

Dimension Hopper

A Tool for Exploring Multidimensional Data in Design Research

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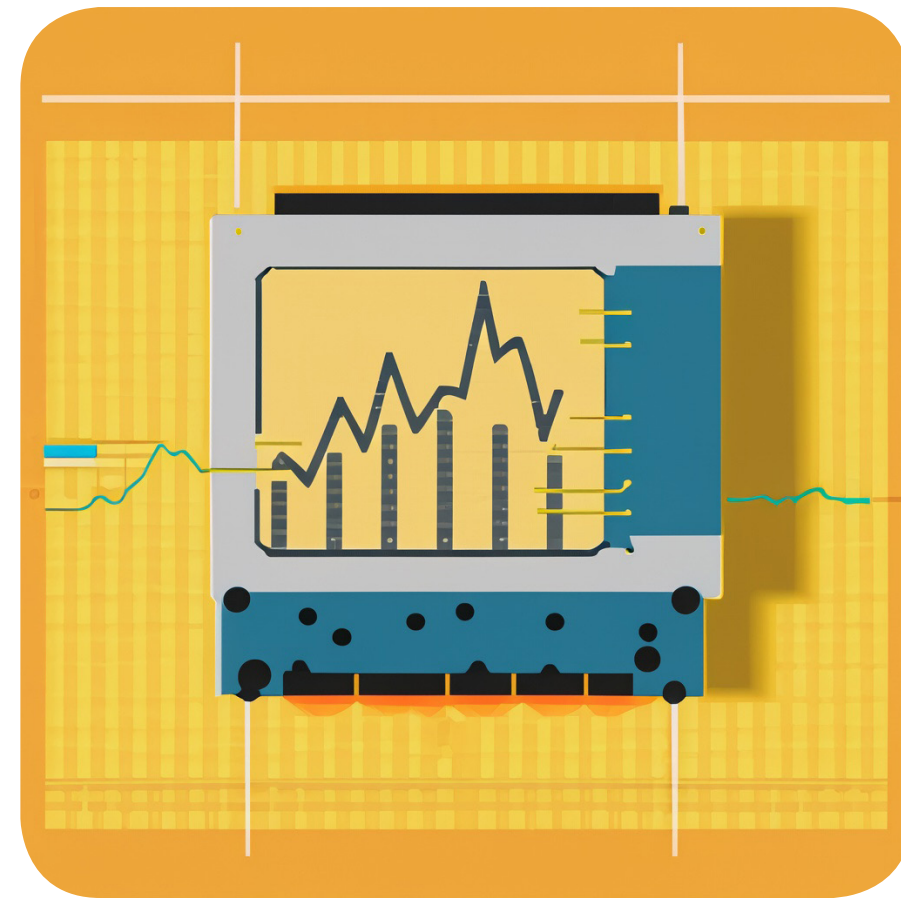


Challenges in exploring multidimensional data

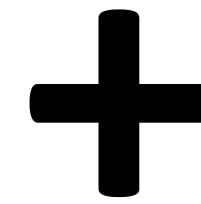


- Designers often find it difficult to explore relationships between data in design research
- Lack of tools that facilitate the simultaneous visualization of different data types

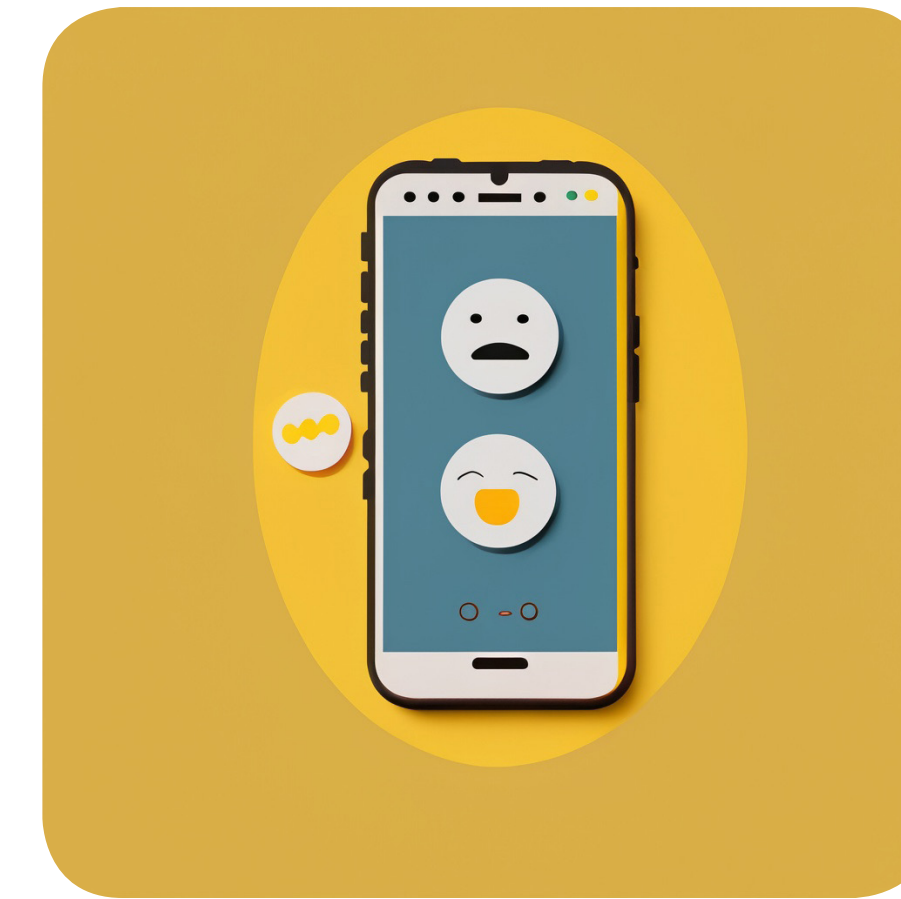
Sensor data



Numerical



Experience sampling data



Numerical/Categorical

Likert scales
Open text field
Multiple choice

- **Understanding the main patterns in the user's behavior**
- **Identifying relationships between different data types**
 - > identify parameters which affect user behavior and interconnections between them
- **Identifying significant changes or anomalies**
 - > understand issues related to the data collection system or the behavior and experience of the user
- **Understanding the context**

DIMENSION HOPPER

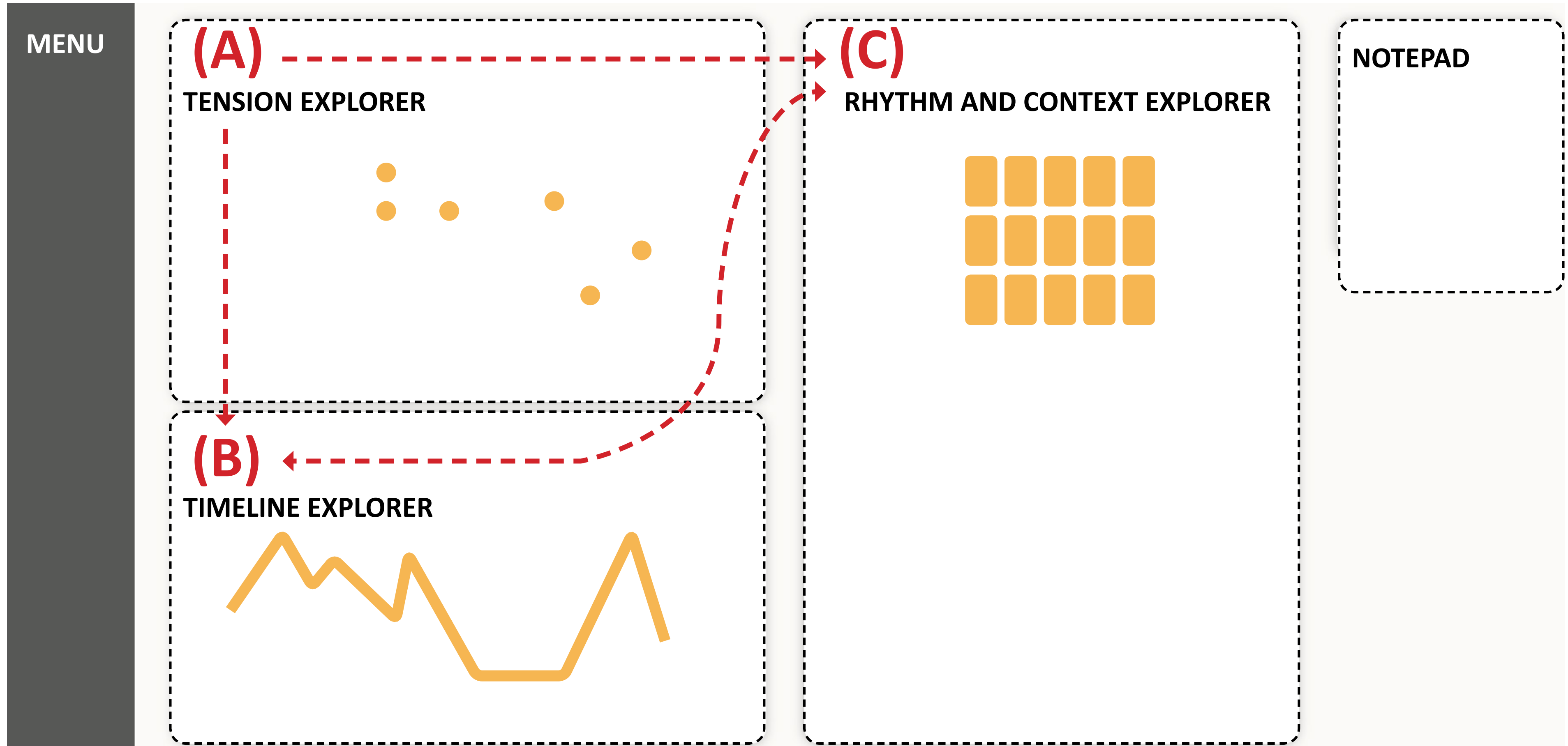


DIMENSION HOPPER: Overview

The interface is divided into several main sections:

- Menu (Left):** A vertical sidebar containing controls: Reset, User01, Colour, Filter: Eating, Hide anomalies, Interactive selection, Hide statistics, and Clear selection. Annotations point to these controls: 'Reset', 'Select colour palette', 'Filter categorical data', 'Display anomalies (outliers)', 'Show statistics', and 'Activate/clear interactive selections'.
- Tension Explorer (Top Left):** A scatter plot of 'Steps (sum)' (Y-axis, 0-4,500) vs 'Fatigue' (X-axis, 1-7). It features a 'Filter: Eating' dropdown and a 'Show details' button. Annotations include 'Change numerical data type' and 'Select text data' pointing to the plot area.
- Timeline Explorer (Bottom Left):** A scatter plot of 'Steps (sum)' (Y-axis, 0-4,000) vs 'Date' (X-axis, Wed 09 to Nov 27). It features a 'Show details' button.
- Rhythm and Context Explorer (Top Right):** A heatmap of 'Date' (Y-axis, 2022-11-07 to 2022-11-27) vs 'Hour' (X-axis, 0-23). It features an 'Eating' dropdown, a 'Show details' button, and an 'Opacity: 100' slider.
- Notepad (Far Right):** A text input area with 'Show' and 'Clear' buttons. Annotations include 'Store observations' pointing to the input area.

Multiple coordinated views (MCV)



Components: Tension explorer

(A)

TENSION EXPLORER

Menu

Reset

User01 ▾

Colour ▾

Filter: Relaxing ▾

Show anomalies

Interactive selection

Hide statistics

Clear selection

Tension Explorer

Stress (X) ▾ Mood (Y) ▾

Stress (X)	Mood (Y)
0	0
1	1
1	2
2	2
2	3
3	2
3	3
3	4
3	5
4	3
4	4
4	5
5	5
5	6
6	4
6	5
6	6
7	6
7	7

Timeline Explorer

Daily sleep score (Y) ▾

Identify

- correlation/mismatches between data
- anomalies, extremes and unexpected events based on data combinations

Rhythm and Context Explorer

Stress ▾ Show details ▾ Opacity: 32

Notepad

Show Clear

Note: not interesting but the meeting was quite good surprisingly, I received an invitation to go out this Sunday, and now I am enjoying the friday night at home

Components: Timeline explorer

Menu

- Reset
- User01 ▾
- Colour ▾
- Filter: Relaxing ▾
- Show anomalies
- Interactive selection
- Hide statistics
- Clear selection

Tension Explorer

Stress (X) ▾ Mood (Y) ▾

Mood

(B)

TIMELINE EXPLORER

Timeline Explorer

Daily sleep score (Y) ▾

7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

Wed 09 Fri 11 Nov 13 Tue 15 Thu 17 Sat 19 Mon 21 Wed 23 Fri 25 Nov 27

Date

Rhythm and Context Explorer

Stress ▾ Show details ▾ Opacity: 32

Date

2022-11-27

2022-11-25

2022-11-23

2022-11-21

2022-11-19

2022-11-17

2022-11-15

2022-11-13

2022-11-11

2022-11-09

2022-11-07

Note: not interesting but the meeting was quite good surprisingly, I received an invitation to go out this Sunday, and now I am enjoying the friday night at home

Identify

- significant changes during the monitoring period
- anomalies (peaks and valleys in the data)

Components: Rhythm and Context Explorer

(C)

RHYTHM AND CONTEXT EXPLORER

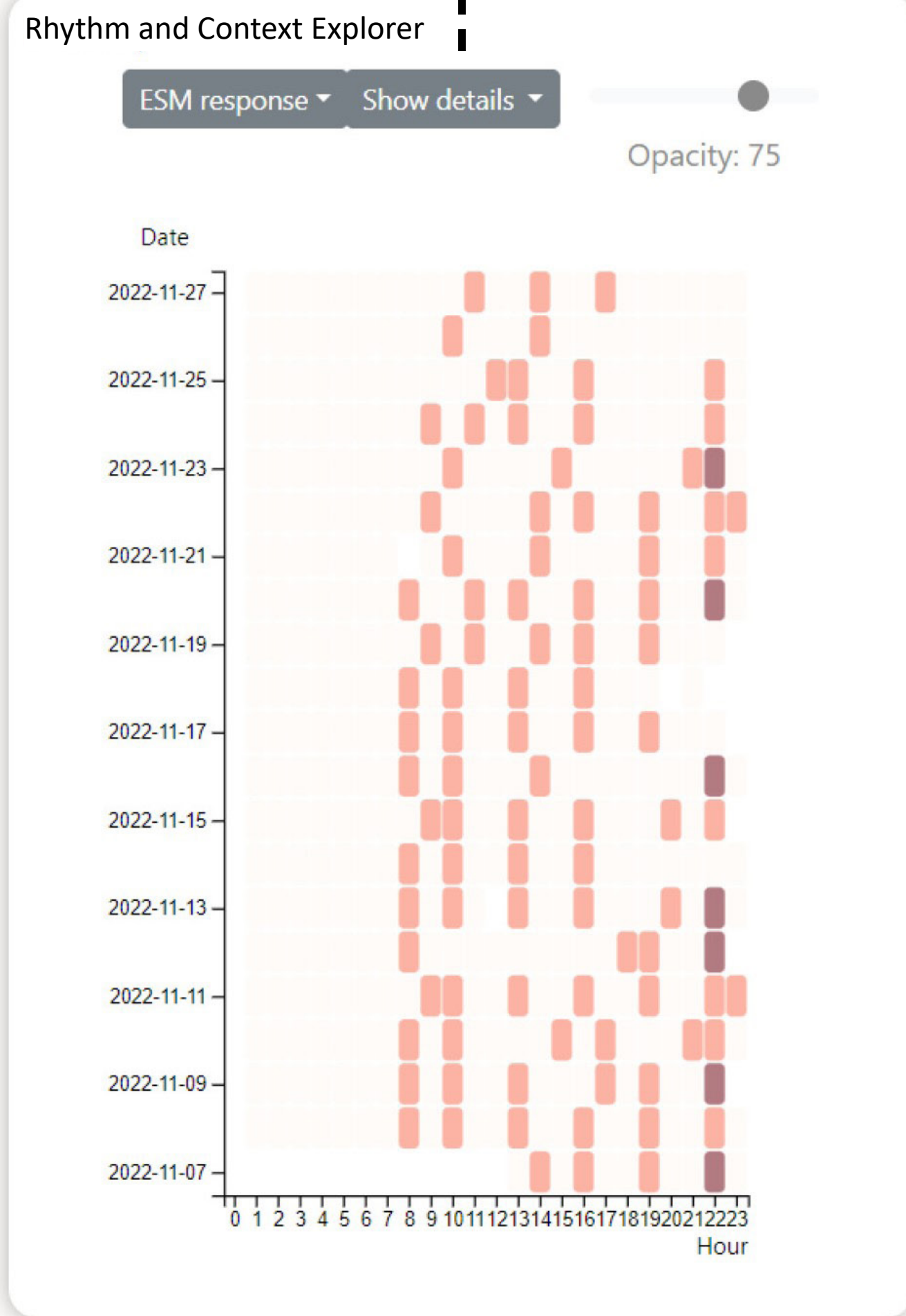


Identify

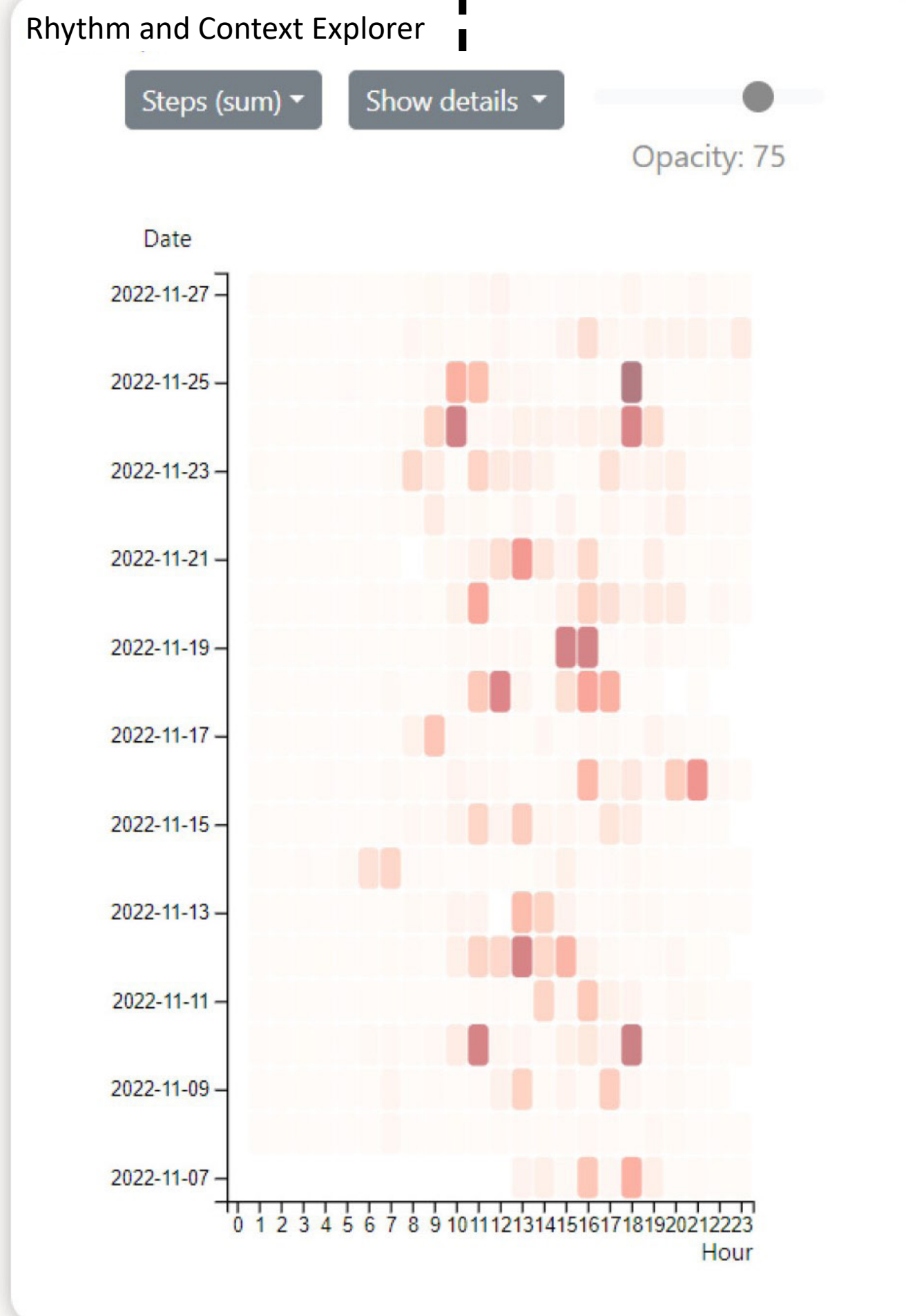
- the daily rhythm of events/behaviors
- the context behind outliers, anomalies and interesting observations

Components: Rhythm and Context Explorer

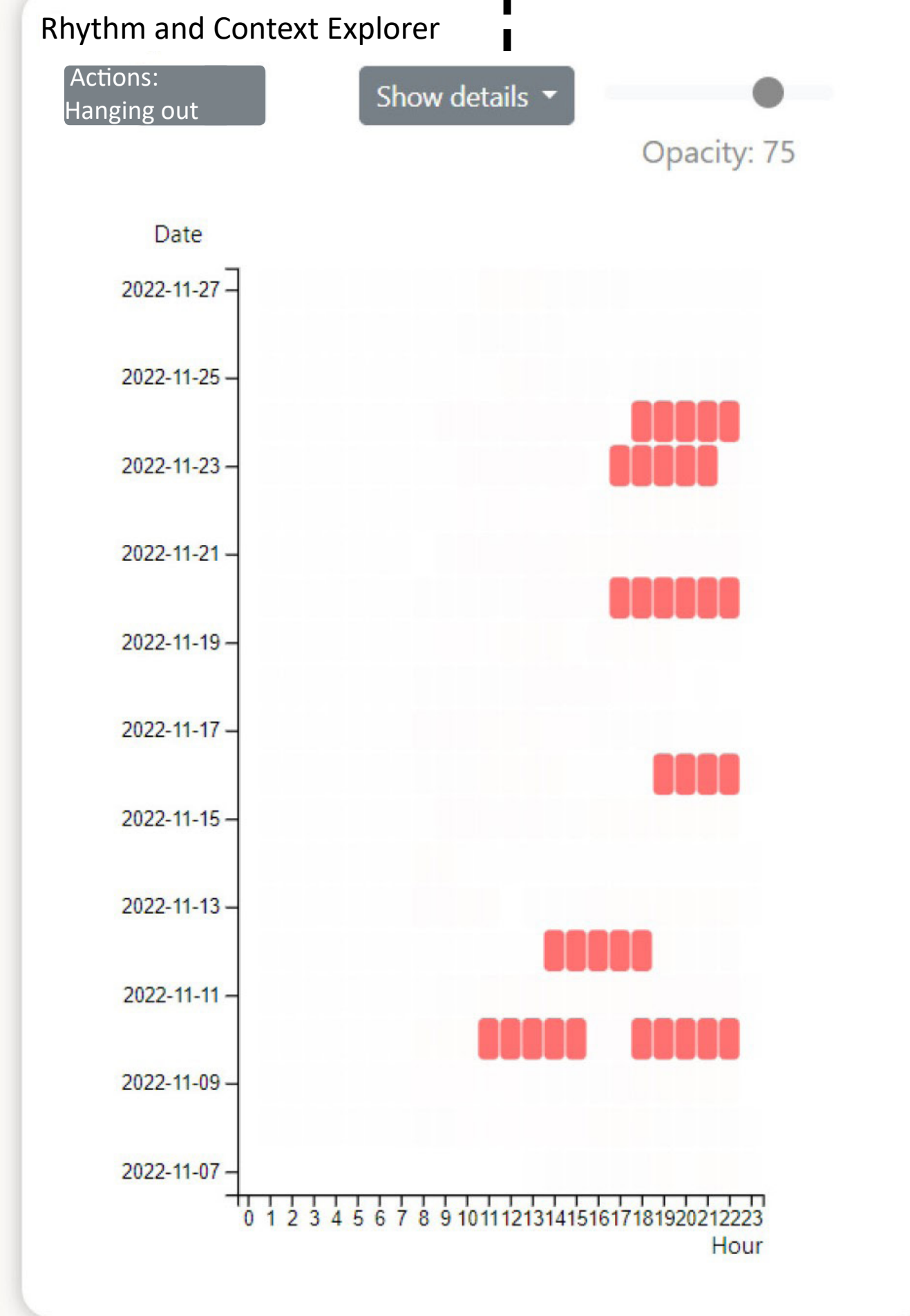
Checking ESM response rhythm



Checking daily steps rhythm



Checking rhythm in hanging out with friends



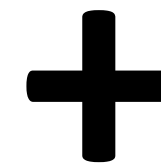
Interactive selections between views

Mood fluctuates during these days, with ESM data providing context



We used the dashboard to explore data collected from 16 users for 3 weeks:

FitBit data



Experience sampling via m-Path



Subjective/objective data:

Sleep duration and quality

Stress

Fatigue

Steps

HR

Activities

Interesting events

...

Demonstration



1 - Start exploration

Demonstration - Anomalies



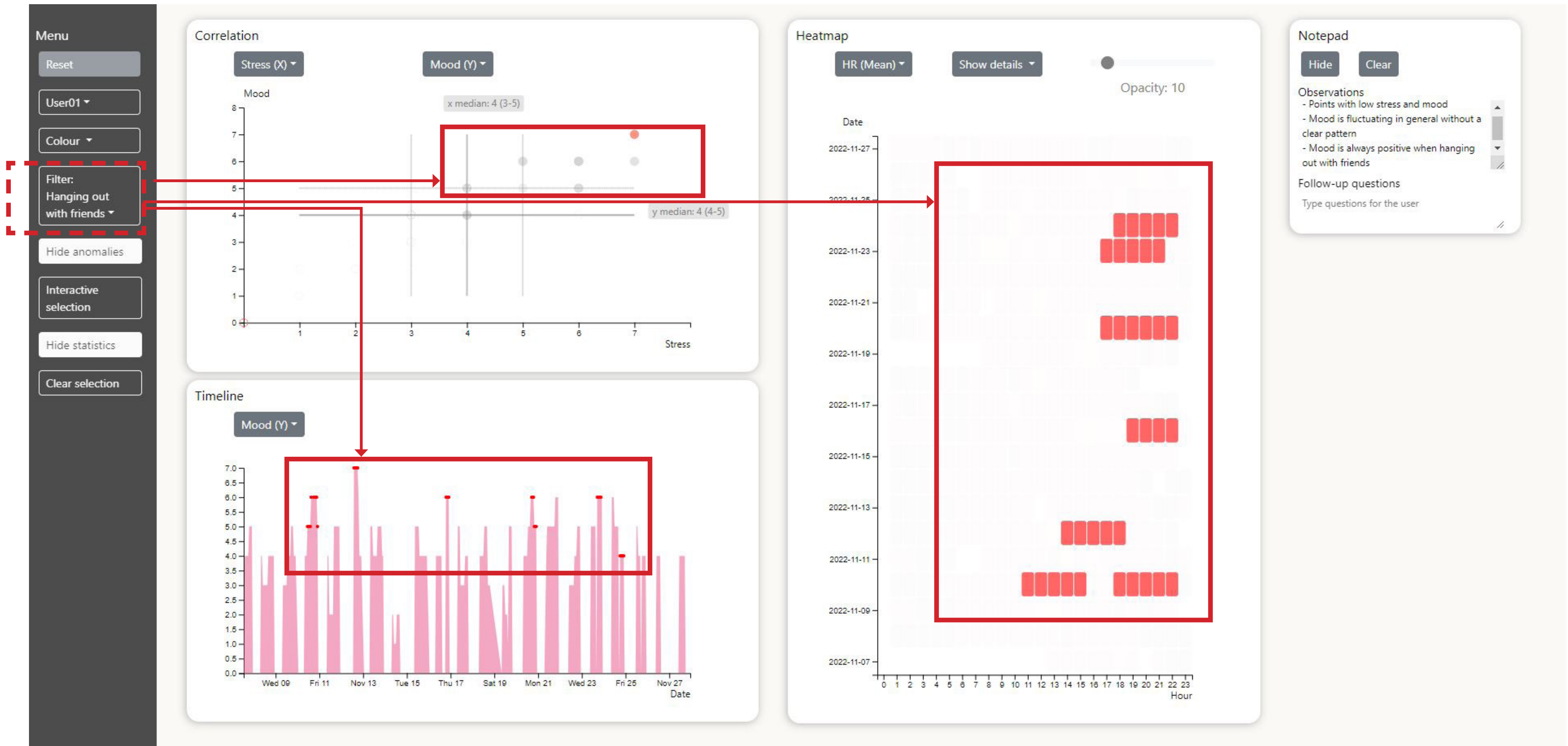
2 - See anomalies

Demonstration - Context behind anomalies



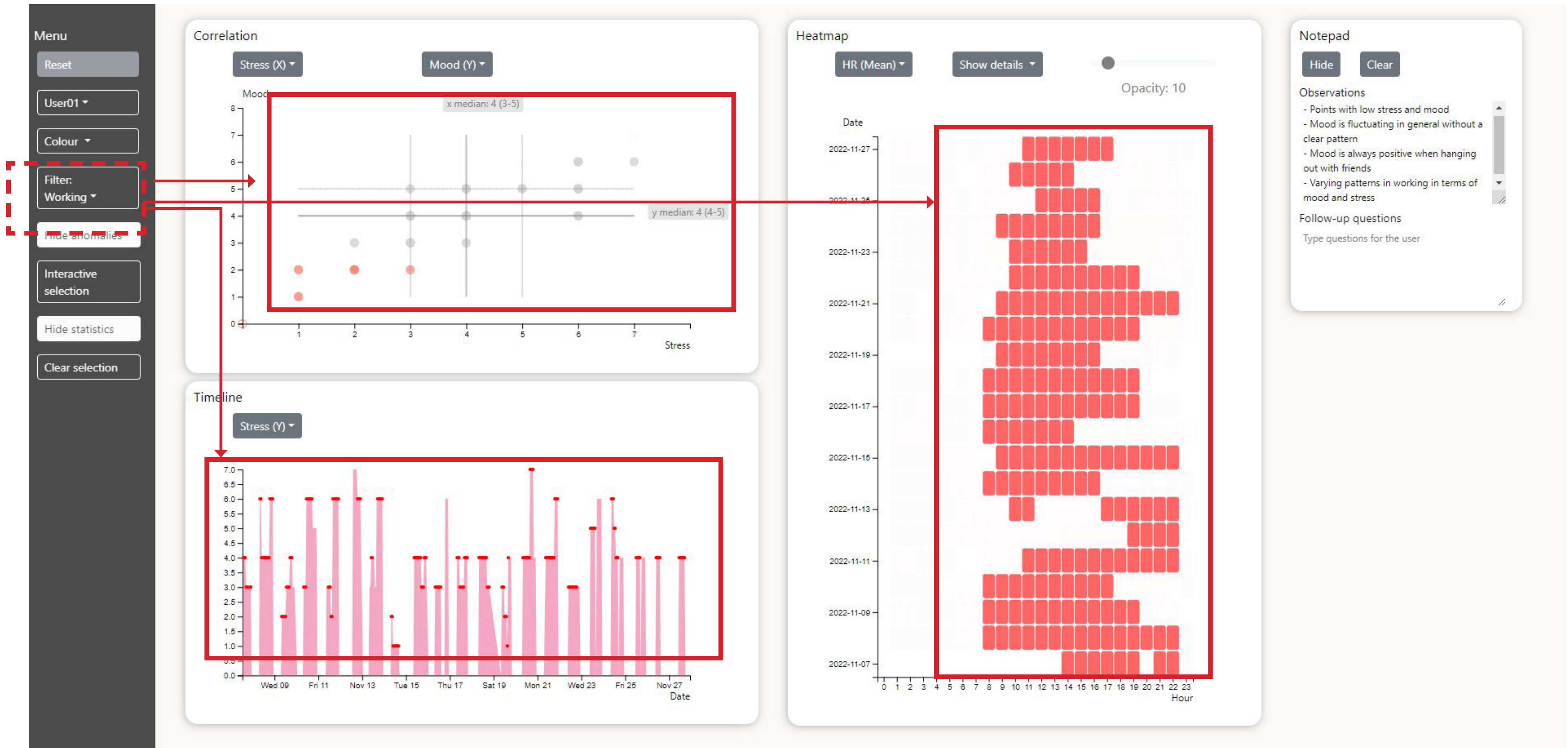
3 - See more details related to anomalies -> Mood fluctuations and HR surrounding highlighted points with low stress and mood

Demonstration - Filtering



4 - Filter points where user is “Hanging out with friends” -> Socialisation happens in the evenings, and is associated with good mood

Demonstration - Filtering



5 - Filter points where user is "working" -> it sometimes happens outside of normal working hours, and is associated with various moods

Demonstration - See context behind contrasting subjective and objective data



6 - Select points where subjective and objective sleep quality disagree -> the sleep duration was high, but the user had nightmares

- **User tests**
- **Documenting findings**
- **Data exploration can still be overwhelming**
-> difficult to decide where to start from
- **User-friendly data processing is needed**
- **Collaborative sensemaking**