Careful Devices: outline of a research program

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ABSTRACT

Careful Devices is the provisional name of a program of research in the IxD lab at the IT University of Copenhagen around medical self-tracking and in-home care technology. This research looks to reframe domestic medical technology as part of a holistic practice of health centering on personal experience and judgement rather than external definitions of "sickness" or "disease." Our devices are not meant to be indexical to particular ailments, but instead are tools that take "health" as a practice of wayfaring. Using RtD, we are committed to making devices that speculate towards a personal kind of healthcare, rooted in care and lived experience—a local medicine.

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self-tracking; health; health care; care; domestic; medicine; RtD; speculative design

INTRODUCTION

Careful Devices is the provisional name of a program of research in the IxD lab at the IT University of Copenhagen around medical self-tracking and in-home care technology. Broadly, this research looks to reframe contemporary understandings of domestic medical technology as being part of a holistic practice of health that centres on personal experience and judgement rather than externally-imposed definitions of sickness or disease.

Medicine makes many of the same commitments as science in general. This is to say that in medicine, conclusions can be drawn about bodies and their conditions that can be abstracted to a broad population. This approach necessarily files down outliers, creating an abstracted body of knowledge that can be broadly applicable to the statistical human. Patients become data become statistics that show the efficacy of a treatment, along with the corresponding mechanized understanding of what kind of action should be taken across different cases [2]. Medical doctors take this knowledge complex—called medicine—and through the lens of experience interpret it to the particulars of a patient. Medical professionals, like general practitioners and nurses, are trained in what is called *the medical gaze* in which the patient as a whole is assessed and not just the available test results. When the medical test practice enters the private sphere, this holistic interpretation of sample data is easily lost and more likely to be analysed with a narrower gaze. On the other hand, the potential of having people themselves – with their lived experience of their own bodies – interpret the data seems like an obvious advantage.

Compounding the issue with respect to interpreting health data, many home testing devices are not used in correlation with a clinical disease, but rather in an interest to track our overall health in general. In these cases, the goals of a user will typically be more diffuse or open-ended. Still, deviations from a statistical norm, a personal baseline, or a personal goal still seems to risk narrowing the focus towards measurement and interpretation.

We believe that this complex balance between the medical gaze and the lived experience of health poses an interesting design space for interaction design. In it, we can work across multiple temporalities and different materials that allow for an ambiguity in which the user can gradually gain an embodied experience with what is measured [7,9]. By avoiding clear feedback such as numeric values, graphs, and algorithmic responses to whether the results are “good” or “bad” and instead work with slow or in other ways ambiguous feedback [7,8,11]. Indeed, our aim is to support

Figure 1. Domestic health technology based on breath. At the top, *Lumen*. On the bottom, FoodMarble's *Aire*.

a different conception around in-home health care that is based on a person's knowledge of their health as a *practice to be maintained* instead of as a *condition to be diagnosed*.

Because the role of design is to create the ultimate particular, after Nelson and Stolterman [10], we can approach the role of interaction design in this medical context as creating a kind of *personal* particular—respecting our idiosyncrasies. Medical technologies that interact with medicalized knowledge in an abstract way to be interpreted by a person based on knowledge of their own life and condition. Technologies like these should be designed help a person understand themselves and their health in a way that is situated instead of abstract, inspirational rather than specific, and offering pathways rather than pathologies. How can interaction design create systems and artefacts that support new forms of clinical encounter in domestic life?

RESEARCH AND DESIGN STRATEGIES

This approach to personal medicine is being explored through two early-stage projects: *SweatIT*, a design research approach to richly understand the qualities of bodily fluids as well as the aspects of the body's condition that they can or could indicate, and *Gut Feeling*, a sensor-based prototype that investigates the connection between the gut and mental health, described in the rest of this paper.

As research through design, these projects investigate how domestic medical practices might be reframed away from simply being diagnostic tools (as is the case with most medical technology startups) or caught up in the kinds of numerical tracking and framing of the body (as the "quantified self" movement has become known for), or current trends towards telemedicine as reducing the cost of providing baseline medical services to home users in rural areas. Instead, these projects attend to the body as a discrete instance of something that is best known by its owner, and try to support that knowing through material and computational exploration. While there has been excellent previous work that unpacks self-tracking devices as a personal experience through autoethnography [13], we feel that a research-through-design approach designing and prototyping personal medical technologies, coupled with iteration and reflection on those prototypes, can produce contextual knowledge around the capacities of these technologies [5,6,14]. This project in particular is rooted in a domestic context, and implicates contemporary research around smart homes and relates to broader issues of public health. How we understand personal health and participate in health practices in broader contexts has implications for how research through design can take a role in civic infrastructure and capacity-building at the macro scale, while also attending to the personal sense and sensation of being healthy at the personal and local level. As RtD, this takes place through designing and prototyping speculative technologies that postulate alternative presents as well as producing different relationships with the body, conceptions of health, and health-care providers.

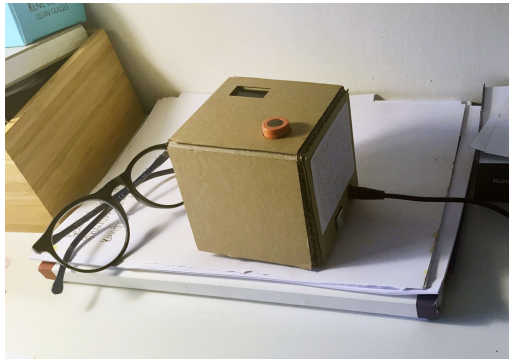

Figure 2: The Gut Feeling prototype.

By sensing the gases you have on your breath, this device can determine which bacteria you have in your gut. New research shows that the type of bacteria you have living inside your stomach dictates your mental state. Some bacteria release hormones that make you feel happy, and some send signals to your brain that encourage anxious and depressed feelings and behaviour. By analysing your breath, this device can determine how your gut health is influencing how you feel.

Instructions for use:
Press the top button.
Breathe into the orange sensor.
Record reflections on what the number it gives you means to you in regards to your gut health and how you feel.
Use the device at least once a day for two weeks.

Figure 3: Label describing Gut Feeling, alongside instructions for its use.

Gut Feeling

Recent research has revealed that a person's emotional and mental health can be closely related to the condition of their intestinal microbiome—or gut fauna [1,4]. This linkage offers a space to speculate about how, precisely, that connection might operate in practice. While the influence of the gut on health broadly is fairly well known, a technical prototype that offers a chance to reflect on that relationship and draw connections between the gut, everyday life, and overall mood might help to spur a person to reflect on this influence [3,12].

Access to medical knowledge can be expensive and inefficient, and like any perceived inefficiency in the current technological climate, has become a venue for disruption via technological innovation. Devices like the *Lumen* (http://lumen.me) or the *Aire*, by FoodMarble (http://foodmarble.com) seek to help a home user know their gut in a way that can be operationalized. The Lumen, for example, tells its users that they can "hack their metabolism" to lose weight and claims to be a "nutritionist in your pocket." The Aire is a "personal digestive tracker" that help its users to understand and know with more precision what kinds of foods might not be well or comfortably absorbed by the body.

Available for purchase alongside the Aire are sachets of FODMAPs items such as lactose, fructose, sorbitol, and insulin that can commonly cause digestive issues. An Aire user is instructed to eat the contents of these packets and measure the undigested and fermenting remainder to test how their own body handles these substances. Implicitly, these products emphasize diagnoses, outliers from the broader abstracted body of knowledge. They are able to tell you how you differ from the broader conditions, and take their technological form as a means of imparting fact and rationality.

The Gut Feeling probe is intended to be reflective, hoping that users would do the interpretation work necessary to impart meaning to the experience its use [12]. This iterative and open-ended process means that the early prototype is a simple gas sensor controlled by an Arduino board that displays a count of particular substances in users' breath packaged in a simple-to-fabricate laser-cut cardboard cube.

Through a series of workshops, as well as a home trial lasting two weeks, our group has been designing and revising the prototype, and we are currently on multiple different tracks exploring both form and interaction. The first real results of the project have come from the home trial. In it, six members of our research group brought the early Gut Feeling prototypes, using it at least once each day, and logging their experiences—how they used the prototypes, what they wanted to know through its use, and the expectations that they may have around using it. Notably, two of our members had strong and opposing opinions about the prototype in use.

The first felt that even a system as simple as the current one offers a sense of empowerment about personal information, that interacting with this device gave them knowledge that could be utilized in the choices that they can make in their daily life. While the "thingness" of the prototype was far from optimal, they felt that the basic premise was correct and that it could be redesigned to more closely fit how they lived and the kinds of health behaviours that they were interested in maintaining. This design process is currently ongoing.

As a contrast, the second participant felt that having a system that—even ostensibly—tracked and prompted reflection on gut health and the concomitant implications for mental health was overwhelming, and not something that made them feel better about their health. They felt that rather than liberating them from worry, as the first participant felt, that reflecting on these concepts created anxiety in their life that wasn't there before. This participant chose not to use the device at all during the testing period, as even imagining how to engage with the system created a surprising amount of anxiety around their health. The sense of obligation to the device as a mediator of personal health and wellness proved to be understood as a reassuring partner for one user, and a point of stress for another.

DISCUSSION

Even as Gut Feeling tried to offer a neutral perspective on a user's inner state by showing a single number that was left to be understood by the user, some participants consider that number as corresponding to an implicit diagnosis of a health condition. Health is so commonly understood as corresponding to a binary relationship between "healthy" or "unhealthy" that any presentation of health-related data must intrinsically have some set of that data that is "good," while data that is outside that range must be "bad." In place of knowing some sort of representation of their health information, the second user from above wanted to know simply whether they were ok. Having knowledge of any specific condition in detail over time creates a point of concern. Rather than representing a sensor reading to that participant at all, sending information to a black box would be sufficient, and it might be possible to imagine how existing services or routines could be adjusted based on this health data in the event of a possible health concern—vegetables delivered as part of a CSA may be balanced to reflect changes in personal biology, or a morning multivitamin taken every day might change its proportions of nutrients to correspond to shifting needs over time.

While these design implications in some sense reify the idea of health as a thing that you either have or you don't, rather than being a practice that is personal and situated, the emotional response to health technology in general emphasizes the need to design technologies that can be negated, are ambiguous, and operate in oblique ways to understand what the internal condition of a person is like. For some, designing devices that are present help them to abdicate responsibility for their own

health practices, and placing health issues in objects around the home might be seen as an empowering network of supportive infrastructure. For others, though, these devices are disempowering, as placing issues as personal as health in artefacts produces still more things to attend to and be responsible for—with the added implication of reflecting something as intimate and potentially concerning as personal health. Balancing these perspectives is a key factor in our ongoing research through design work.

CONCLUSION

In this project, we are designing personal medicalized devices that are not meant to be indexical to ailments or trauma, but rather tools that understand "health" as a practice of wayfaring instead of as corresponding to an external, abstract standard. These devices don't discount medical knowledge or contemporary understanding of illness, but rather offer a means of encountering health differently: as a practice, as something that people do, as something that is personal. Using research through design to explore this topic, we are committed to making devices that speculate towards a personal kind of healthcare, rooted in care and lived experience—a local medicine.

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