A Notebook of Data Imaginaries

Gabrielle Benabdallah
Human Centered Design and Engineering
University of Washington
Seattle, USA
gabben@uw.edu

Maya Kaneko
School of Art + Art History + Design
University of Washington
Seattle, USA
makaneko@uw.edu

Audrey Desjardins
School of Art + Art History + Design
University of Washington
Seattle, USA
adesjard@uw.edu

ABSTRACT
The processes of data collection and transformation are often opaque to users. This means they rely on their imagination to make sense of the data they produce. The images data conjure up, however, tend to be homogenous and flat: black screens, ones and zeros, big server farms in the desert. For designers and researchers who work with data as a material, this small repertoire can be stifling. For device users, it can lead to a removal of agency in how they make sense and engage with the data they produce. In this pictorial, we draw from a two-year data fictionalization project to start building an expanded repertoire of data imaginaries. We worked with seven households and seven writers to transform smart home data sets into fiction stories. Based on the interviews we conducted, we present the images participants shared with us as a step towards more expressive and varied imaginaries of data.

Authors Keywords
Imaginaries, data, IoT, imagination, fiction, data visualization, sketching, RtD

CSS Concepts
•Human-centered computing~Interaction design~Interaction design process and methods

DIS '23, July 10–14, 2023, Pittsburgh, PA, USA

ACM ISBN 978-1-4503-9893-0/23/07.

INTO THE HIDDEN LIFE OF DATA
In 2019, the total number of Internet of Things (IoT) connections in North America amounted to 2.8 billion connections and is expected to increase to 5.4 by 2025 [46]. The vast majority of these connections are collected and stored as data, which amount to numbers so large they are impossible to conceptualize. Yet, people rarely engage with the data they produce, outside of communities such as the Quantified self movement and home automation enthusiasts [11,22]. Even in these contexts, however, people often struggle to interpret the data they produce; the process of interpretation is often left to companies through data reports and visualizations, which can convey normative visions or push certain economic agendas [4,16,25,38]. As a result, what data are, what data do and what data mean are left largely to the imagination. Imagination is defined as the faculty or action of forming new ideas, images or concepts of external objects not present to the senses. Yet, imagination draws from the sensorium to compose its images. Texture, smell, color, light, form, and movement are only some of the many elements that compose personal and collective images. These collective images tend to circle around the same visual metaphors [6,24] and when it comes to data, these images are sadly (but perhaps unsurprisingly) homogeneous. A quick Google Images search of the term "data" reveals a dominance of glowing blue and green light on dark screens, with a fast moving cascade of numbers We see a disconnect between how data are imagined and represented commonly, and the diverse contexts in which they are produced. Especially when it comes to data produced in the home, the sources of data are many and varied—body movements, voices, accents, light schedules, music stations, temperature changes, sleep patterns and camera feeds, to name just a few.

This disconnect can be partially traced back to the process of datafication itself, which tends to flatten the multiple dimensions and diversity of phenomena data capture [17,32]. This homogeneity is due in part to how data tend to be construed—as objective facts [17,23]. This "declarative attitude" is reinforced by the graphical culture of data representation, in which graphs and

tables contribute to an imaginary of neutrality and objectivity [18]. For designers and researchers who work with data as material [30,43], this can often mean reverting to well-known tropes and images that lock them into circumscribed interactions. Several researchers have worked to expand imaginaries of technology and data by building new metaphors [31,34,40] and we situate this pictorial within this ongoing research agenda to explore new modalities of data representation and imaginaries.

By attending to other ways of describing data, we can build a new vocabulary that can help designers, researchers, and users articulate the types of interactions they might want with data. In this paper, we present an initial repertoire of data imaginaries based on work we conducted with seven households and seven fiction writers in 2021 and 2022 to fictionalize data sets from Internet of Things (IoT) devices.

These fictionalizations—the Data Epics [39]—are a collection of short stories which invites owners of smart devices to encounter their data differently. We commissioned seven fiction writers to write short stories based on people's home IoT devices' data, in Seattle, USA. Each writer was paired with a household and worked with four sets of monthly data from devices such as smart plugs, a smart bed, voice assistants, a smart camera, a garage door opener, a smart exercise bike, and motion sensors. The Data Epics collection comprises 28 short stories which cast data in a variety of ways (as a narrator, as a main character, as an underlying force, etc.). Note that the stories produced during this project were not stories about data but data stories (or epics)—stories told from the perspective of data or in which data played a central role.

As part of our research approach, we conducted introductory and exit interviews with the participating households (total of 10 participants) to better understand their mental models for home IoT data. During these interviews (which were about nine months apart), we conducted an association game during which we asked participants to quickly answer a series of 13 questions that aimed at describing data. For example, what might data smell like? How might it move? What friends do data make? By creating a playful and sensorially rich context to think about data, the questions opened up a space that allowed participants to flesh out their data imaginaries. In this pictorial, we use their answers to start to build a repertoire of data imaginaries.

IMAGINARIES AND DATA REPRESENTATION IN HCI

Imaginaries—from the Latin imago, 'image'—are an important way people experience both objective and subjective phenomena, give shape to affects, envision possible outcomes and work towards preferred futures. As such, imaginaries do not refer to what is 'made up' or 'unreal,' but to what exists in the liminal space between ideas and things. Imaginaries are a fertile terrain for designers, as they present a rich expanse of aesthetic possibilities and sensory information that can open up new vistas of intervention and interaction.

In the last decade, important work in design research has engaged with data as an equivocal, poetic and visceral phenomenon rather than as an abstract and purely mathematical one [19,36,41], and in particular in the context of home environments [5,13].Designers have also engaged with imagination and fiction through a range of approaches, from design fiction [7,8] to science fiction and writing workshops [1,8,14,27,29,44]. When working with data specifically, imaginaries are one way to surface more situated, ambiguous and 'diffractive' encounters with data [37]. Because imaginaries speak to the sensorium as well as the intellect—weaving ideas with sensations, concepts with forms—and are multidimensional—layering impressions and aesthetic resonances—this pictorial leverages the equivocality and expressivity of sketches and juxtaposition to convey the multiple strata of sense experience and conceptual associations that imaginaries bring forth. As such, it adopts an approach similar to earlier contributions which use drawings, sketches, paintings and collages to represent the richness and often unresolved nature of design processes and methods [15,20,45].

This pictorial makes two contributions to the interaction design community: 1) a repertoire of data imaginaries and 2) a reflection on the process of visually representing data imaginaries.

METHOD

To build this repertoire, we started by sketching the answers participants gave to each question of the association game. This game included questions such as *What might data feel like*? or *What secrets might data make*? We met weekly to share sketches, and discuss how they represented imaginaries and how connected they were to the answers given by participants.In that sense, the sketches served as conversation prompts as well, facilitating our sense making process of the participants' answers and of the imaginaries they conveyed [21]. We then moved to digitally modified illustrations, which offered more flexibility with complex or abstract concepts. Our process involved modifying photographs in an application that mimics painting styles. As we moved illustrations to the page, we layered them with captions, titles, additional written concepts, and watercolor. It was only after seeing all the images all together, as a collection, that we decided to go back to sketches. While digital images offered more visual information, they could also be too prescriptive, and the simpler line sketches offered more visual cohesion while also embracing the imprecise and expressive dimensions of imaginaries.

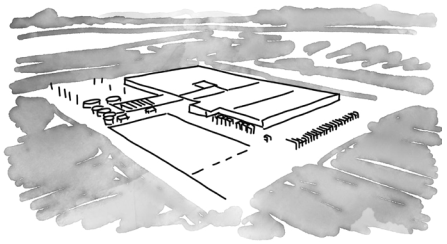
In our process of representing participant's answers to the association game, we entered a complex interpretative process. We had to find the balance between detail and ambiguity and develop the level of 'interpretation' we would apply to the concepts participants gave us. For

instance, we were challenged with sketching imaginaries that were non-discrete (e.g. 'air' or 'clean') and were difficult to represent using singular images. To illustrate these broader concepts and phenomena, we opted for recognizable metaphors and images (e.g. a plastic bottle for "plastic", an astronaut for "space exploration"), but this came with implications. We wrestled with the extent to which we should employ our own imaginaries onto the participants' words in order to create these representations. Take, for instance, "plastic" as the imagined material of data. To decode "plastic" is to go on a journey of chemistry, history and environmental science. We could conjure an image of plastic bottles littering a beach, plastic goods being assembled on a factory line, and plastic children's toys scattered around a living room. Plastics are so prevalent, yet go unnoticed—invisible to those who are not looking. In this sense, the process of illustrating the participants' answers was an impressionistic one—after the 1860s art movement—as we sought to convey not a fixed and stable phenomenon but an open-ended one, giving priority to the experience of the images rather than their literal meaning. To synthesize data is to reassemble traces of everyday life [27] and by embarking on this process it's unavoidable to infuse the outcome with one's own perspective. In this way, the process of representing also became a process of acknowledging the layering of our own interpretations and positionalities upon the participant's words to create this initial repertoire —a process we reflect on in more detail in the Discussion.

TIMELINE

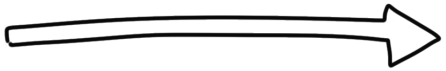
Throughout this project, we encountered many data imaginaries in the stories themselves. These imaginaries came from the writers' engagement with data sets and were substantially fleshed out by the fictionalization process. In this pictorial, we focus on the participant's imaginaries and how these sometimes changed in the course of the project. The timeline shared here indicates the time that elapsed between the onboarding and exit interviews.

Where do data go?

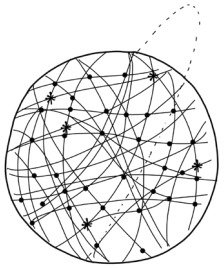


To a server farm in the Arizona desert

Spring 2021
Participants played the data sensory association game in the onboarding interview



Winter 2022
Participants played the data sensory association game in the exit interview



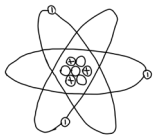
Everywhere

COMPARING AND CONTRASTING

The images and concepts the participants shared with us when answering our association game were both expected and surprising. Perhaps because these are already richly imaginative spaces, Fiction genres and Characters presented images more readily associated with data and its world: Neo from *The Matrix*, Data from *Star Trek* or the Asimov's Robot series were all figures and references that did not stray far from usual data imaginaries. But answers such as realist novels and surrealism (in response to what fiction genres the participants associated with data) prompted other aesthetic and conceptual avenues to engage with data. Data as a realist mode of representation like the 19th-century narratives *Anna Karenina* and *Madame Bovary*, with their tensed depictions of social morality, opened a rich creative space for data's roles and uses. Questions that were more sensory-based, such as W*hat might data feel like*? yielded answers that further challenged traditional notions of data: "like glass beads" or "bumpy, like braille" pointed to experiences and aesthetics that illustrated data in completely novel ways.

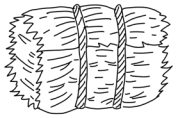
These images were not static. Between the first interview with the participants (in spring 2021) and the last (in winter 2022), nine months elapsed and four data stories were shared with the participants based on their smart devices datasets. Later in this pictorial, we consider how some of the images evolved and how these adjustments or abrupt changes reflect the imaginaries that were conveyed through the stories. The comparisons also reveal how the conceptualization of certain sensations and dimensions of data were more resistant to the introduction of new narratives, while others changed significantly.

Screens

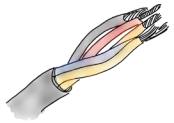


Electrons

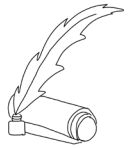
Carbon fiber



Hay



Wires
& Fiber Optic Cords



Paper
with Ink or Pencil

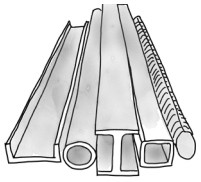
What materials do you associate with data?

The materials associated with data were often the results of extensive human processing: metal, rubber, plastic, concrete, wires, paper. By contrast, electrons and hay evoke more elemental and biological matter, but also matter that cannot be seen with the naked eye, or only when it is aggregated.

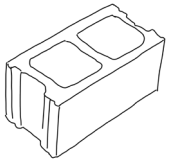
Rubber

Soft

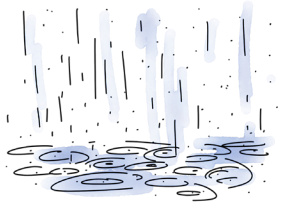
Plastic



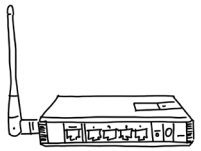
Metal



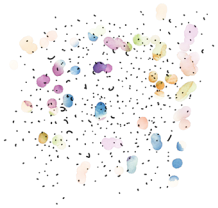
Concrete



Rain



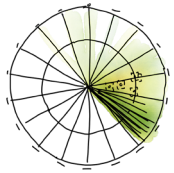
Moden sounds
Variations: an old modem; bip boop bip boop like an old dial up modem, 2800 band modem, sound machine



Sparkles
Positive sounds

mistakes

beep bop



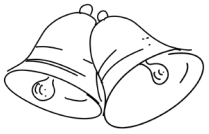
Pinging
Like a sonar in a submarine, bouncing, high pitch

buzz

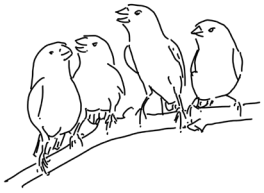
What might data sound like?

The juxtaposition of electronic sounds and natural ones, such as onomatopoeia and birds, brings expressivity to the 'voice' of data. Beyond technical imaginaries, sounds also included the chime of bells, and more ambient and distributed sounds like sparkles or rain.

quiet

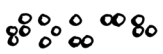


Bells



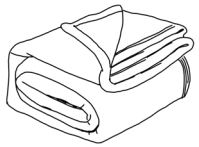
Birds

The hum of a server farm

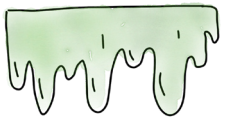


Bumpy
Like Braille

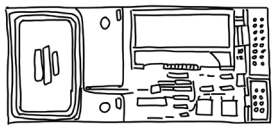
reliable, Safe and hard



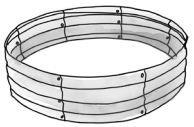
Warm and Fuzzy



Slime



Silicon Board



Raised Metal

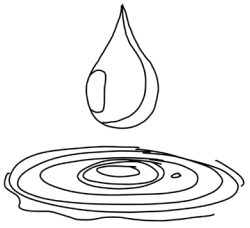
What might data feel like?

Data simultaneously feels like singular haptic interactions, while also being a more immersive sensory experience. The localized sensations of Braille, glass beads, and foot falling asleep contrast with the all-encompassing silkiness of liquid, slime and warm and fuzzy, revealing a diverse and rich tactile imaginary.

Rubber

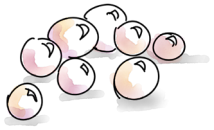
Waves of Data

your foot falling asleep



Liquid

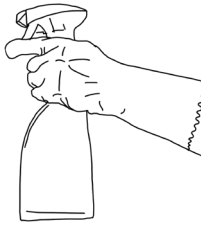
heavy and always moving



Glass Beads

Air

Burnt electronics
Variation: Fried circuit boards



Clean

Rotten food

Metallic

nothing, no smell

What might data smell like?

Data's smells were either artificial, like that of a computer or burnt electronics, or organic, like rotten food or feces. Often, however, data's smell was elusive and subtle, like a clean scent, air or metal: something that can be detected only when paying attention.

Dusty
Variation: Stale

Computer
Variations: Silicon, computer parts

Shit

Elegantly
Gracefully

Like a cheetah
Really slow, smooth, stealthy and preying animal

The Oobleck
the neutonian solid (cornstarch with liquid)

Word of mouth

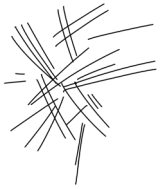
Like in the Matrix

Like a snake

Straight line
Quickly, directly, blur

How might data move?

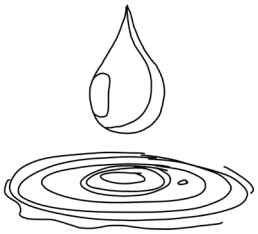
Fast, direct, uni- and multi-directional beams were one clear image for data's movement. Yet, these quick moves contrasted with more fluid, smooth, and elegant ondulations—complicating the idea that data might only go from A to B as efficiently as possible.



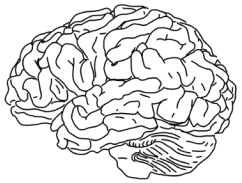
Fast
and multidirectional, in a distributed fashion, very quickly

On beams of light

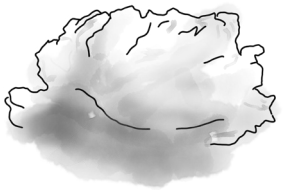
Undulatingly



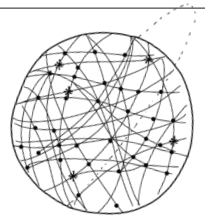
Like liquid



Into your brain



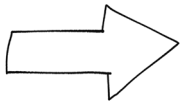
The cloud



Everywhere

Where no man has gone before

Home



Where you tell it to go

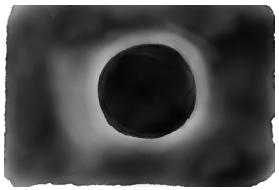
Where do data go?

Wide spaces, the confines of the universe, distributed locations. Data simultaneously goes to specific places like server farms in the Arizona desert or 'home', and to nondescript, vast areas like the cloud or the ether. In either cases, it seems there are not a lot of places beyond its reach.

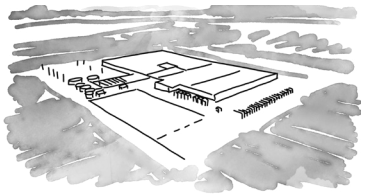
data doesn't go anywhere, it just sits there, waiting to answer a question

Into the air, into the ether

Nowhere



Into the void



To a server farm in the Arizona desert

Back of a file cabinet

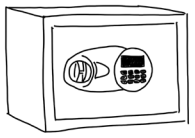
A diary

In a bedroom closet

Old device that doesn't turn on anymore
or computer trash and recycling

the internet

2 factor authentication



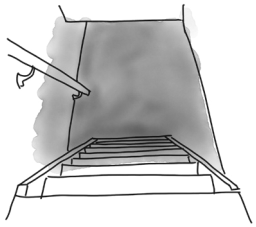
Safes

Where do data hide?

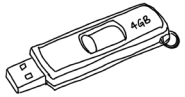
Data is thought to hide in 'locked away' places likes safes and file cabinets, but is also 'stuck everywhere' like glitter, or in a device that doesn't turn on. The enduring traces of data can be found in all sorts of dark and hidden corners, but are hard to access or erase.

Glitter stuck everywhere

Server farm
in the Arizona desert



Dark seedy basement
and corners



Thumbnail
in a spy movie

Personal matters

Bank account

Private interests

Personally identifying data. your SIN, name

The secret is in our inability to read it
What we miss in it.

What secrets do data have?

Data secrets seem to be related to people's ability to access and act upon information. While some saw data's secrets as their own secrets (personal information for example), others reflected on the actions required to uncover a secret.

All the secrets

none

don't know

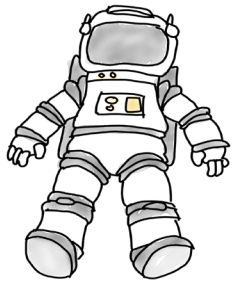
It stays around for a lot longer
Data's secret is that it's never really gone when you think it is.

If you never look at it...
The data itself can be secret, depending on how you store it. But if you never look at it, then it's secret by definition. it's not actionable.

Exploration

Detective work
Variation: True crime

We take it everywhere with us, like a little buddy on our shoulder



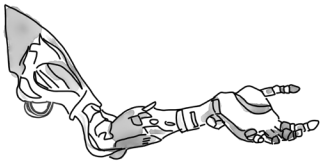
Space exploration

What adventures might data be a part of?

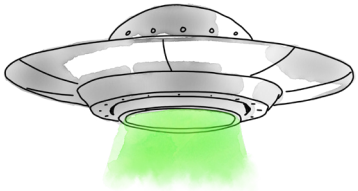
Data is a part of adventures that involve uncovering and discovering the unknown. Some of these adventures are open-ended and potentially dangerous, like space exploration and detective work, while others are more familiar and playful, like slip and slide tubes. Between congeniality and mystery, data's adventures are many.

I don't think of data as very adventurous

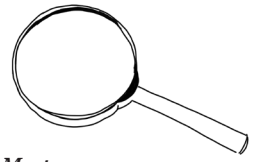
every adventure — what adventure is data not a part of?



Cyberpunk



Science-fiction

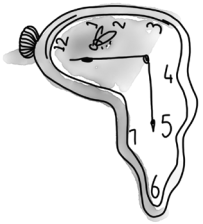


Mystery
Variation: Detective novels

What fiction genre do you associate with data?

While science-fiction, cyberpunk and dystopian are fiction genres usually associated with data, the presence of realism and surrealism show an interesting tension between the association of data with both facts and fiction.

Realist novels
Like 19th century Russian novel *Anna Karenina*

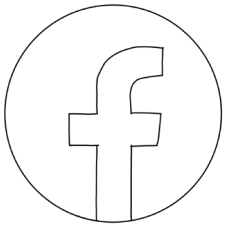


Surrealism

Dystopian

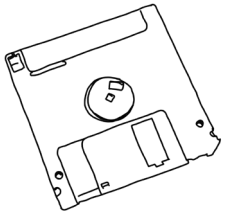
Alexa and Siri

Data scientists and capitalists
Variation: Capitalism and science



Facebook friends

Can it make friends?



Physical media
Like floppy disks, hard drives, CDs.

What friends does data make?

Data's friends are powerful, sometimes bad, connected to the higher spheres of the economic system. But it also befriends older information technology and contemporary smart devices. These images might suggest data's ethics are dubious by association, but also evoke narratives in which the relationships of data are a product of its environment.

Powerful friends
Like presidents, CEOs, people with influence

interdisciplinary ones

bad friends

other data

Habits, thoughts
Online browsing patterns

The hero

Janet
From The Good Place, physical manifestation of a human Alexa

Neo
From the Matrix, all-knowing all-seeing kind of deity

Data
From Star Trek

insecure — who is trying to remain relevant

marvin marshen

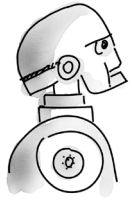
Indiana Jones

What characters do you associate with data?

Data is often casted as an action oriented character, one who can investigate mysteries, who seems informed, and who presents as clean and slick. Yet, some characters associated with data can also be secretive, insecure, and multifaceted (such as Janet from *The Good Place*), offering a more nuanced view on data.

Impartial

Business suit man
Running home, sprinting like he had to get somewhere



Asimov robot series

Hacker

Road Runner

Hair slicked back
James Bond type

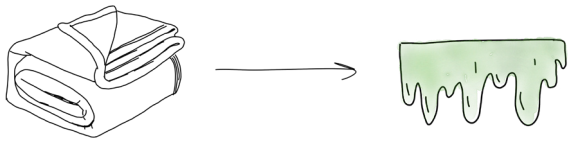
What secrets do data have?

Private interests → *The secret is in our inability to read it*

From safeguarded to illegible

This participant's answers reflect key themes ofthe stories they received, which all dealt with the opacity of data

What do data feel like?



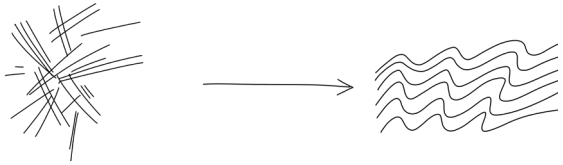
Warm and fuzzy → *Slime*

From comforting to slippery

The stories this participant received featured many biological metaphors to describe data, perhaps influencing their tactile sense of it

How do data move?

Like a cheetah → *Like a snake*

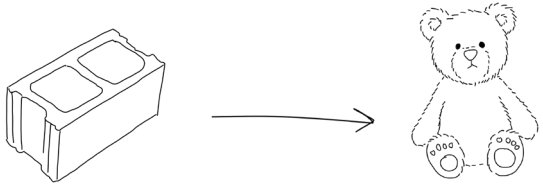


In fast bursts → *Undulatingly*

From fast to slow

In the course of the project, these participants' imaginary of data gained in fluidity and slowness

What materials do you associate with data?



Concrete → *Soft*

From hard to soft

This participant's material imaginary of data could have been influenced by the intimate and poetic voice featured in the stories they received

SHIFTING DATA IMAGINARIES

The difference between some of the participants' imag es about data offered a glimpse into how people's mental models shift and can be influenced by unfamiliar narratives. Some of the participants' images remained exactly the same, even after nine months of participation in the study. For instance, the smell of data was still 'rotten food' for one participant, and still 'nothing' for another at the end of the study. In general, we found that colors, fiction genres and characters varied less than other categories, but there were no hard and fast rules when it came to these variations: some categories which appear to remain more stable in general exhibited some of the most striking changes. This leads us to consider how future studies on data imaginaries could be designed to bring more granularity to the observation of how imaginaries are shaped. If particular images, concepts and sense experiences emerge from the exposure to certain data narratives, how can we use data fictionalization to prompt certain experiences and encounters with home data? Such studies could employ similar defamiliarization techniques as the one used in the Data Epics project (through the fictionalization of data sets emphasizing data's voices) but focus on particular narrative and formal strategies to achieve specific effects through fiction. For instance, one participant was paired with an author who often used aquatic and biological metaphors in her stories. The participant initially described the feeling of data as 'warm and fuzzy' but expressed it as 'slimy' at the end of the project –perhaps as a response to the stories they had received during nine months.

DISCUSSION

This notebook of data imaginaries is intended to show the complexity and diversity of how we can understand data. As such, it stands in contrast with the current social imaginary of data and offers an initial repertoire of images and metaphors for designers and researchers to work with when designing with data. In the following paragraphs we reflect on our process of representing data imaginaries, examine the stakes of diversifying imaginaries and discuss the broader implications for HCI and design communities.

On Interpretation

As mentioned in an earlier section of this pictorial, our process of interpretation of the participants' answers was a core aspect of creating this initial repertoire of data imaginaries. Sketching was initially an exploratory process that helped us make sense of the participants' answers and experiment with different formats, perspectives and versions of the images. As such, in the early stages of the Notebook creation, sketching was part of what Kirsh and Maglio call epistemic actions –"actions performed to uncover information that is hidden or hard to compute mentally" [28]. Except the information in this case was not a comparatively stable unit of meaning but a multilayered space of images and significations. The process of fixing the participants' evocative answers to the page required aesthetic decisions that prioritized certain sensibilities over others. Gaver et al. remind us of the 'interpretive relationship' that ties people and artifacts, and the role that ambiguity plays in this relationship.This ambiguity is at the heart of the Data Epics, since the relationship between people and their data is a particularly ambiguous one. Through the project, notions of visibility, authorship, and intimacy between participants and their data were significantly complicated and challenged. However, this Notebook argues more specifically against the neutrality and objectivity of data, calling attention to the situated manipulations and interpretive transformations that shape encounters with data [17]. To paraphrase Geoffrey Bowker: data should be cooked with care, and their imaginaries even more so [10]. The preparation and transformation of these word-based imaginaries into visual ones was informed by our perspectives as Western and female-identifying designers working in an academic institution –the choices we made in terms of style, imagery, visual rhythm and even design tools are a reflection of this context.

On Social Imaginaries

Philosopher Charles Taylor describes social imaginaries as "the ways people imagine their social existence, how they fit together with others, how things go on between them and their fellows, the expectations that are normally met, and the deeper normative notions and images that underlie these expectations" [42]. Taylor is pointing at the intangible aspects of life that nonetheless conditions people's actions and behaviors. Social imaginaries enable the "common understanding that makes possible common practices and a … shared sense of legitimacy" [Ibid], which makes them constitutive of politics [9,12] in the strongest sense of the term: how people live and organize their common experience together. What this means for data imaginaries is that the expectations and very possibilities of what can be experienced with and through data are constrained by a surplus of homogeneous and toneless images. "Storytelling reveals meaning without committing the error of defining it" writes Hannah Arendth [2], reminding us that narratives are useful devices to stabilize and disseminate particular worldviews and imaginaries, but that these visions are always open to new interpretations. Narratives are important and ubiquitous ways of conveying and deepening the reach of images, in personal and collective domains. Literature plays a role in the development of moral imagination and narratives have the ability to inspire and nourish visions of preferred political futures [26,33]. Data are now predominantly connected to narratives of economic growth and capital accumulation into the hands of a powerful minority. By starting to open up and expand the images associated with data, new stories can start to emerge in which data is not the agent of an exclusionary and exploitative system but the product of local and intimate relations. In this notebook, we see data receiving attributes as varied as warm and fuzzy, slimy, or hard, its movements like that of a cheetah or the Oobleck, befriending online browsing patterns and floppy disks, hiding in diaries and glitters. What this palette of images and sensations gives us is not a more accurate way to represent data—in fact, it completely shifts the very notion of accuracy when it comes to data. What is accurate here is not data's description of phenomena—the result of extensive measurements, transformations and computation—but the phenomenal description of data: how data presents itself to sense experience, which is a profoundly imaginative encounter.

On What it Means to Have More Expansive Data Imaginaries

How data is represented shapes what narratives we associate with it. The "realist" approaches to data visualization tend to assume transparency and objectivity, "as if the phenomenal world were self-evident and the apprehension of it a mere mechanical task" [18]. Media theorist Johanna Drucker suggests in fact that the term data be replaced with *capta* (from capture), to emphasize the extraction and collection processes that make data possible in the first place. In the Data Epics project, data was forcibly presented as capta, as we worked closely with the participants to collect datasets that were timebound and specific to certain devices in their homes. More importantly, however, data was also presented as *fanta* (from fantasia)—not just 'taken' but 'imagined', fictionalized. Joining the calls against the "commodity fiction" of data—the narrative that data is 'raw' and available for extraction independently from its origins and context [37]—we argue against mechanistic interpretations of data which assume a realist approach

to data analysis, i.e. that data contains stable meanings that needs only be extracted or deciphered. Instead, we embrace constructivist traditions that view knowledge—or in this case, information—as the product of situated and partial manipulations and epistemologies. In this approach to knowledge production, interpretation is supported not through mechanistic (probabilistic) means, but through imaginative ones. According to philosopher Paul Ricoeur, it is imagination that makes interpretation possible. Communication between people is not achieved through fixed, static meanings but through a constant re-interpretation of speech in context. The cognitive ability to remain open and fluid when it comes to linguistic meanings, and to share significations, is imagination [35]. By visceralizing data [3,17,32] through a richer sensorium, such as the one presented in this notebook, designers and researchers can feed the data imagination and support fertile interpretations and meaningful encounters with data.

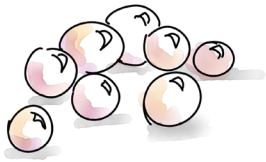
The imaginaries that we encountered in the course of this project—including the ones presented in this pictorial—are only one sliver of the wealth of images and sense experiences that could come out of other similar studies. This notebook is only one step in the direction of expanded data imaginaries, which are one way to design systems and interactions that support a richer sense of what data is and how it is woven into the fabric of the connected home today. Beyond spreadsheets, graphs or SQL servers, which are all useful tools for data tracking and management, personal data archives can also be images, smells, sounds, textures, and stories: vignettes into a richer sensory world.

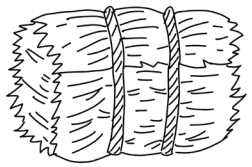
CONCLUSION

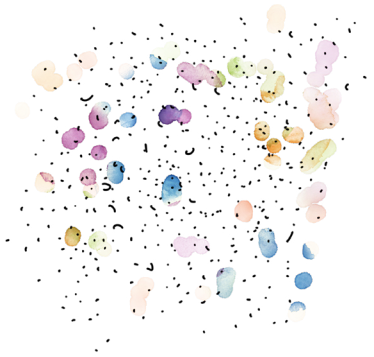
A Google search of "data" reveals a homogeneous imagery that conveys a flat and unidimensional narrative about data: numbers, mined by algorithms, used to build the next machine learning models, and facilitate corporate and state control. But when this strained imaginary was probed with unusual questions, the responses were more varied and nuanced than this initial scenario leads to believe. The repertoire of data imaginaries presented in this notebook is the beginning of a conversation about the multifaceted experience of data. It can be used to spark conversations with designers, researchers, participants and other stakeholders in future studies. This repertoire can serve as useful probes within a participatory design workshop for example, allowing for people to react to these collages and build upon them. The questions themselves (e.g. *Where does data go*?) can be asked to participants to add to this notebook, and contribute to a growing resource of data associations and imaginaries.

ACKNOWLEDGMENTS

We thank the participants and writers who made the Data Epics possible, as well as our collaborators and colleagues: Heidi Biggs, Stephanie Tang Waldrop, Auden Finch, Jackson Jiang, Sai Kukkadapu, Hannah Liao, Riley Mehl, Aivy Phan, Yuna Shin, Chandler Simon and Janey Yee. This work was partially funded by the National Science Foundation (grant # 1947696).







REFERENCES

[1] Aloha Hufana Ambe, Margot Brereton, Alessandro Soro, Laurie Buys, and Paul Roe. 2019. The Adventures of Older Authors: Exploring Futures through Co-Design Fictions. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19), Association for Computing Machinery, New York, NY, USA, 1–16. DOI:https://doi.org/10.1145/3290605.3300588

[2] Hannah Arendt. 1970. Men In Dark Times (First edition ed.). Mariner Books, San Diego, Calif.

[3] S. Sandra Bae. 2022. Towards a Deeper Understanding of Data and Materiality. In Creativity and Cognition (C&C '22), Association for Computing Machinery, New York, NY, USA, 674–678. DOI:https://doi.org/10.1145/3527927.3533734

[4] Samuel Barnett, Nico Brand, William Odom, and Kaitlyn Andres. 2022. Exploring Data Intermediaries as Infrastructure for a Human-Centric Data Economy: Speculations & Critical Reflections. In Nordic Human-Computer Interaction Conference (NordiCHI '22), Association for Computing Machinery, New York, NY, USA, 1–20. DOI:https://doi.org/10.1145/3546155.3547286

[5] Genevieve Bell, Mark Blythe, and Phoebe Sengers. 2005. Making by making strange: Defamiliarization and the design of domestic technologies. ACM Trans. Comput.-Hum. Interact. 12, 2 (June 2005), 149–173. DOI:https://doi.org/10.1145/1067860.1067862

[6] Genevieve Bell and Paul Dourish. 2007. Yesterday's tomorrows: notes on ubiquitous computing's dominant vision. Pers. Ubiquitous Comput. 11, 2 (February 2007), 133–143. DOI:https://doi.org/10.1007/s00779-006-0071-x

[7] Julian Bleecker. Design Fiction: A Short Essay on Design, Science, Fact and Fiction.

[8] Mark Blythe, Kristina Andersen, Rachel Clarke, and Peter Wright. 2016. Anti-Solutionist Strategies: Seriously Silly Design Fiction. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16), Association for Computing Machinery, New York, NY, USA, 4968–4978. DOI:https://doi.org/10.1145/2858036.2858482

[9] Chiara Bottici. 2014. Imaginal Politics: Images Beyond Imagination and the Imaginary. Columbia University Press.

[10] Geoffrey C. Bowker. 2008. Memory Practices in the Sciences (Illustrated edition ed.). MIT Press, Cambridge, Mass.

[11] A.J. Bernheim Brush, Bongshin Lee, Ratul Mahajan, Sharad Agarwal, Stefan Saroiu, and Colin Dixon. 2011. Home automation in the wild: challenges and opportunities. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11), Association for Computing Machinery, New York, NY, USA, 2115–2124. DOI:https://doi.org/10.1145/1978942.1979249

[12] Cornelius Castoriadis. 1997. The Imaginary Institution of Society: Creativity and Autonomy in the Social-historical World (Second Edition ed.). Polity Press, Cambridge.

[13] Andy Crabtree and Peter Tolmie. 2016. A Day in the Life of Things in the Home. In Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16), Association for Computing Machinery, New York, NY, USA, 1738–1750. DOI:https://doi.org/10.1145/2818048.2819954

[14] Audrey Desjardins and Heidi R. Biggs. 2021. Data Epics: Embarking on Literary Journeys of Home Internet of Things Data. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21), Association for Computing Machinery, New York, NY, USA, 1–17. DOI:https://doi.org/10.1145/3411764.3445241

[15] Audrey Desjardins and Cayla Key. 2020. Parallels, Tangents, and Loops: Reflections on the "Through" Part of RtD. In Proceedings of the 2020 ACM Designing Interactive Systems Conference (DIS '20), Association for Computing Machinery, New York, NY, USA, 2133–2147. DOI:https://doi.org/10.1145/3357236.3395586

[16] Audrey Desjardins, Afroditi Psarra, and Bonnie A. Whiting. 2021. Voices and Voids: Subverting Voice Assistant Systems through Performative Experiments. In Creativity and Cognition (C&C '21), Association for Computing Machinery, New York, NY, USA, 1–10. DOI:https://doi.org/10.1145/3450741.3466807

[17] Catherine D'Ignazio and Lauren F. Klein. 2020. Data Feminism. The MIT Press, Cambridge, Massachusetts.

[18] Johanna Drucker. 2020. Visualization and Interpretation: Humanistic Approaches to Display. The MIT Press, Cambridge, Massachusetts.

[19] Chris Elsden, Abigail C. Durrant, David Chatting, and David S. Kirk. 2017. Designing Documentary Informatics. In Proceedings of the 2017 Conference on Designing Interactive Systems (DIS '17), Association for Computing Machinery, New York, NY, USA, 649–661. DOI:https://doi.org/10.1145/3064663.3064714

[20] Sarah E. Fox, Samantha Shorey, Franchesca Spektor, and Daniela K. Rosner. 2020. Crafting Everyday

Resistance through Lightweight Design. In Proceedings of the 2020 ACM Designing Interactive Systems Conference (DIS '20), Association for Computing Machinery, New York, NY, USA, 101–113. DOI:https://doi.org/10.1145/3357236.3395571

[21] Mafalda Gamboa, Sara Ljungblad, and Miriam Sturdee. 2023. Conversational Composites: A Method for Illustration Layering. In Proceedings of the Seventeenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '23), Association for Computing Machinery, New York, NY, USA, 1–13. DOI:https://doi.org/10.1145/3569009.3572793

[22] Dize Hilviu and Amon Rapp. 2015. Narrating the quantified self. In Adjunct Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2015 ACM International Symposium on Wearable Computers (UbiComp/ISWC'15 Adjunct), Association for Computing Machinery, New York, NY, USA, 1051–1056. DOI:https://doi.org/10.1145/2800835.2800959

[23] Sun-ha Hong. 2020. Technologies of Speculation: The Limits of Knowledge in a Data-Driven Society. NYU Press.

[24] Sun-ha Hong. 2021. Technofutures in Stasis: Smart Machines, Ubiquitous Computing, and the Future That Keeps Coming Back. Int. J. Commun. 15, 0 (April 2021), 21.

[25] Noura Howell, John Chuang, Abigail De Kosnik, Greg Niemeyer, and Kimiko Ryokai. 2018. Emotional Biosensing: Exploring Critical Alternatives. Proc. ACM Hum.-Comput. Interact. 2, CSCW (November 2018), 69:1-69:25. DOI:https://doi.org/10.1145/3274338

[26] Robin D. G. Kelley. 2022. Freedom Dreams: The Black Radical Imagination. Beacon Press, Boston.

[27] David Kirby. 2010. The Future is Now: Diegetic Prototypes and the Role of Popular Films in Generating Real-world Technological Development. Soc. Stud. Sci. 40, 1 (February 2010), 41–70. DOI:https://doi.org/10.1177/0306312709338325

[28] David Kirsh and Paul Maglio. 1994. On distinguishing epistemic from pragmatic action. Cogn. Sci. 18, 4 (October 1994), 513–549. DOI:https://doi.org/10.1016/0364-0213(94)90007-8

[29] Bowen Kong, Rung-Huei Liang, MengChi Liu, Shu-Hsiang Chang, Hsiu-Chen Tseng, and Chian-Huei Ju. 2021. Neuromancer Workshop: Towards Designing Experiential Entanglement with Science Fiction. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21), Association for Computing Machinery, New York, NY, USA, 1–17. DOI:https://doi.org/10.1145/3411764.3445273

[30] Matthew L. Lee-Smith, Jesse Josua Benjamin, Audrey Desjardins, Mathias Funk, William Odom, Doenja Oogjes, Young-Woo Park, James Pierce, Pedro Sanches, and Vasiliki Tsaknaki. Data as a Material for Design: Alternative Narratives, Divergent Pathways, and Future Directions. In CHI 2023 Workshop. Retrieved February 13, 2023 from https://materialfordesign.net/chi2023_workshop/

[31] Makayla Lewis, Miriam Sturdee, John Miers, Josh Urban Davis, and Thuong Hoang. 2022. Exploring AltNarrative in HCI Imagery and Comics. In Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22), Association for Computing Machinery, New York, NY, USA, 1–13. DOI:https://doi.org/10.1145/3491101.3516394

[32] Deborah Lupton. 2017. Feeling your data: Touch and making sense of personal digital data. New Media Soc. 19, 10 (October 2017), 1599–1614. DOI:https://doi.org/10.1177/1461444817717515

[33] Martha C. Nussbaum. 1997. Poetic Justice: The Literary Imagination and Public Life (1st edition ed.). Beacon Press, Boston, Mass.

[34] James Pierce and Carl DiSalvo. 2017. Dark Clouds, Io&#!+, and [Crystal Ball Emoji]: Projecting Network Anxieties with Alternative Design Metaphors. In Proceedings of the 2017 Conference on Designing Interactive Systems (DIS '17), Association for Computing Machinery, New York, NY, USA, 1383–1393. DOI:https://doi.org/10.1145/3064663.3064795

[35] Paul Ricoeur. 1975. La métaphore vive (La Métaphore Vive edition ed.). Seuil, Paris.

[36] John Rooksby, Mattias Rost, Alistair Morrison, and Matthew Chalmers. 2014. Personal tracking as lived informatics. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14), Association for Computing Machinery, New York, NY, USA, 1163–1172. DOI:https://doi.org/10.1145/2556288.2557039

[37] Pedro Sanches, Noura Howell, Vasiliki Tsaknaki, Tom Jenkins, and Karey Helms. 2022. Diffraction-in-action: Designerly Explorations of Agential Realism Through Lived Data. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22), Association for Computing Machinery, New York, NY, USA, 1–18. DOI:https://doi.org/10.1145/3491102.3502029

[38] Stephen Snow, Awais Hameed Khan, Stephen Viller, Ben Matthews, Scott Heiner, James Pierce, Ewa Luger, Richard Gomer, and Dorota Filipczuk. 2020. Speculative Designs for Emergent Personal Data Trails: Signs, Signals and Signifiers. In Extended Abstracts of the 2020 CHI Conference on Human Factors in Com-

puting Systems (CHI EA '20), Association for Computing Machinery, New York, NY, USA, 1–8. DOI:https://doi.org/10.1145/3334480.3375173

[39] Studio Tilt. Data Epics. Retrieved May 11, 2023 from https://dataepics.webflow.io/

[40] Miriam Sturdee, Lauren Thornton, Bhagya Wimalasiri, and Sameer Patil. 2021. A Visual Exploration of Cybersecurity Concepts. In Creativity and Cognition (C&C '21), Association for Computing Machinery, New York, NY, USA, 1–10. DOI:https://doi.org/10.1145/3450741.3465252

[41] Alex S. Taylor, Siân Lindley, Tim Regan, David Sweeney, Vasillis Vlachokyriakos, Lillie Grainger, and Jessica Lingel. 2015. Data-in-Place: Thinking through the Relations Between Data and Community. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15), Association for Computing Machinery, New York, NY, USA, 2863–2872. DOI:https://doi.org/10.1145/2702123.2702558

[42] Charles Taylor. 2003. Modern Social Imaginaries. Duke University Press Books.

[43] Jordan Wirfs-Brock, Maxene Graze, Laura Devendorf, Audrey Desjardins, Visda Goudarzi, Mikhaila Friske, and Brian C Keegan. 2022. Sketching Across the Senses: Exploring Sensory Translation as a Generative Practice for Designing Data Representations. In Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22), Association for Computing Machinery, New York, NY, USA, 1–7. DOI:https://doi.org/10.1145/3491101.3503712

[44] Richmond Y. Wong, Ellen Van Wyk, and James Pierce. 2017. Real-Fictional Entanglements: Using Science Fiction and Design Fiction to Interrogate Sensing Technologies. In Proceedings of the 2017 Conference on Designing Interactive Systems (DIS '17), Association for Computing Machinery, New York, NY, USA, 567–579. DOI:https://doi.org/10.1145/3064663.3064682

[45] Paulina Yurman. 2021. Fluid Speculations: Drawing Artefacts in Watercolour as Experimentation in Research Through Design. In Creativity and Cognition (C&C '21), Association for Computing Machinery, New York, NY, USA, 1–13. DOI:https://doi.org/10.1145/3450741.3466777

[46] IoT connected devices worldwide 2019-2030. Statista. Retrieved February 13, 2023 from https://www.statista.com/statistics/1183457/iot-connected-devices-worldwide/