ETTAC 2020

1st Workshop on Eye Tracking Techniques, Applications and Challenges

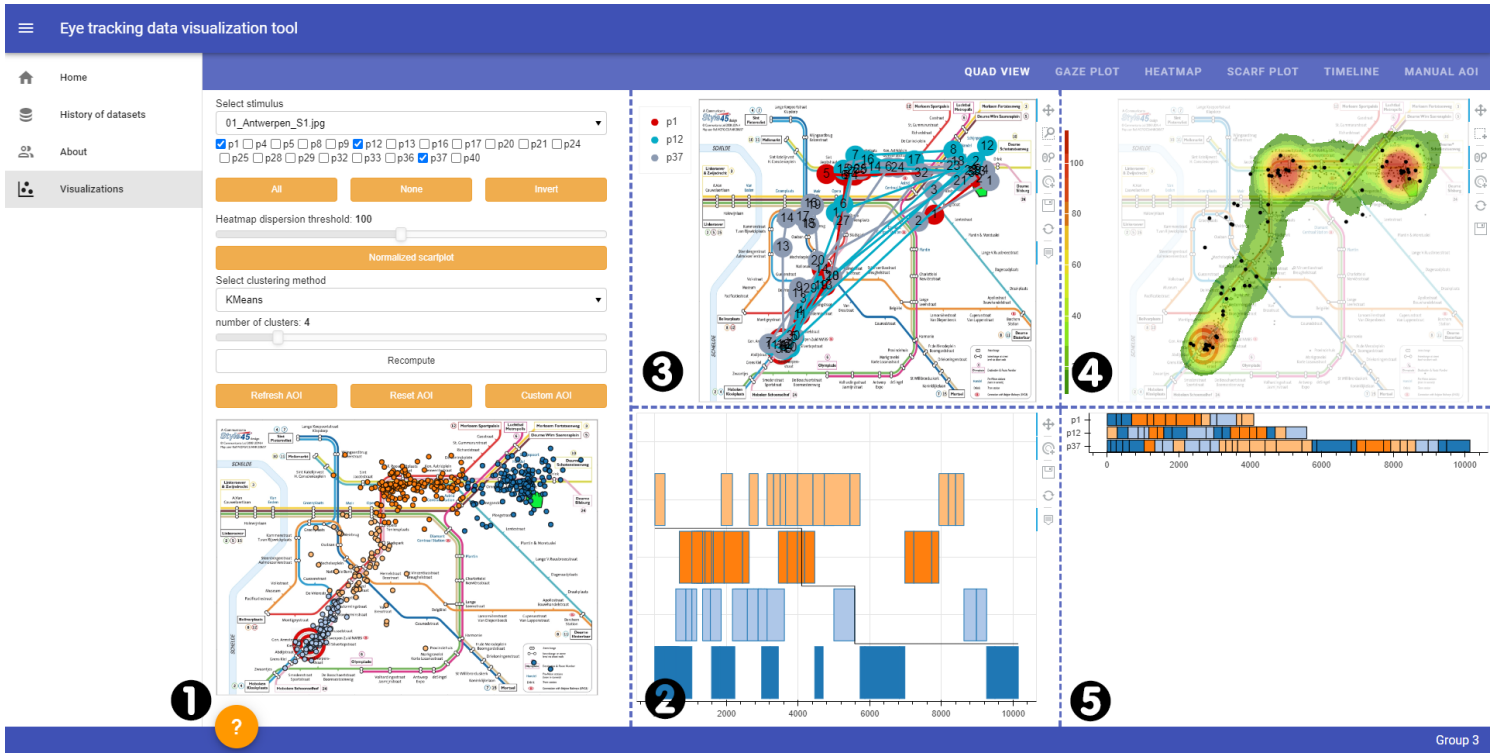
https://vision.unipv.it/ettac2020/

10 January 2021

In conjunction with

ICPR 2020

A Web-Based
Eye Tracking Data Visualization Tool



Hristo Bakardzhiev, Marloes van der Burgt, Eduardo Martins Bart van den Dool, Chyara Jansen, David van Scheppingen, Guenter Wallner, and Michael Burch

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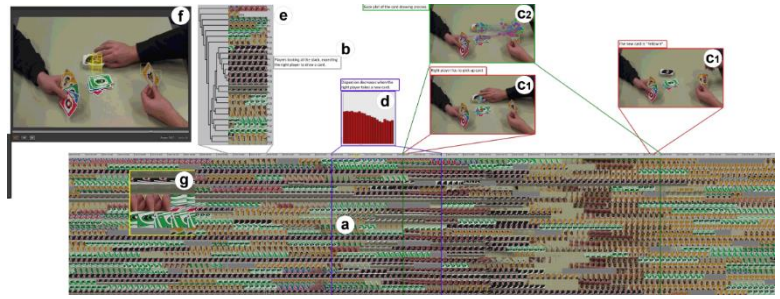
Motivation

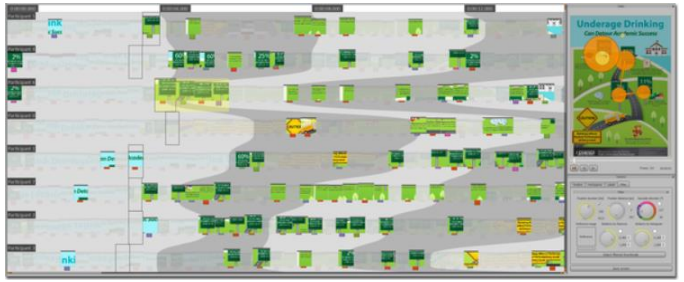
- Eye tracking data provides insights in many research fields
- Visualizing efficiently is challenging without well-designed tools
- Easily accessible web application
  - Combination of visualizations
  - Interactively linked

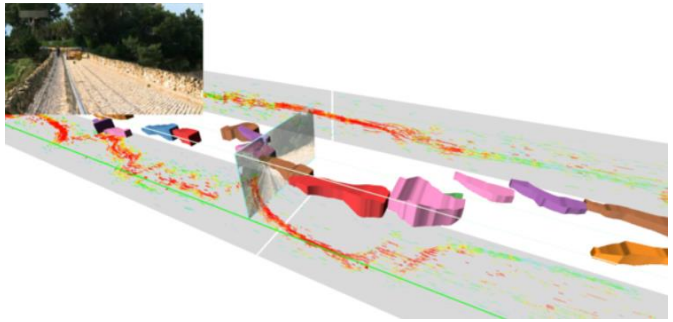
Related Work

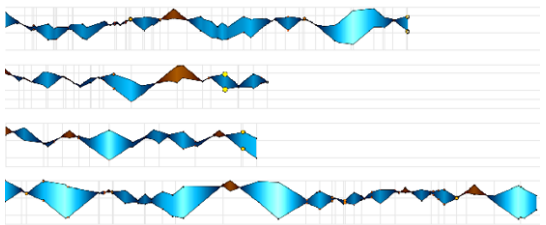
Eye Tracking Data Visualization

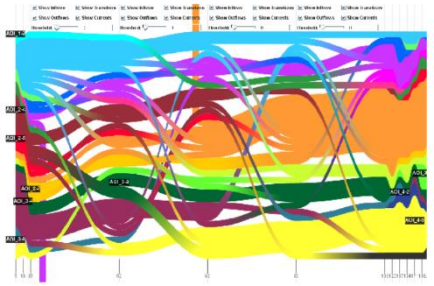
Tanja Blascheck, Kuno Kurzhals, Michael Raschke, Michael Burch, Daniel Weiskopf, Thomas Ertl:
Visualization of Eye Tracking Data: A Taxonomy and Survey. Comput. Graph. Forum 36(8): 260-284 (2017)











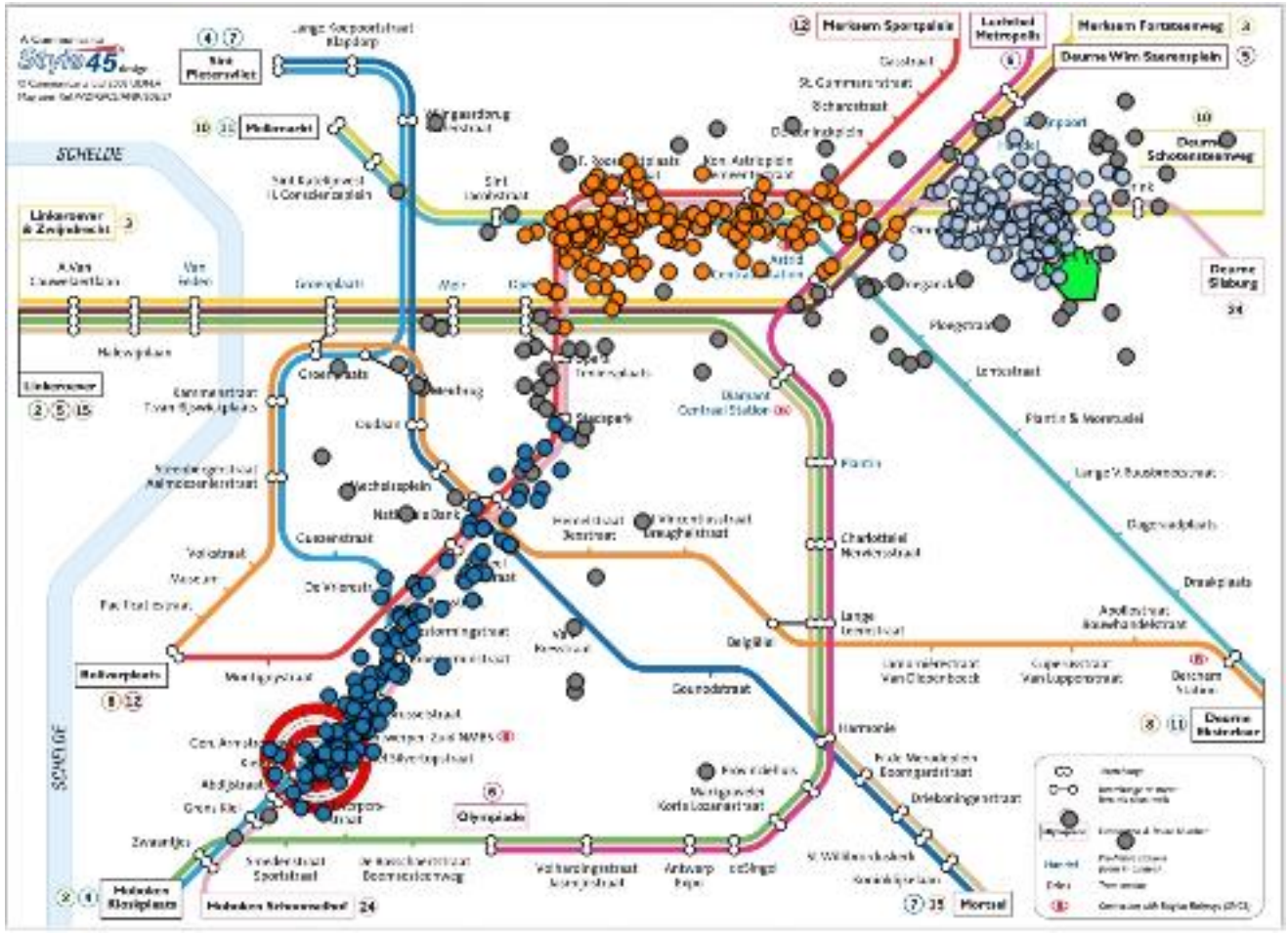
Data Validation

- Upload eye tracking data via zip files
  - Include the eye tracking data in form of csv files
  - As well as images of the stimuli

- Data verified first to
  - Ensure correct format and completeness
  - Dataset checked for internal consistency

Clustering

- AOI-based
  - Clustering
  - Manual selection
- Options
  - Mean shift
  - k-means
  - HDBSCAN



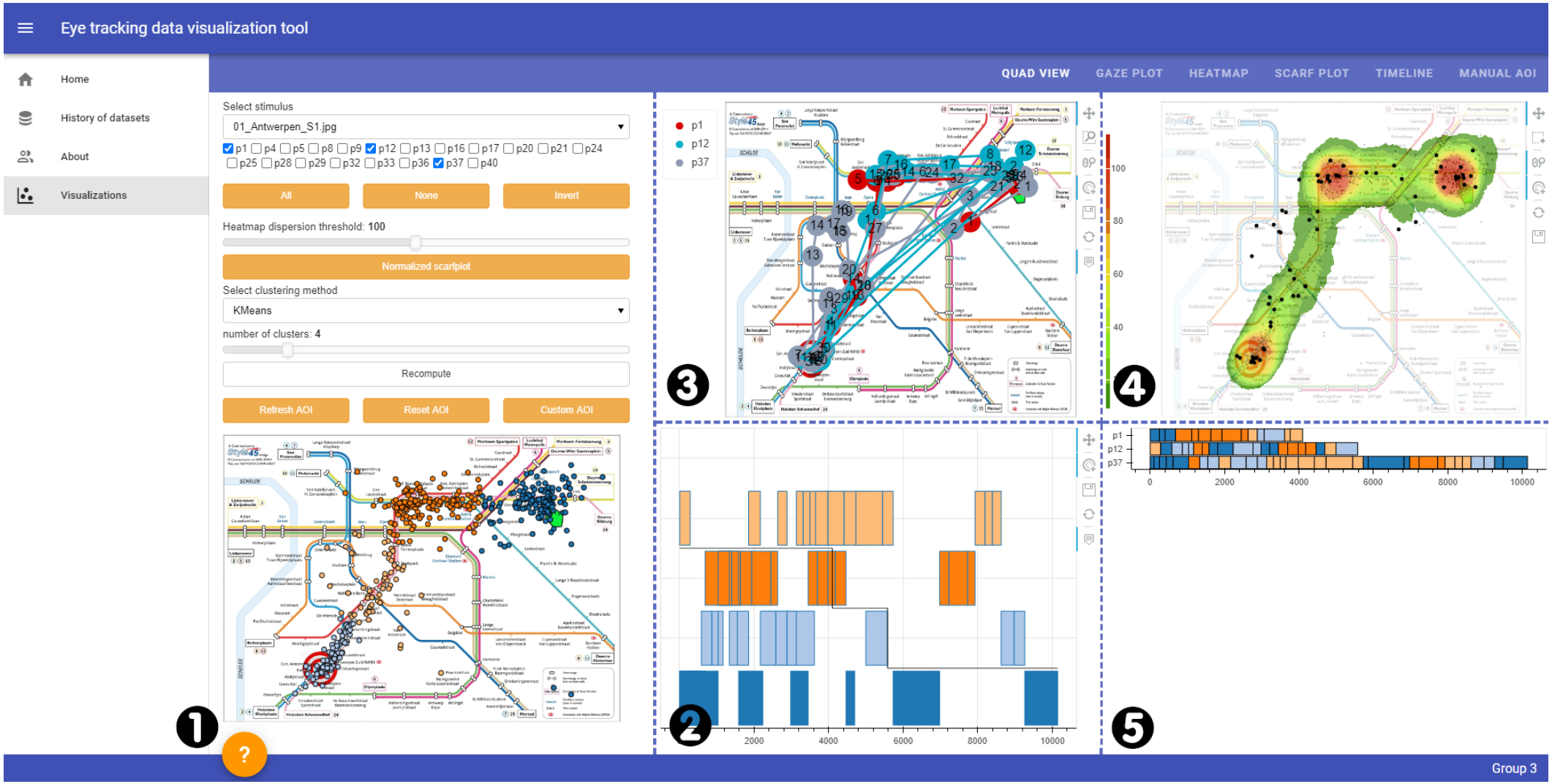
Heatmap Data

- Based on fixation points
- Grid with user-definable size
- Determining intensity value for each cell
- Scalar field can further be smoothed

Caching

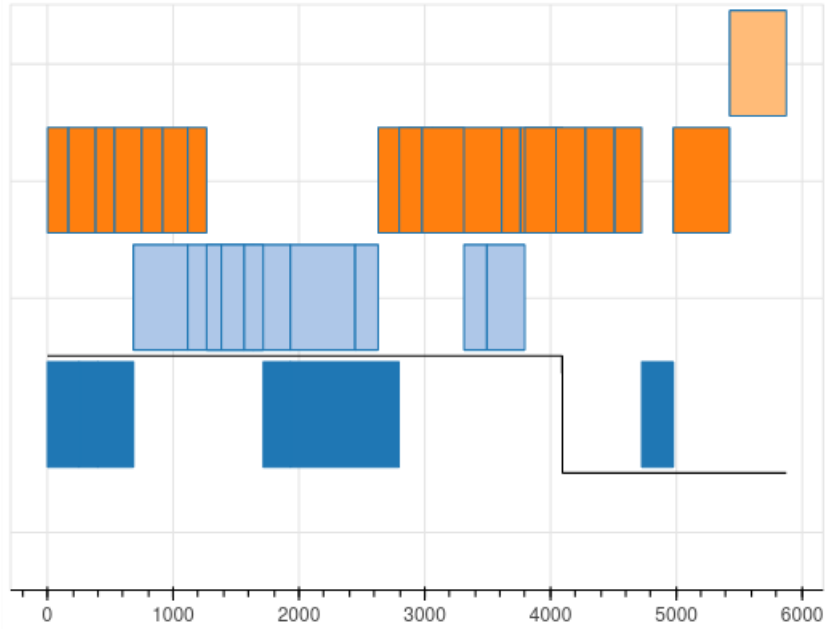
- All data processing and clustering cached
- To mitigate delays for user interactions
- To improve user experiences

GUI and Visualization Techniques



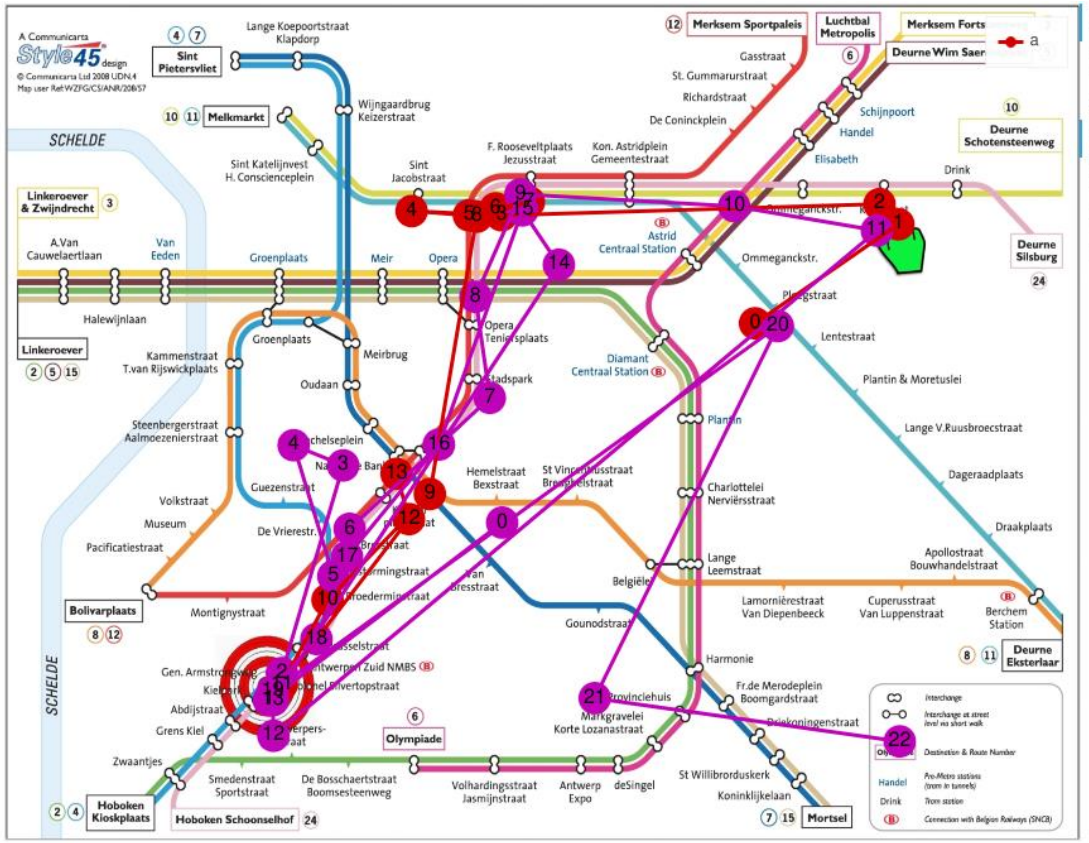
AOI Timeline

- Vertically, all selected AOIs are shown
- Each AOI has a representative horizontal line
  - Progress over time
  - Same color coding as for the AOI definitions
- Each rectangle shown with the horizontal extent
  - Fixation time for one or more participants



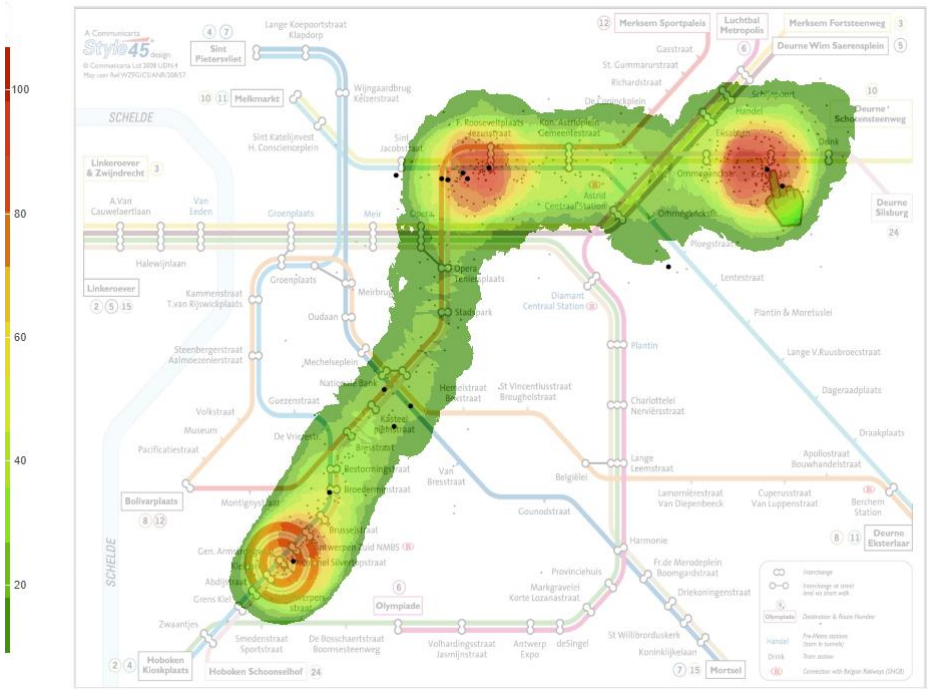
Gaze Plot

- Shows the scanpaths overdrawn on stimulus
  - Spatio-temporal visualization
  - Order of fixations
  - Fixation durations
  - Participants
- Problem: Visual clutter



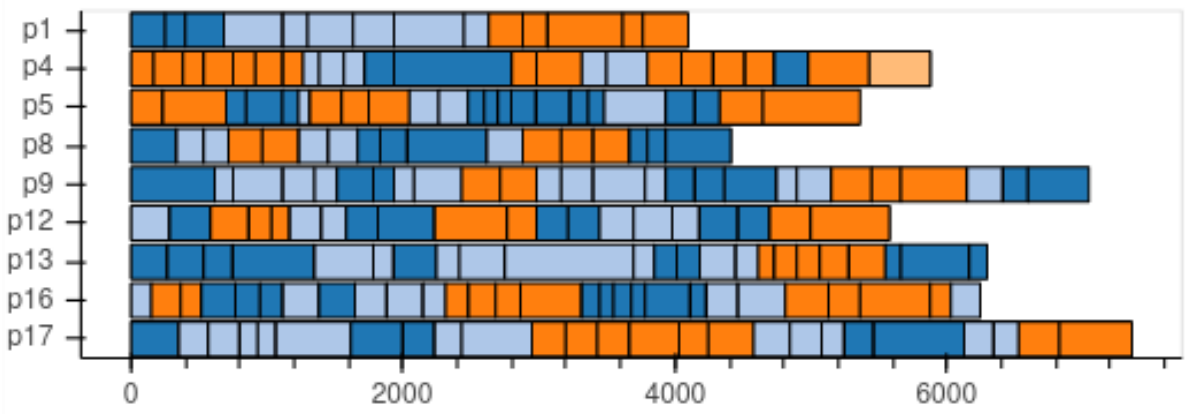
Heat Map

- Visual overview of attention hot spots
  - Aggregation over time and participants
  - Easy to read
  - Overlay on stimulus for context
- Problem: Time/participant information lost
  - Leads to misinterpretations



Scarf Plot

- Shows AOIs being gazed at over time
- Simplification of the data
- Temporal overview of the data
- Multiple participants at once
- Limitations
  - Number of displayable AOIs
  - No temporal pattern alignment



Interactions

- Tapping or mouse clicking functionality
- Selecting certain rectangular segments of interest
- Linking all views
- Saving as image with a legend embedded
- Zooming in and out
- Details-on-demand
- Filtering for space, time, participants
- …

Web Application Architecture

- Vue.js, combination of HTML, CSS, and JavaScript
  - Several modules such as Vuetify
- Front-end communicates with Flask back-end
  - Flask uses Python with Axios requests and URL parameters
  - Flask itself runs a Bokeh server
  - Rendering interactive visualizations in the web browser
- Content rendered on the server-side
  - Then sent directly to the client of the user
  - Little computation is done on the users' devices

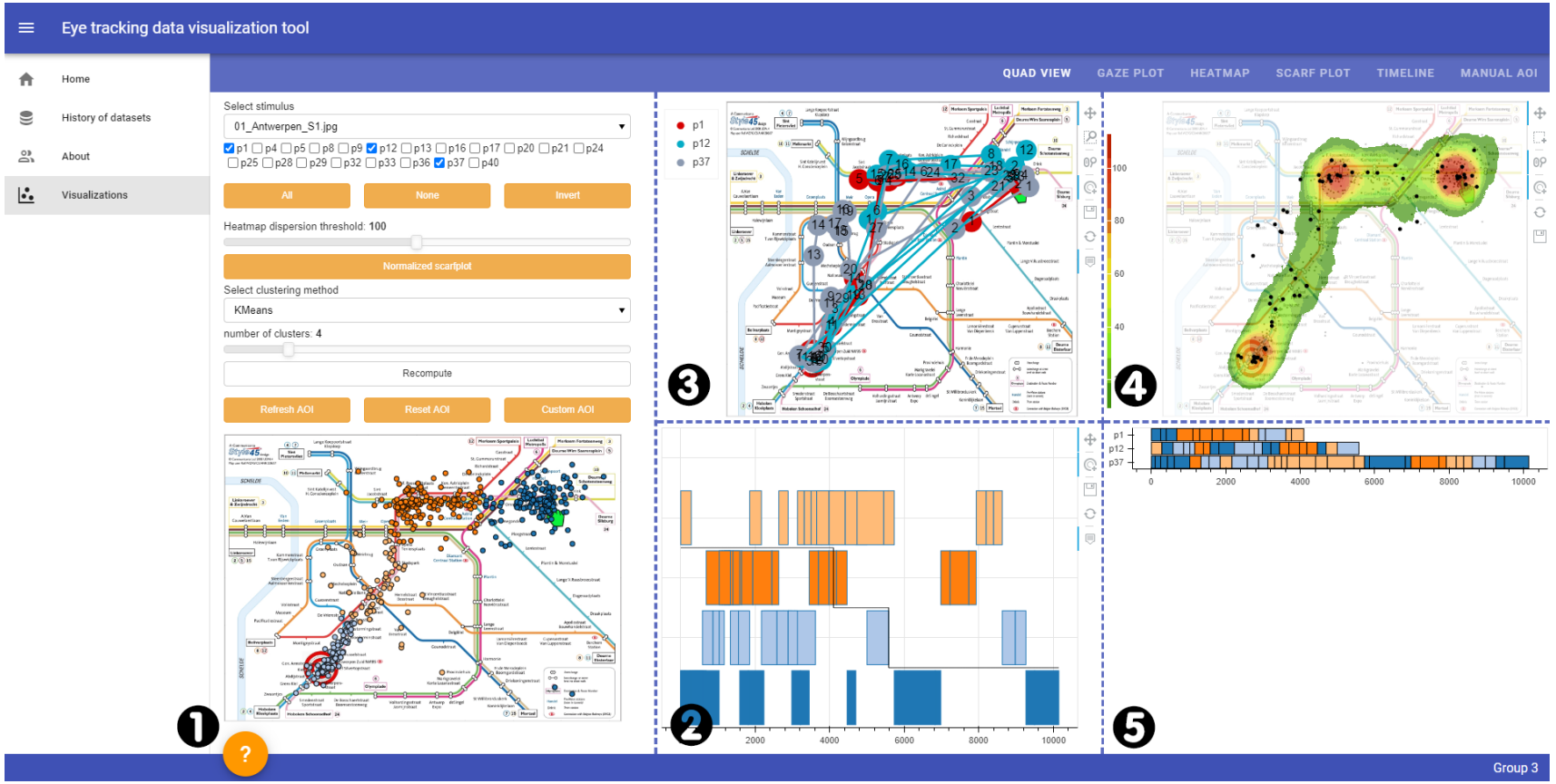
Conclusion

- Online tool to assist with the analysis of eye tracking data
- Different types of interactive visualizations
- Choosing clustering method
- Analyzing data in different ways

Future Work

- User study
  - Assessing simplicity, usability, and practicality of the tool
- Focus on performance for more responsive design
- Further linked visualizations
- Further interaction techniques

Questions?



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