Spark final report

Exploring digital health monitoring with a complex systems approach

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Members:

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Fig. 1. An overview of the process of this Spark journey.

Introduction

This final report presents our Spark journey for the project "Exploring digital health monitoring with a complex systems approach". It was originally named 'Interdisciplinary explorations of a complex systems approach to study socio-technical challenges', when we first applied the Spark grant in June 2023. First we will introduce our project motivation.

A complex system is different from the mere sum of its parts, and is an increasingly popular concept when studying phenomena in modern health research. But what does complexity add beyond buzzwords and blue-sky thinking? And does this concept mean the same thing when applied by different disciplines?

This project helps answer these questions. Researchers from different disciplines – physics, demography, marketing and sociology – attempt to reach a common understanding of what complex systems approaches can bring to health research.

To do so, we aim to reflexively apply a complex systems lens to a case study, digital health monitoring with smart technology. This involves a host of different factors –

technology, human behavior, medicine, data – that interact and can produce results greater than the sums of their parts. We will examine how such a lens can enrich the implementation of these technologies whilst learning more about how complex systems concepts travel across disciplinary boundaries.

Looking backwards to this Spark journey, to ultimately apply complexity science lens to this topic, we found that several steps needed to be taken first. As discussed below, we are not experts in this topic, and it takes time to build up the relationships within our team. With such nonlinear exploration in this Spark journey, we summarize our process in Fig. 1.

Team

We are a team of researchers from diverse fields: physics and nonlinear dynamics (Peter, TU/e), marketing (Anouk, UU), health and society (Kristina, WUR), and sociology/science and technology studies (Callum, UMCU). Our epistemological traditions range from positivist and pragmatist to constructivist, and our methodological approaches include both qualitative and quantitative methods.

Торіс

How does the theme of "digital health monitoring" relate to our team's background and interests? For example, the business of wearables and digital technology ties into marketing. The way humans perceive wearables and how these devices empower individuals to understand themselves can be analyzed through an embodiment perspective. The impact of wearables and digital health monitoring on health outcomes is relevant to public health. Additionally, modelling the dynamics of individuals adopting wearables and exploring the potential use of networks is connected to physics. In this Spark phase, we focused on wearables, human experience, and physical activity.

Process and output

We initially came up with the theme of complex systems, focusing on how technology, society, and humans interact with each other. Initially we did online meetings, each of explaining what complexity can mean in our own field. Our team did not feel moving forward well after a few online meetings. Therefore, we asked help from a process coach Neža Krek. With a one-day facilitation from Krek in February 2024, we refined this theme to "digital health monitoring," which better aligns with our backgrounds and interests (see "Topic" above for a brief elaboration).

Since none of us were experts in this field at the beginning, we have been conducting a literature review and interviewing experts. We have visited each other and individually and sometimes collectively attended workshops and conferences related to our topic. There are several outputs gained from these activities which will be elaborated below.

Preparing a manuscript

We have been conducting a literature review and interviewing experts, focusing on wearables, human experience, and physical activity. We aim to understand why healthy people use wearables. We investigate the barriers for adoption and (dis)continuous use. For the expert interviews, we aim to invite 15 experts. From our initial findings during the process of literature review, we found that there is limited complexity science method employed from our search, and the quantitative analysis are mostly statistical correlations between different factors. The study of the dynamics of people adoption using complexity science method, e.g. through social network, is limited. The literature review and the expert interviews served as a ground for the Unusual Collaboration (UCo) phase in which we then employ the complex systems methodology to study why health people use wearables.

The literature review and the analysis of the expert interviews are not finished yet. It is being continued in the Unusual Collaboration (UCo) phase.



Fig. 2. The PRISM flow diagram for the literature review understanding why

Poster presentation

Together with some other CUCo Spark and UCo teams, the Complexity Team represented by Peter presented a poster on the UMCU Research day 2024 (30 sep 2024). While we did not attract much interests from other audience, we re-connect with other CUCo teams and share experience between each other. The poster is shown in Fig. 3.

A flash talk and a discussion at a complexity science workshop

The team, represented by Peter, attended a <u>complexity science methodology workshop</u> organized by <u>POLDER</u> ("a research initiative led by the Institute for Advanced Study [IAS] at the University of Amsterdam" on complexity science and policy) at IAS on 26 mar 2024. Since the Spark exploration journey is at the early stage, we introduced the team formation, the process, and the topic. We presented the questions that are asked by each of our team members. For example, "what are the barriers and facilitators for the implementation of "wearable smart tech for health"?", and "how do the users make sense of their health through smart wearables?"

The audience include researchers who employ complexity science methods to tackle health-related problems. During the discussion, we asked the following questions to the audience to gain feedback about our project:

From your own perspective and expertise,

– What interests you in this theme "digital health monitoring" and "complex system approach"?

- What other questions would you ask on this theme?

– If you'd like to investigate this topic, what aspect are you interested in?

– How do you think about our posted questions in the last slide? Do we ask the right questions?

We gained valuable feedbacks and interesting perspectives. For example, we can look up the use of ecological momentary assessment (EMA) for "repeated sampling of subjects' current behaviors and experiences in real time" (Shiffman 2008), which aligns with the "system approach" that incorporates the environmental conditions in studying the samples dynamically. We also gain valuable resources on digital health monitoring from some participants too.

Collaboration with another UCo team - Plasticity

On 30-31 May 2024, Peter (and Kristina on 31 May) attended an transdisciplinary 2-day event "<u>The Shapeshifters Symposium</u>" organized by the <u>UCo Plasticity team</u>. We learnt from the fruitfulness of transdisciplinary discussions, and found similarities between these two CUCo teams that we both started from a concept ("plasticity" and "complexity"). Since there are overlaps between the concepts of "complexity" and "plasticity", a separate discussion between these two concepts was held on Day 2. For example, on Day 1 one speaker Prof. Peter Sloot from UvA made a claim of "complex (adaptive) systems show plasticity". We are preparing a Whitepaper together with the Plasticity team on exploring the relationship between complexity and plasticity by applying an interdisciplinary angle during also the UCo phase of this project.



Fig. 3. The poster shown on the UMCU Research Day 2024.

Career steps made possible through CUCo project

One of the team members, Peter, partly thanks to the CUCo Spark training and working through two Spark projects (this team Complexity team and the other <u>IMPAct</u> team), was able to find a Postdoc position to work on another transdisciplinary project <u>Rethink</u> <u>Hydrogen</u>, at Utrecht University between 15 aug to 14 dec 2024.

Conclusion

Our Spark journey is nonlinear and exploratory. We started with a team interested in the concept of "complexity". At the beginning, we struggled to move forward and explored many ideas through a few online meetings. It turns out to be more concrete and workable after we converge our theme to "digital health monitoring" and "wearables" with the help of a facilitator. Since we are not experts in these fields, we have been performing literature review and expert interviews to understand why healthy people use wearables. From these we learnt that indeed complex systems method has of limited use in this theme, and can be advantageous in studying the dynamics and going beyond merely statistical correlations between different factors. From the collaboration point of view, there is an advantage of forming a small team of four, that we can communicate more effectively while having diverse background. This allows us to find our way to continue to collaborate as a team even for the UCo phase. For the UCo phase, we are lucky to have dr. Heleen J. Pennings from UMCU and TNO, who is an expert in complex system and education, in our team to continue to explore health technology adoption and maintenance using a complexity science approach.

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References

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