Crowding and Queuing in Entrance Scenarios

Influence of Corridor Width in Front of Bottlenecks

23.08.2018

| J. Adrian[1], M. Boltes[1], S. Holl[1], A. Sieben[2], A. Seyfried[1,3]

| [1]Forschungszentrum Jülich, [2]Ruhr-University Bochum, [3]University of Wuppertal

RUB

BERGISCHE UNIVERSITÄT WUPPERTAL

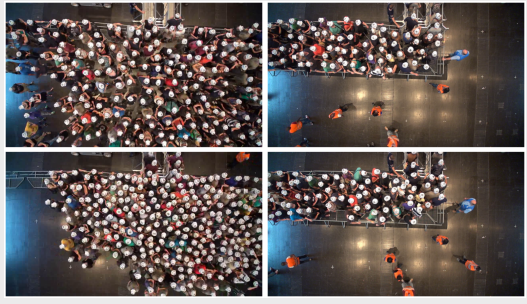
JÜLICH Forschungszentrum

Introduction

Previous Study

- Different spatial barrier structures in front of bottleneck

→ Question:
critical corridor width limiting queuing and stimulating pushing?



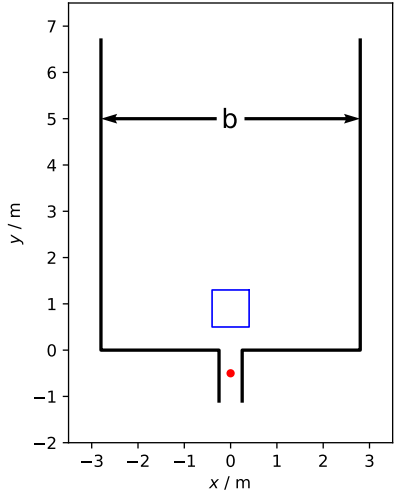
Source: A. Sieben, J. Schumann, A. Seyfried, Collective phenomena in crowds - Where pedestrian dynamics need social psychology, PLoS ONE 12(6): e0177328 (2017).

New Study

Investigation: influence of the corridor width on

- density and waiting time
- queuing or pushing

Bottleneck Experiments



- Experiments at the University in Wuppertal
- ***b***: Corridor width, 1.2 m to 5.6 m
- ***N***: number of participants, students
- ***h***: motivation, high and low

b	1.2 m	2.3 m	3.4 m	4.5 m	5.6 m
N	11, 24, 25, 63	20, 42	22, 67	42, 42	57, 75
h	hi, lo	hi, lo	hi, lo	hi, lo	hi, lo

JÜLICH Forschungszentrum

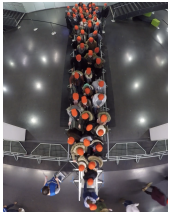
Bottleneck Experiments

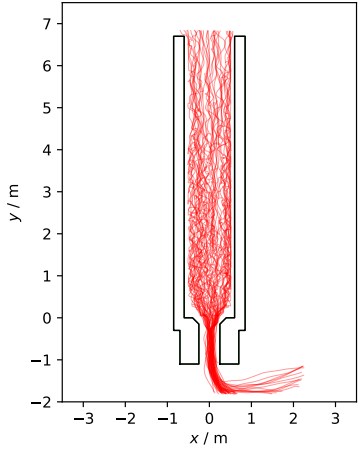
b = 1.2 m
N = 63
h = high

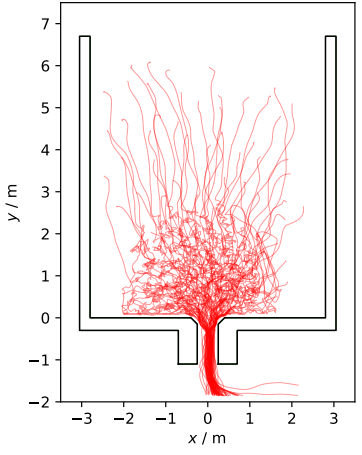
b = 5.6 m
N = 75
h = high

Play/Pause

Bottleneck Experiments







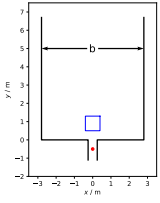
JÜLICH Forschungszentrum

Results: Voronoi Density

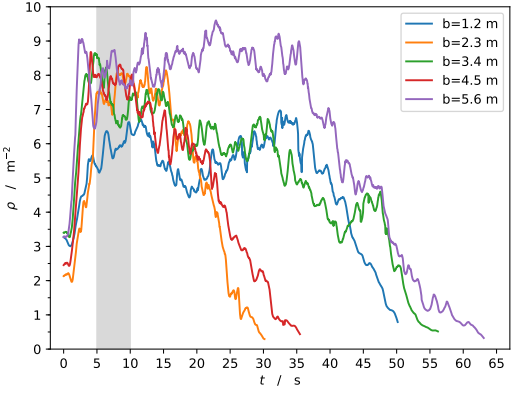
Play/Pause

Density Time-Series

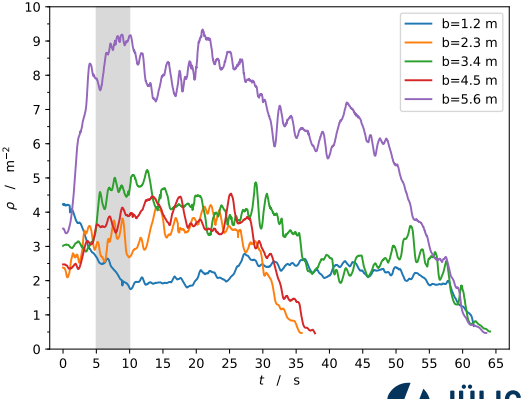
Mean density within the measurement area



high motivation

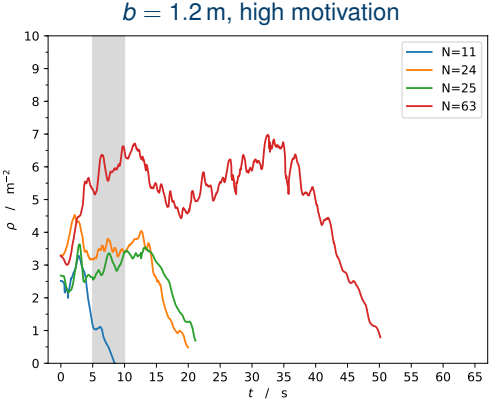


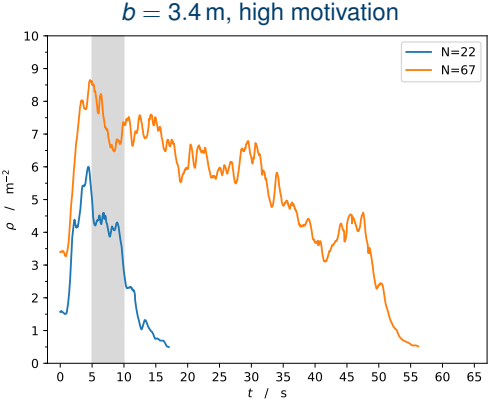
low motivation



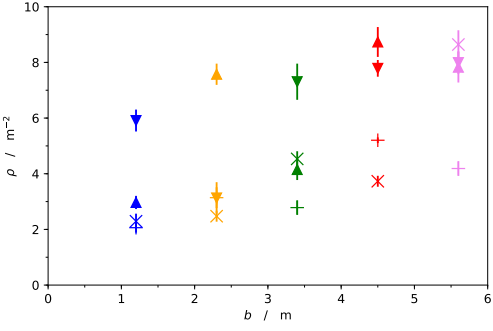
JÜLICH Forschungszentrum

Density Time-Series



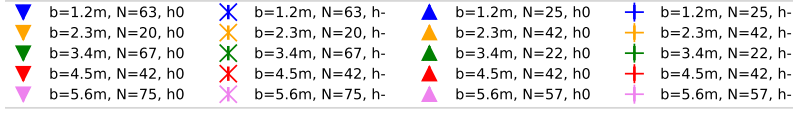


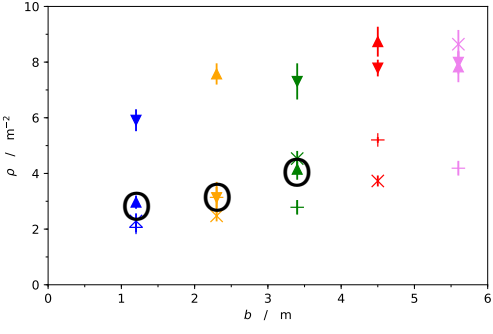
Corridor Width and Number of Participants



JÜLICH Forschungszentrum

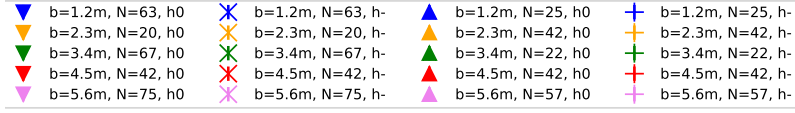
Corridor Width and Number of Participants

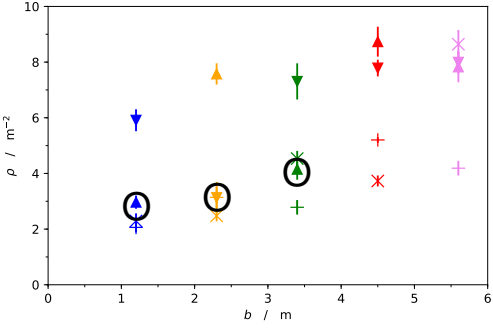


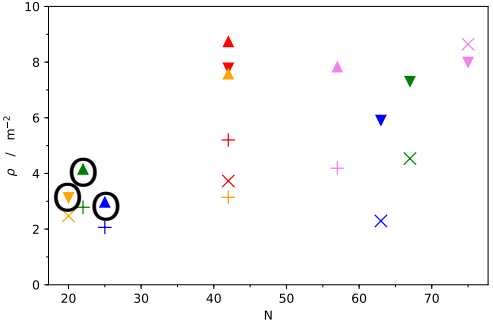


JÜLICH Forschungszentrum

Corridor Width and Number of Participants







JÜLICH Forschungszentrum

Summary and Conclusion

- Transition between queuing and pushing behavior
- High density ...
  - indicates pushing behavior
  - reduces the participant's well-being
- Mean density increases ...
  - with increasing corridor width
  - with increasing motivation
- Number of participants also influences the density

Summary and Conclusion

- Transition between queuing and pushing behavior
- High density ...
  - indicates pushing behavior
  - reduces the participant's well-being
- Mean density increases ...
  - with increasing corridor width
  - with increasing motivation
- Number of participants also influences the density

Future Studies

- Investigate more intermediate steps of corridor width
- Use the number of participants as controlled parameter
- More repetitions for each corridor width

Acknowledgments

We would like to thank

- all students of the University of Wuppertal who participated in the experiments
- our partners and all volunteers of

RUB

Ruhr-University Bochum
Chair of Social Theory and Social Psychology

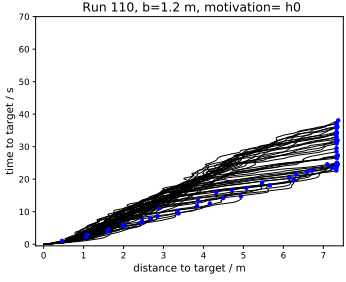
BERGISCHE UNIVERSITÄT WUPPERTAL

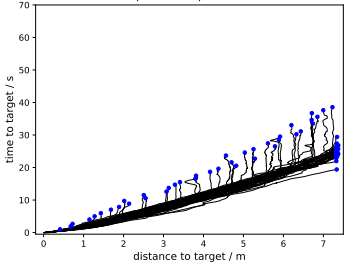
University of Wuppertal
School of Architecture and Civil engineering

JÜLICH Forschungszentrum

Forschungszentrum Jülich
Institute of Advanced Simulation,
IAS-7: Civil Safety Research

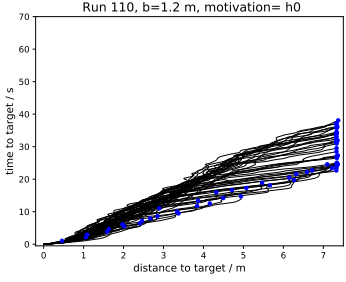
Waiting Time and Distance to Target

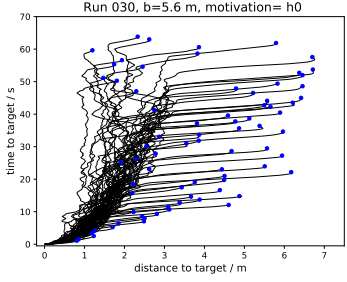


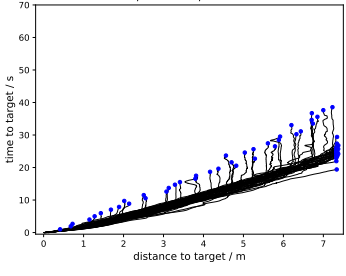


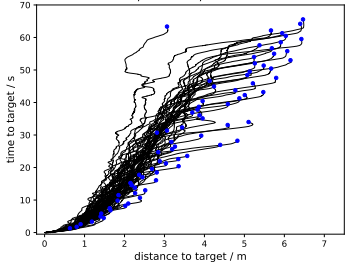
JÜLICH Forschungszentrum

Waiting Time and Distance to Target







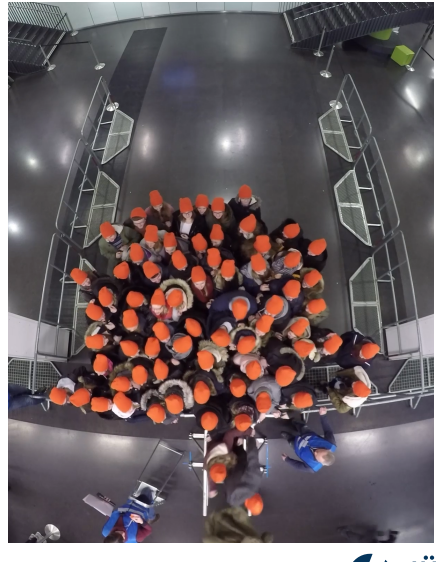


JÜLICH Forschungszentrum

Bottleneck Experiments

$b = 1.2\,\mathrm{m}$, $N = 63$, high motivation

$b = 5.6\,\mathrm{m}$, $N = 67$, high motivation



Voronoi Density