Bridging Biochemists and Communities of DIY Biochemical Testing – A Co-Design Challenge

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At-home chemical tests are increasingly used to measure the health of people and environments. The procedure thus often involves sending the test to interpretation by an expert. However, there is a middle ground where the skills of professional biologists and chemists are made accessible through digital services. There is also an opportunity to develop technologies that support interpretation. This position paper contributes to the development of bio-digital interfaces by identifying key challenges for interdisciplinary bridging biochemists and communities of DIY biochemical testing. These challenges are based on ethnographic and co-design studies of citizens interested in sustainability. These citizens conducted soil chromatography, a chemical test method to assess the composition of soils. The research showed that citizens could conduct the tests reliably, while it was much more challenging to access the resources needed to interpret the tests in a meaningful way.

CCS CONCEPTS • Insert your first CCS term here • Insert your second CCS term here • Insert your third CCS term here

Additional Keywords and Phrases: Soil chromatography, DIY chemical testing, sustainability, co-design, citizen science.

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Figure 1: Left: a chromatogram of fertile soil. Right: a chromatogram of infertile soil.

Figure 2: Left: Fully developed soil chromatograms. Right: The process of conducting soil chromatography.

1 BACKGROUND

There are limits to what can be sensed with digital sensors. Chemical tests are thus increasingly used to provide data about the environment and our bodies [1,8,10,12,13]. Commercial examples include sampling saliva to approximate ethnic heritage and screening for various diseases such as COVID-19. This often involves sending the samples to a laboratory and online consultation with experts such as doctors. However, there are also examples of more Do-It-Yourself (DIY) approaches where citizens themselves develop bio-labs for testing [12,13] and explore various biological phenomena such as air quality [11], fermentation [4], menstrual health [3], and gut microbes [2]. In such settings, citizens must be skilled in conducting the test reliably and capable of interpreting the results. Online knowledge resources are instrumental in such processes. There is also potential in technologies that automate the interpretation of results, for example, through image recognition and machine learning [6,7,9]. In my research, I have investigated *opportunities and challenges for how DIY chemical testing can complement digital bio-sensors* when measuring the health of people and environments.

2 WORKSHOPS ON SOIL CHROMATOGRAPHY: A CASE OF DO-IT-YOURSELF BIOLOGY

This position paper is based on insights from a long-term ethnography of an urban permaculture farm. This permaculture farm is an example of a context where citizens aim to live closer to biological processes. They were interested in designing with nature and using biomaterials. They were also interested in better understanding their environment through observations, including laboratory practices such as using microscopes and chemical testing. In this setting, I conducted workshops on soil chromatography with citizens interested in soil health to improve the growing conditions of food crops. Soil chromatography is a low-cost, qualitative method for visually assessing soil health [5]. These workshops have been described in more detail in a DIS 2022 pictorial [14]. In this position paper, I point at the more discursive questions and challenges for bio-design that arose during the research. These insights are based on additional workshops on soil chromatography with artists interested in soil as a medium, and with design researchers interested in designing with soli.

3 FINDINGS AND CHALLENGES IDENTIFIED IN THE WORKSHOPS

The workshops show that the process of soil chromatography is relatively easy to conduct, with fairly accessible materials. However, the chromatograms are harder to interpret. It is possible to make very general comparisons of fertility (see Figure 1), but it is much harder to interpret the specific composition of substances. Although the chromatogram colors represent specific substances, distinguishing between different nuances of brown is challenging for amateurs (see figure 2). Both users and design researchers tend to lack the biochemical competence to fully interpret the results. There is thus an opportunity to develop bio-digital interfaces that support the interpretation of chemical tests that produce a visual outcome (e.g. through image recognition). To develop such supportive technologies there is a need to bridge co-design practices with the biological and chemical sciences. Co-design practices can identify use cases where DIY biochemical sensing makes sense (e.g improving soil health by understanding its composition). They can also offer engaged user groups who are interested in the early adoption of bio-digital interfaces. The biological and chemical sciences can contribute to these settings with the skills and competence needed to conduct and interpret the test with reliable and meaningful results.

However, citizens in my studies were often met with disinterest when they contacted biologists and chemists. Supporting citizen science communities was not seen as a prioritized task by scientists - and some even dismissed the chromatographic method itself, as it is no longer used as a method in "real lab settings". There is thus a central challenge to investigate *how scientists can be engaged to support communities of DIY biology.* The limited capacity of scientists to set aside time to engage in citizen sciences further implies that developing interfaces and applications that support or even automate the interpretation of chemical tests are needed.

4 QUESTIONS TO DISCUSS

The conducted workshops on soil chromatography inspire a set of questions that could be further discussed in the workshop "Living Bits and Radical Aminos":

- *How can HCI designers help bridge the scientists with bio-labs communities?*
- *How can DIY chemical tests such as soil chromatograms be interpreted in more detailed ways? How is the misinterpretation of DIY chemical tests avoided?*
    - What can be read from a chromatogram (presence of microbes, metals, nutrition, impurities, PH, etc.)?
    - *How can machine learning and image recognition be utilized to support citizens' interpretations of chemical tests? What are the possible implications of this?*
    - *How can services for online consultation be developed for the interpretation of chemical tests?*
- *In what contexts other than cultivation could chromatography illuminate interesting aspects?*
- *Are there other DIY methods for measuring the composition of soil and other environmental parameters? How can they be utilized?*
- *How can you work with biosecurity in a community setting? For example, avoiding harmful substances or microbes leaking out into the environment.*

5 AUTHOR-BIO

Anton Poikolainen Rosén is a postdoctoral researcher at Aalto University, department of design. He focuses on sustainable futures in HCI research and more-than-human design. He works with ethnographic methods, research through design, co-design, and speculative design. He has a Ph.D. in Informatics from Umeå University and Södertörn University, Sweden. His thesis focused on more-than-human design in urban farming communities. Anton currently works on the project "Methodology for HCI Evaluations of Possible Futures" [15]. In this work, he focuses on how people can experience and evaluate conflicting ideas of sustainable futures through the use of interactive prototypes. His design research portfolio is available at *www.poiros.com.*

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