain and harness the bacteria we have lost today due to our modern lifestyles started to emerge. While pharmaceutical companies focused on creating probiotics and prebiotics to restoring these bacteria into our bodies [10], other industries focused on re-introducing these beneficial bacteria into our environments [11].

2 THE PROBLEM

Yet, today, we can look at our microbiome data the same way we have started to look at our genome data. Our microbiome is considered as our second genome, our second brain and even as a virtual organ controlling our body systems and our behaviors [6]. Studies show that our unique microbial composition does not only lie in or on our bodies but also floats around us in a spatial cloud [13]. This cloud is composed of heat radiating from our bodies, our breath and our skins. Apart from giving off information about our lifestyle, our diet, our occupation, our travel, our drug use and our gender, this cloud's specific composition also reveals information about our physical and mental health. A person's microbial signature can reveal whether a person is schizophrenic, anorexic, obese, autistic, suffers from depression or anxiety, has mood disorders or even cognitive developmental disorders [5]. This new form of identification has proven to be useful in applications such as forensics, for instance.

Yet, all these new discoveries make our microbiome a very sensitive form of information that not only identifies us, but also classifies us into different types. In our human history, classification has been found in many different ways: people have been classified based on their race, religion, nationality, vocation etc. and this has led to many forms of discrimination. Also, with our human genome being sequenced for commercial purposes, people have been discriminated against in job interviews and in insurance companies. Such technologies are strong enough to impose a form of power and control.

Moreover, today, the hype and obsession with health has blinded us, distracted us and lead us to give very little attention to this ethical, social and even political implications of these discoveries. We live today in a world driven by and thirsty for data. Our genome and microbiome data are simply, new forms of this data. In fact, past incidents show that there have been occurrences of pharmaceutical companies trying to buy this data from companies such as 23andMe for medical purposes and without the user's consent [4]. However, this new type of data, on the other hand, does not only excite medical professionals and scientific researchers but also grabs the attention of

governments, big tech companies and other private companies working in all different sectors and fields [17].

With companies such as Google rushing to collect this data [11], what are the implications of letting private companies have access to this sensitive data? And, with the rise of this new form of data, what if this information, just as the human genome, moves out of research labs and into the everyday life?

2 METHODOLOGY

I approach this project from a speculative design perspective where I create a “functional fiction”, that can help explore the kind of biotechnological worlds we want to live in [8]. I design an object prototype to implement, demonstrate and test new possible interactions in this future. This is a technique of speculation called “implications for adoption” [16] where such speculations are used in research projects to scrutinize and explore implications of a technology’s adoptions in a certain future.

3 RELATED WORK

3.1 Interpreting Human Breath for Data

Susanna Soares’s Bee’s project is an example of ways we could use biological systems to increase our perceptive abilities [19]. She proposes “new organs of perception” as alternative means of diagnosis where bees are trained to function as bio-markers for several chemicals in human breath. This project allowed me to dive deeper into the human breath and to explore what microorganisms we can detect in the human breath and how and why to do so.

3.2 Bacteria as a Wearable that Governs our Bodies

Neri Oxman’s Mushtari project is an example of how a wearable could act as a “microbial factory” that uses synthetic biology to augment the biological functionality of a human’s body. Living organisms within this structure would ultimately transform sunlight into energy that the body could absorb and use [14]. Such a design is a great example of how microbes could be designed to govern body systems.

3.3 Wearable that Allows Sharing of Intimate Information

Period Share [15] is a speculative project that quantifies and shares menstrual data on social network automatically using a wireless menstrual cup. Such design is an example of how intimate data could become shared publicly.

3.4 Wearable Probiotics

Future Flora [20] is a project that allows women to wear healthy microbes - probiotics - on their bodies by providing the right conditions for these targeted bacteria to grow. This is an example of an ecosystem designed to keep the body healthy and to balance our skin flora.

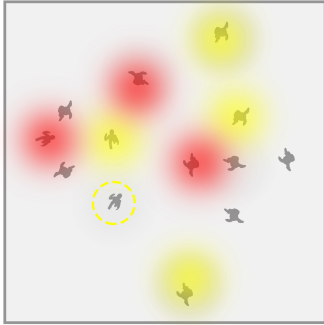


Figure 1: Social Microbial Prosthesis as a navigation tool in a space

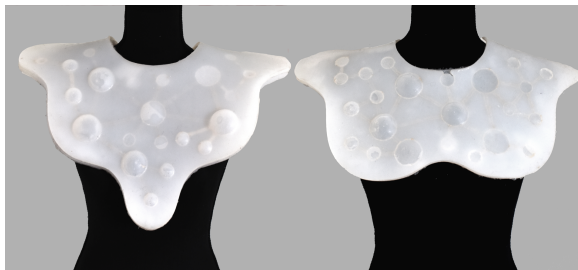


Figure 2: Different shapes and sizes



Figure 3: Prototype

4 SCENARIO

Today, systems such as clubs, membership programs and even bank cards - decide who gets access to certain facilities and spaces. In some areas, like China, our identities have also become integrated into these systems with technologies like computer vision used in social context [3].

In this project, I speculate on a future where we lose access and hence control over our own biological data. In this world, technologies that collect this data evolve faster than our ethical frameworks and become an integral part of our daily lives. Our biological data, then - stored and controlled by private companies and by governments - begin to govern our social systems, redefine our social identities, reshape our spaces and reinvent the reasons behind our social interactions.

As our microbial data becomes easier to collect and analyze, these “authorities”, by exerting excessive commercial and governmental pressure, use this data as a form of social control where our microbial signatures become a new form of a social identification system. People, then, become related to each other based on their abundance of certain microbes over others in their bodies. This new reality leads people to become obsessed with their health to an extent that their interactions become largely and purely driven by their microbial compositions and their biological need to exchange bacteria. In this world, socializing is no longer for entertainment but rather becomes an act of survival for the super-organism.

Hence, this project is a speculation of a world where the collection of our biological data is on the rise, where our identities become decentralized and public and where these new identities become a tool that divides society and reshapes spaces. It is also a criticism of the race of private companies and governments to collect this data, the role technology plays in shaping and changing our social identities and a response to the loss of microbial diversity in our environments due to our modern lifestyles and surroundings.

5 SOCIAL MICROBIAL PROSTHESIS

5.1 Design Process

The design of the new identification system must be in a very visible area on the body. For this, inspired from Behnaz Farahi’s project, *Caress the Gaze* [9], that uses the chest as a display area to analyze human gaze, the design is a largely visible chest piece that takes the shape and curves of the human body and adapts to it as a second skin. I tested the design in different shapes and patterns as seen in Fig. 2 and Fig. 3. All these designs are valid and function the same way. In reference to the scenario, the different shapes could potentially be used by different governments to designate different countries.

5.2 Our Breath as an Input

With the mouth being an extension of the digestive tract, the area where there is the largest concentration of bacteria in our bodies [18], the design relies on data from our breath to analyze our oral microbial composition and translate it into a visual system displayed on our chests as form of temporal identity, thus creating a microbial prosthesis on our bodies. This

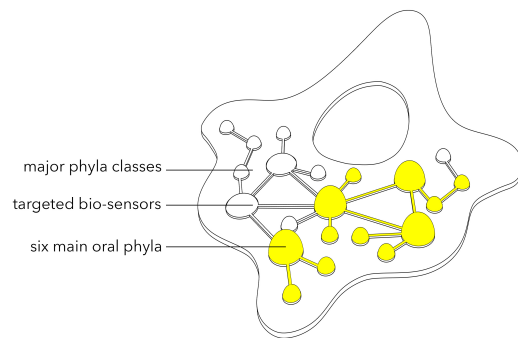


Figure 4: Main components of Social Microbial Prosthesis

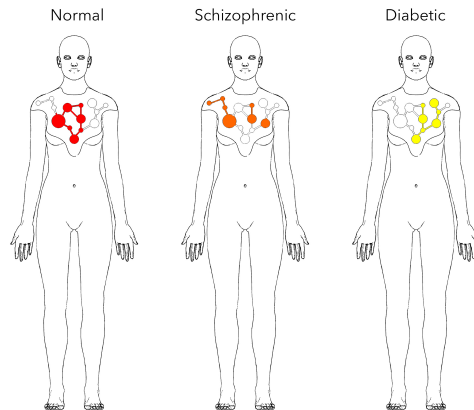


Figure 5: Social Microbial Prosthesis as an identity system and a communication language



Figure 6: Deflated and inflates states of Social Microbial Prosthesis

displayed information can be used by others and by us as a navigation tool to know who to interact with and who to avoid, as shown in Fig.1.

5.3 Main Components

The prosthesis is a soft robot that sits as a second skin on the chest area. This new “skin” is composed of six main compartments, as shown in Fig. 4, that represent the six main phylum categories of bacteria in our oral microbiology [7]. Each compartment then branches out into smaller cells that represent classes of these phyla. Within each pocket is a biosensor that tests for, reacts to and recognizes only one specific bacteria. This network of biosensors acts in a similar way to agar plates that provide the right conditions for only a particular bacterium to grow.

5.4 New Communication Language

When a person breathes into this microbial prosthesis, a unique composition of abundant bacteria is displayed, giving off information about their social, mental and physical status. Yet, since our microbiomes are affected and altered by different factors, this prosthesis is constantly updated by human breath. This, then, creates a new communication language, shown in Fig. 5, that can be decoded by people or smart devices to identify worthwhile interactions as well as creates more opportunities for the wearer to change their identities to suit their social needs.

5.4 Scenarios of Application – Spatial Dimension of our Microbes

This microbial prosthesis allows the wearer to scan their environments as soon as they walk into a new space and explore the space’s microbial composition easily as shown in Fig. 7. Since our interactions play a huge role in the transmission and exchange of bacteria, being able to know the composition of someone’s microbial cloud before interacting with them can impact greatly a person’s behavior and the way they interact with others. This prosthesis acts as a navigation tool that allows the person to directly find the bacteria their body’s desire and to be aware of possible unhealthy interactions that might lead to an undesired exchange of bacteria. This creates a social network of bacteria in a physical space.

6 CONCLUSION

In this paper, I introduced Social Microbial Prosthesis, a wearable that translates our oral microbiome into a coded visual system on our chests. This research is directed to criticize the current hype for microbiome outside the medical field and the classification system it can lead to.

In this project, I question the implications that our microbial identities can have on our social, cultural and political motivations. In the current design, the coded system is based on biosensors embedded into a new “second skin” and is designed as a very visible color-coded system aimed to highlight and discriminate. By creating such “functional fictions”, we can help explore the kind of biotechnological worlds we want to live in [8].

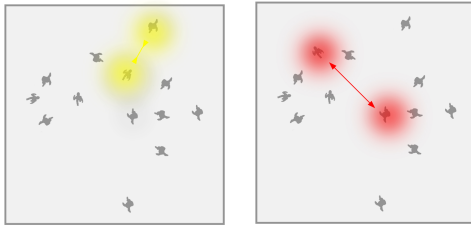


Figure 7: Scenarios of use of Social Microbial Prosthesis: creating vs. avoiding interactions

ACKNOWLEDGMENTS

I would like to thank Prof. Harpreet Sareen for his invaluable support and guidance through my research process and for providing me with resourceful insights and suggestions that enabled me to realize this project.

Yet, this improved knowledge of the oral microbiota and their impact on overall health can actually contribute greatly to the health of society as a whole. Hence, in the future, I plan to collaborate with biologists to design a less visible, ubiquitous system that helps one study their own microbiome from their breath, the environmental microbiome and perhaps, that of others around them to help them navigate the world healthily, naturally and accordingly.

REFERENCES

- [1] Abbott, Alison. "Scientists Bust Myth That Our Bodies Have More Bacteria than Human Cells." *Nature News*, Nature Publishing Group, 8 Jan. 2016, www.nature.com/news/scientists-bust-myth-that-our-bodies-have-more-bacteria-than-human-cells-1.19136.
- [2] "About the Human Microbiome." NIH Human Microbiome Project - About the Human Microbiome, hmpdacc.org/hmp/overview/.
- [3] "Blacklists and Redlists: How China's Social Credit System Actually Works · TechNode." *TechNode*, 23 Oct. 2018, technode.com/2018/10/23/china-social-credit.
- [4] Brodwin, Erin. "DNA-Testing Company 23andMe Has Signed a \$300 Million Deal with a Drug Giant. Here's How to Delete Your Data If That Freaks You out." *Business Insider*, Business Insider, 25 July 2018, www.businessinsider.com/dna-testing-delete-your-data-23andme-ancestry-2018-7.
- [5] Castro-Nallar E, Bendall ML, Pérez-Losada M, Sabuncyan S, Severance EG, Dickerson FB, Schroeder JR, Yolken RH, Crandall KA. 2015. Composition, taxonomy and functional diversity of the oropharynx microbiome in individuals with schizophrenia and controls. *PeerJ* 3:e1140 <https://doi.org/10.7717/peerj.1140>.
- [6] Clapp, Megan, et al. "Gut Microbiota's Effect on Mental Health: The Gut-Brain Axis." *U.S. National Library of Medicine*, 15 Sept. 2017, www.ncbi.nlm.nih.gov/pmc/articles/PMC5641835/.
- [7] Dewhirst, Floyd E., et al. "The Human Oral Microbiome." *Journal of Bacteriology*, American Society for Microbiology Journals, 1 Oct. 2010, jb.asm.org/content/192/19/5002.
- [8] Dunne, Anthony, and Fiona Raby. "Consuming Monsters: Big, Perfect, Infectious." *Speculative Everything: Design, Fiction and Social Dreaming*, MIT, 2014, pp. 47–61.
- [9] Farahi, Behnaz. "Caress of the Gaze." Behnaz Farahi, behnazfarahi.com/caress-of-the-gaze/.
- [10] Frost, and Sullivan. "Harnessing Microbiome Science for Therapeutic Development." *The Alliance of Advanced BioMedical Engineering*, 12 July 2017, aabme.asme.org/posts/human-microbiomics-harnessing-microbiome-science-for-therapeutic-development.
- [11] "Google Genomics - Store, Process, Explore and Share | Cloud Genomics | Google Cloud." Google, Google, cloud.google.com/genomics/.
- [12] Green, Jessica. "We're Covered in Germs. Let's Design for That." *TED Ideas Worth Spreading*, Ted, Feb. 2013, www.ted.com/talks/jessica_green_good_germs_make_healthy_buildings#t-395191.
- [13] Iyengar, Lakshmi. "You Have a Microbial Cloud!" *Yale Scientific Magazine*, Yale Scientific Magazine, 3 Feb. 2016, www.yalescientific.org/2016/02/you-have-a-microbial-cloud/.
- [14] "Living Mushtari - MIT Media Lab." MIT Media Lab, Mediated Matter Group - Neri Oxman, www.media.mit.edu/projects/living-mushtari/overview/.
- [15] Juul Søndergaard, Marie Louise and Hansen, Lone Koefoed. "PeriodShare: A Blood Design Fiction." *ACM Digital Library*, 2016. DOI: <https://doi.org/10.1145/2971485.2996748>
- [16] Lindley, Joseph, et al. "Implications for Adoption." *ACM Digital Library*, 2017. doi.org/10.1145/3025453.3025742.
- [17] Molteni, Megan. "Google Is Giving Away AI That Can Build Your Genome Sequence." *Wired*, Conde Nast, 12 Dec. 2017, www.wired.com/story/google-is-giving-away-ai-that-can-build-your-genome-sequence/.
- [18] Moos, W H, et al. "Microbiota and Neurological Disorders: A Gut Feeling." *Current Neurology and Neuroscience Reports*, U.S. National Library of Medicine, 1 May 2016, www.ncbi.nlm.nih.gov/pubmed/27274912.
- [19] Susana Soares. "Bee's Project." Susana Soares, www.susanasoares.com/index.php?id=56.
- [20] Tomasello, Giulia. "Future Flora Is a Harvesting Kit Designed for Women to Treat and Prevent Vaginal Infections." Giulia Tomasello, gitomasello.com/Future-Flora.