Large-scale bicycle flow experiment: set-up and implementation

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HIGHLIGHTS

- We performed a controlled large-scale cycling experiment that captures high cyclist volumes as well as overtaking and yielding interactions
- We delineate the process to set it up; these steps can be used as a guide in future experimental data collections
- We describe the performance of the experiment
- We present the collected dataset and elaborate on its potential uses

BACKGROUND

Cycling research at the operational behavioral level is limited, primarily lacking insights into:

- bicycle flow dynamics for high demand situations when overtaking is allowed
- the effect of the infiltration rate of electric bicycles on the shape of the fundamental diagram
- overtaking decisions on a uni- or bi-directional cycle path
- yielding decisions when cycle paths cross or merge

This is mainly due to the lack of empirical data.

EXPERIMENT SET-UP

The following steps were followed:

1. Survey on influencing factors
2. Scenario design
3. Track design
4. Number of participants
5. Scheduling
6. Selecting location
7. Recruiting participants
8. Preparing equipment

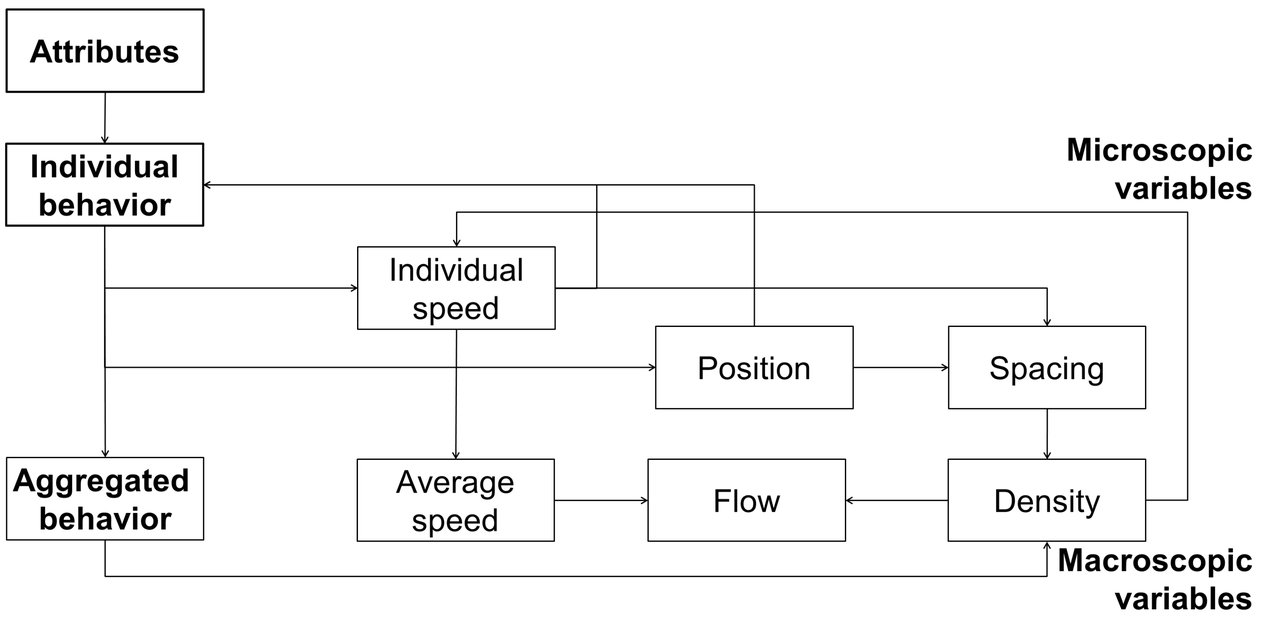

Figure 1: Conceptual model of operational cycling behavior.

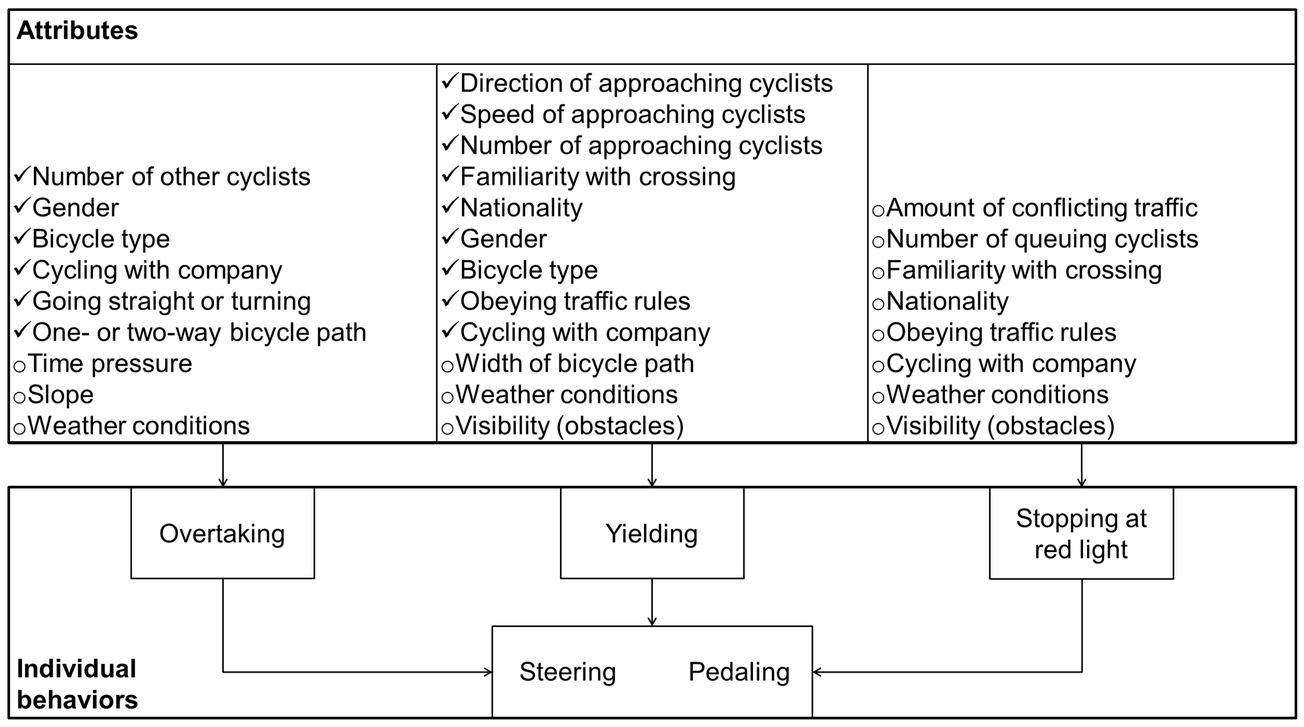

Figure 2: List of influential attributes per decision according to our survey results. The check marks indicate the attributes that can be studied with the dataset collected in our experiment.

Scenario	Regular	Electric	Racing	Width [cm]	Duration [min]	Break [min]
Overtaking	60%	20%	10%	125	7	1
Bottleneck	60%	20%	10%	125	5	5
Overtaking	86%	-	14%	-	7	5
Bottleneck	75%	25%	-	75	7	15
Overtaking	75%	25%	-	125	7	1
Bottleneck	75%	25%	-	125	5	5
Merging	60%	20%	10%	-	10	5
Bottleneck	86%	14%	-	75	7	15
Crossing	60%	20%	10%	-	10	5
Bottleneck	60%	20%	10%	75	7	5
Bottleneck	86%	14%	-	125	7	15
Merging	60%	20%	10%	-	10	-

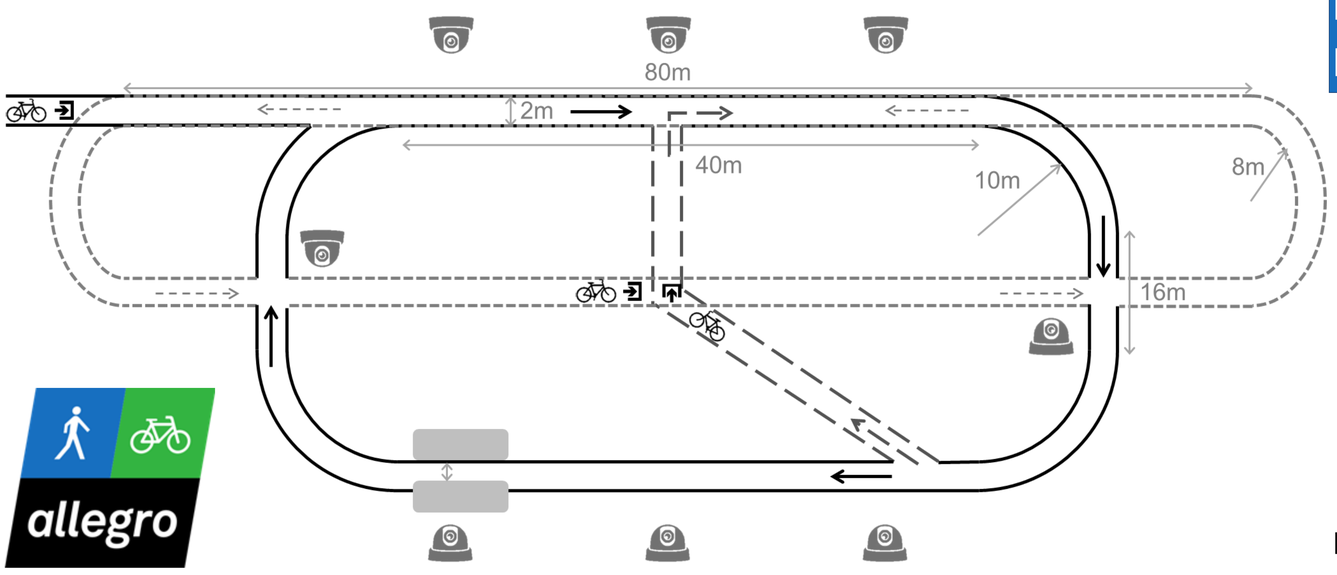

Figure 3: Track layout showing the elements activated for the different scenarios.

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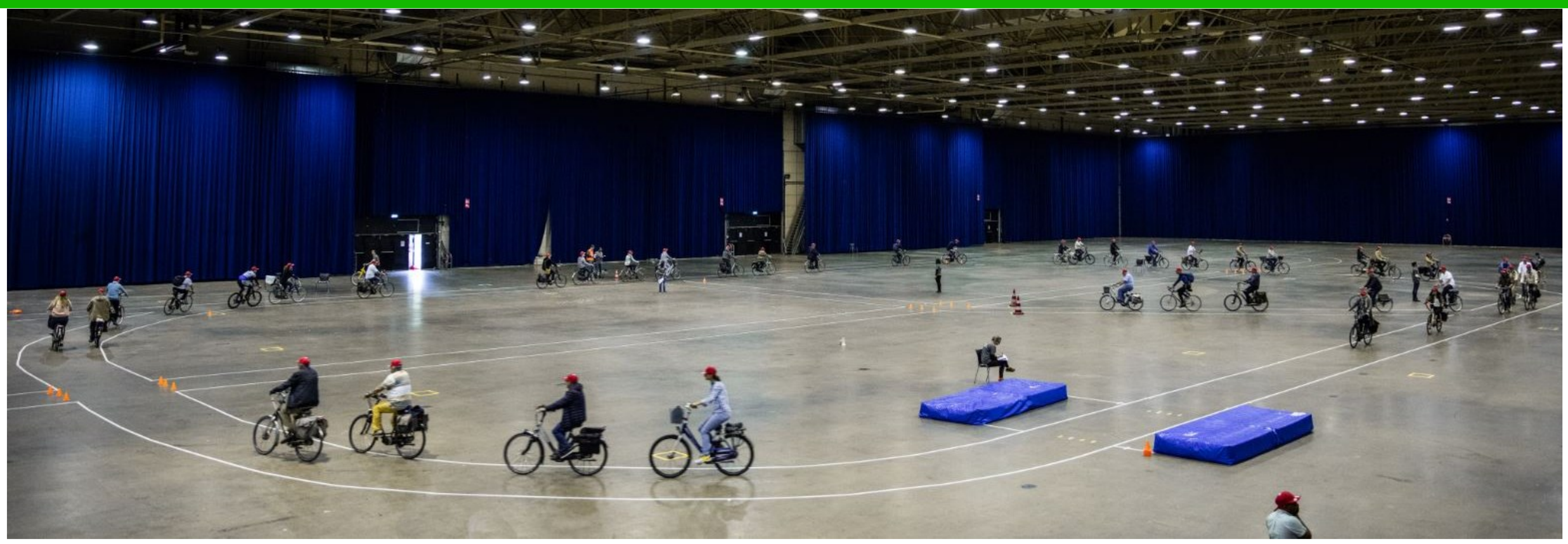

EXPERIMENT IMPLEMENTATION

- 1 hall in Ahoy Rotterdam, The Netherlands
- 1000 metres of tape
- 200 participants
- 100 red caps
- 8 tracking cameras placed over the track
- 6 hours of videos

Characteristic	Morning	Afternoon
Females	34	30
Males	54	60
Dutch	78	84
Other European	8	2
Non European	2	4
Minimum age	19	17
Average age	52	51
Maximum age	80	89
Standard deviation of age	19	19
Average height [cm]	174	177
Standard deviation of height	10	10
Average weight [kg]	79	77
Standard deviation of weight	15	13
Electric bicycles	31	3
Racing bicycles	8	0
Average bicycle length [cm]	180	180
Standard deviation of bicycle length	6	5
Average handlebar width [cm]	59	59
Standard deviation of handlebar width	6	4

OBSERVATIONS

- Anticipation plays a key role while cycling. Cyclists adjusted their speed in preparation for the curve and bottleneck, as they were in sight.
- In the merging scenario, cyclists self-organized by distributing themselves over the two routes.
- Pairs were formed on the track, which blocked overtaking.
- Speed differences could be better expressed in curves.
- Copying effect when indicating the intended direction.
- Personal characteristics seem to be dominant with respect to yielding decisions.

Figure 4: Top view at the merging location.

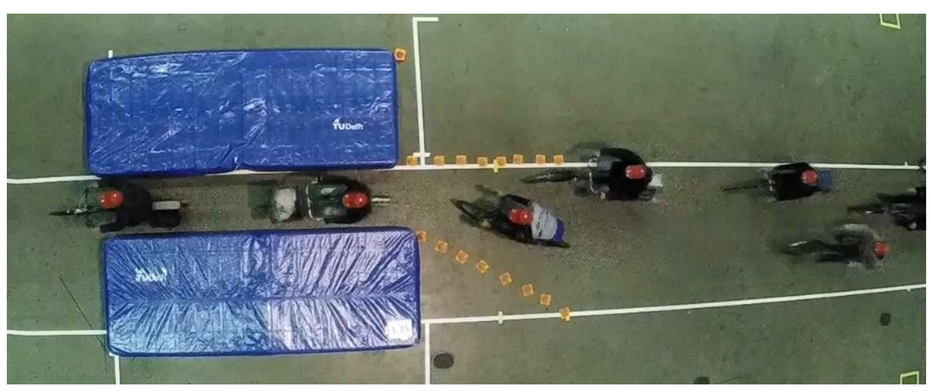

Figure 5: Top view at the bottleneck location.

NEXT STEPS

Process the video data

1. Automatically extract trajectories out of the videos.
2. Stitch trajectories between consecutive cameras.
3. Link extracted trajectories to a participant number.

Use this rich dataset to

1. Investigate behavior of different bicycle types and persons.
2. Find the attributes that best explain the decisions to overtake and yield.
3. Retrieve the characteristics of the fundamental diagram when overtaking is allowed.
4. Study the effect of bicycle type, and in particular electric bicycles, to the overall flow dynamics.
5. Calibrate and validate theoretically derived models.