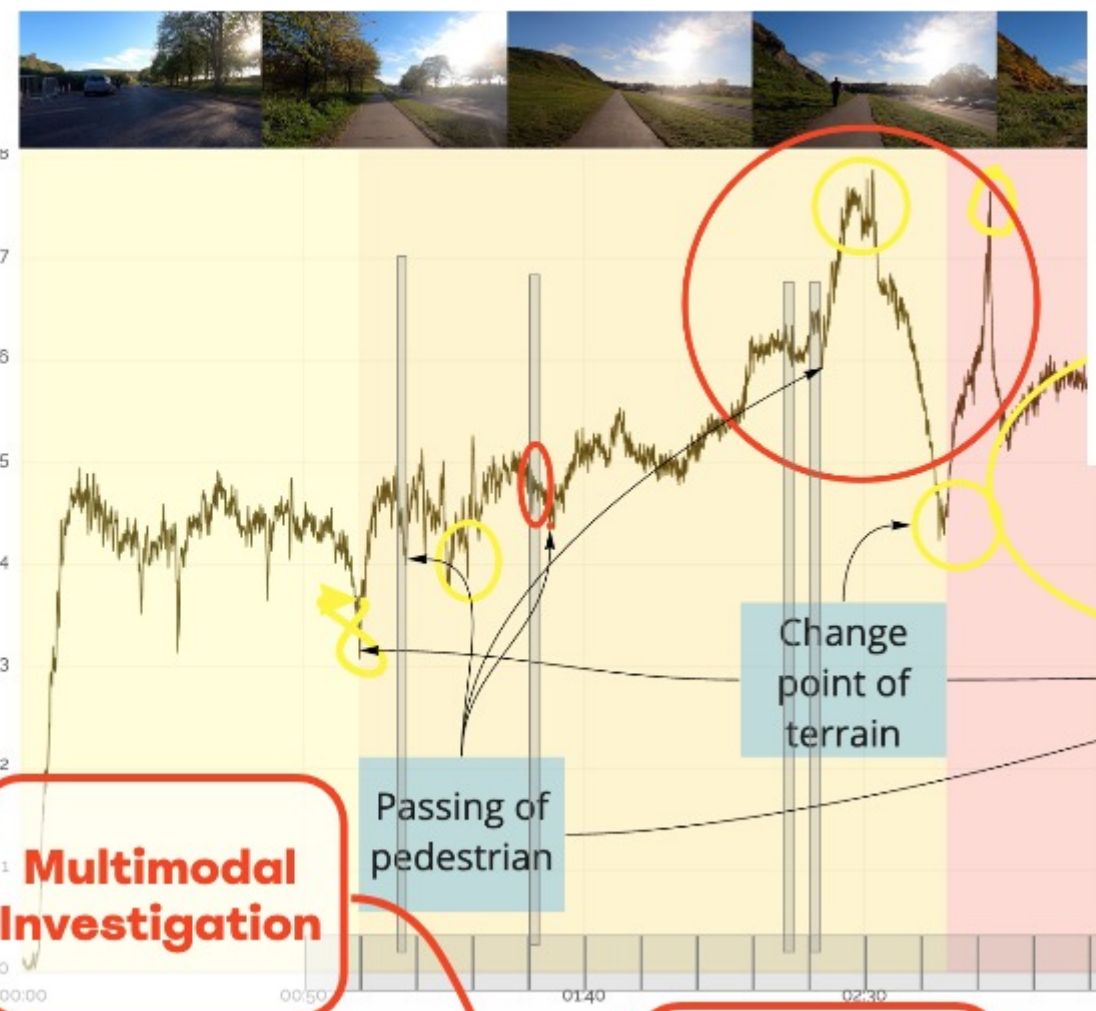


# Annotations, sensemaking and speculative models: trajectories between multimodal data and hypotheses

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Telemetry data from the use of physical products is a particularly interesting design material, as it connects to specific moments in physical space, that integrate human experience, physical mechanics, social dynamics and more. This pictorial covers a case study carried out where designers were asked to carry out exploratory sensemaking around telemetry data from a GoPro camera attached to a bicycle. They looked across video and sensor data, supplemented by conversations with the cyclist, fluidly generating and speculating on research hypotheses.



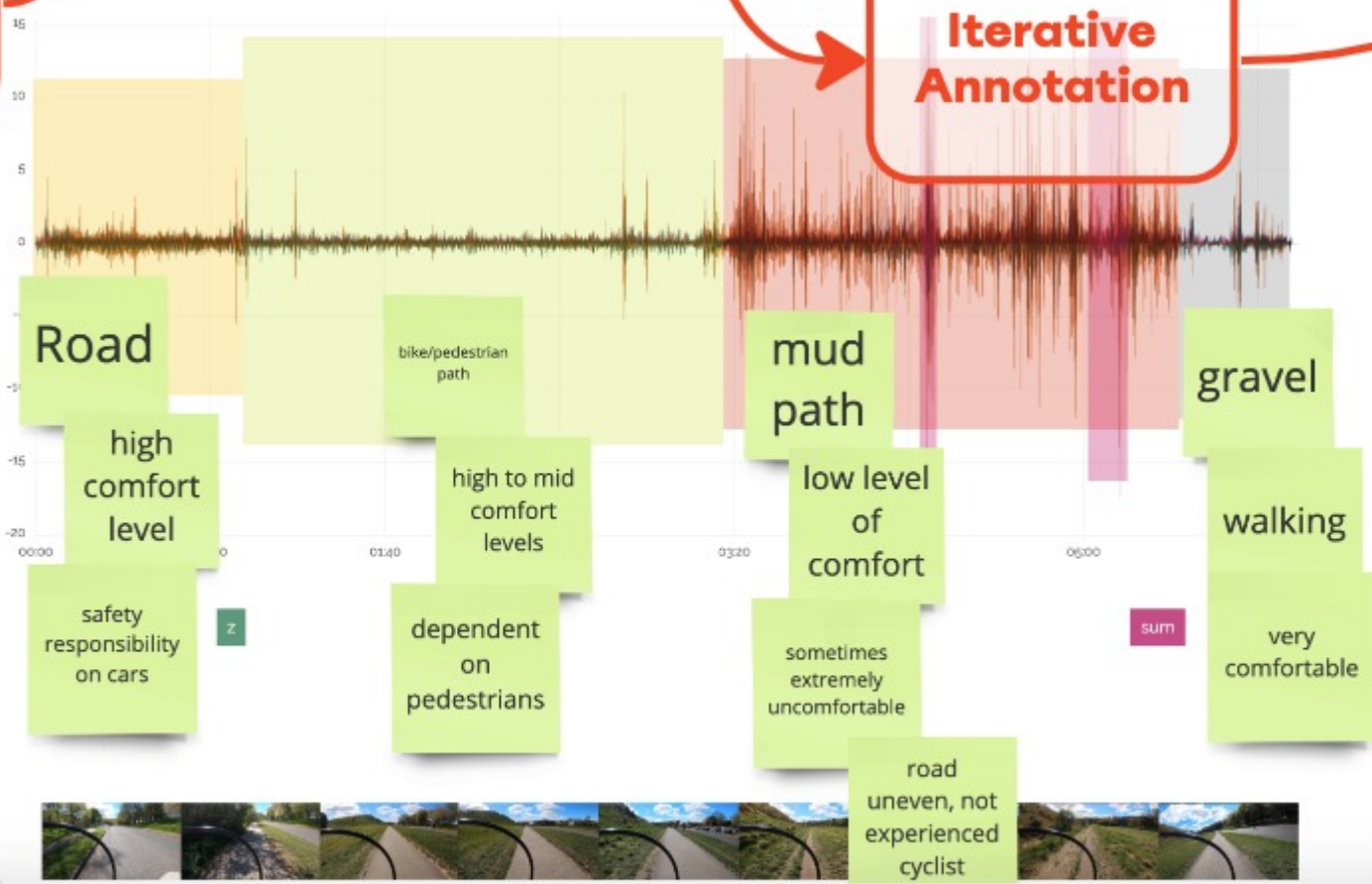
Experiment details - bicycle, rider and all of the sensor information captured by the GoPro - acceleration, GPS, scene detection, light levels, as well as the video data

Hi, I am Katya. I am 29. I purchased this bike 4 years ago, second hand. I mainly use it during the summer for fun.



**Initial Questions**

- Does a lower bike frame increase safety during emergencies?
- How the type of chain influences speed
- Efficiency of getting from highest to lowest gear
- When does the chain guard become damaged
- How visible the reflectors are to others (by way of cameras recording the bike moving)
- What is the ideal amount of pressure to activate the brakes for this user
- What do people rate to be the aesthetic value of the bike
- Your experience using the bike at different points in time
- Optimal gear for different conditions (based on self-reported effort of pedalling)



The work follows the designers' questions, methods, and explorations, both immediate concerns and speculations about working at larger scales with machine learning models. This points to the possibility of tools that use data as a design material to help designers to engage with machine learning, not just for optimisation and refinement, but for creative ideation in the early stage of design processes.

The interesting part here is the use of annotation, and how fundamental it is to designers making use of data - the annotations connect the various types of data and understandings of human experience. Participants used data and annotation practices to connect the micro and macro, spot interesting moments, and frame questions around an unfamiliar problem.



Show me the video capture each time there is a peak in the graph

Show perceived confidence level at peak or troff

Show me each time there is a person/bike/tree/animal or car in shot

Revised Question: What behaviours does the user present when the demographics of surrounding pedestrians are different in their pathway?

Revised Question: How do obstructions affect the behaviour of the cyclist? E.g. Cones, Cars, Animals.

Is the terrain a cause of the change in stability or is this the confidence of the rider?

Pragmatically, annotation has multiple possibilities that can be appropriated for use in early stage design and RtD research:

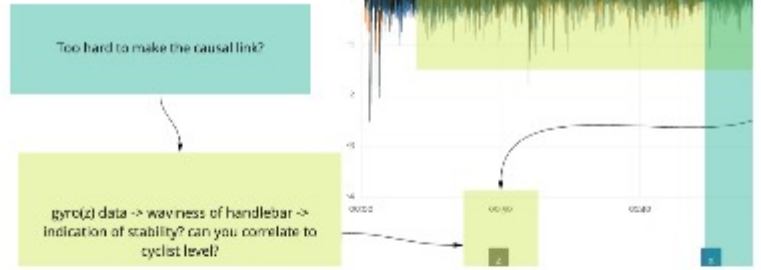
- Annotation provides a way to navigate multimodal complex datasets, and integrates viewpoints across different domains of knowledge (Badam et al., 2022; Cassidy & Schmidt, 2017; Chandrasegaran, 2016).
- Annotation can form the basis of collaboration patterns. This is already present in CAD models (Li et al., 2009) as a generic coordination tool, but can give rise to specific practices. This includes critique, discussion and feedback on what is happening, e.g. critical feedback in nursing contexts (Cattaneo et al., 2020), as well as collaborative annotations on shared material as a distance learning technique (Zhu et al., 2020).
- Annotation supports sensemaking in new fields - in particular, providing a way in for less data-literate designers working with telemetry data, as shown by the progression of annotations here from speeds to accelerations to thinking into terrain and vibration.
- Annotation connects humans and computational systems. This can include machine annotations for warnings and errors on code or digital models but also extends to machine learning systems through the creation of the labels on which models are built, for example in education with multimodal machine learning analytics (Di Mitri et al., 2019).

Where annotations can connect between human and machine agencies, they create new possibilities within the messier, interconnected world of post-industrial design (Giaccardi & Redström, 2020). Curious annotation from designers can work through practices such as thing ethnography (Giaccardi et al., 2016) and entangled ethnography (Murray-Rust et al., 2019) to re-speculate about connections between the physical, digital, vibrant and agential.

The raw telemetry visualisation supported several designerly strategies – mediating between different datasets and approaches, supporting creation and exploration of ad-hoc models, and connecting small scale behaviours to wider contexts. This suggested a rich set of ways designers can engage with this kind of data, from contextual grounding for concepts and hypotheses to a way to interact with machine learning systems. Of particular interest were the trajectories that designers took between looking at telemetry, video capture and engaging with the research subject. They also used strategies of zooming in and out to mediate between micro-data, potential for analysis and wider social questions.

**Revised questions**

**Desires for tools**



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