



Crowding and Queuing in Entrance Scenarios

Influence of Corridor Width in Front of Bottlenecks

23.08.2018

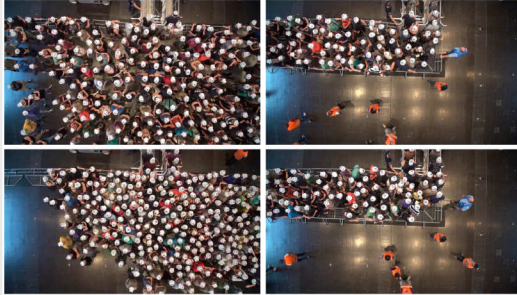
| J. Adrian¹, M. Boltes¹, S. Holl¹, A. Sieben², A. Seyfried^{1,3}

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

Introduction

Previous Study

- Different spatial barrier structures in front of bottleneck
- **Question:** critical corridor width limiting queuing and stimulating pushing?



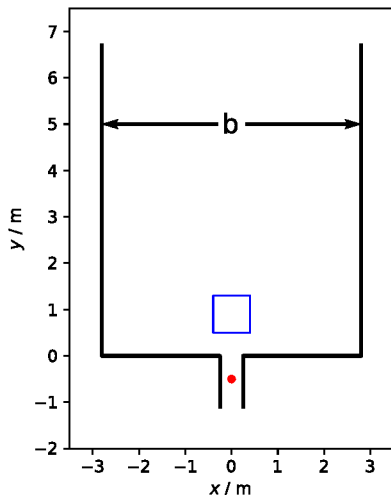
Source: A. Sieben, J. Schumann, A. Seyfried, Collective phenomena in crowds - Where pedestrian dynamics need social psychology, PLoS ONE 12(6): e0177328 (2017).

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

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

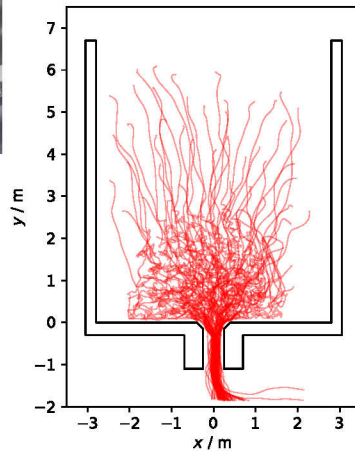
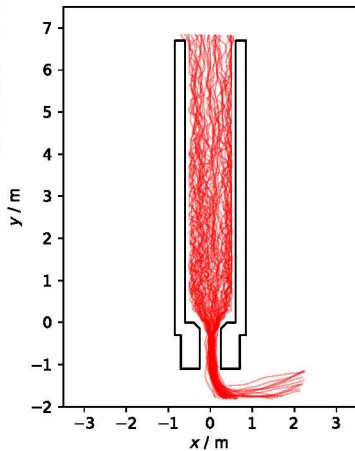
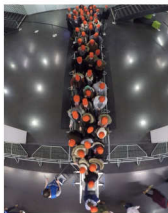
Bottleneck Experiments

$b = 1.2 \text{ m}$
 $N = 63$
 $h = \text{high}$

$b = 5.6 \text{ m}$
 $N = 75$
 $h = \text{high}$



Bottleneck Experiments

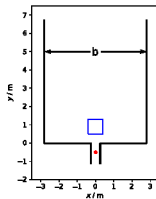


Results: Voronoi Density

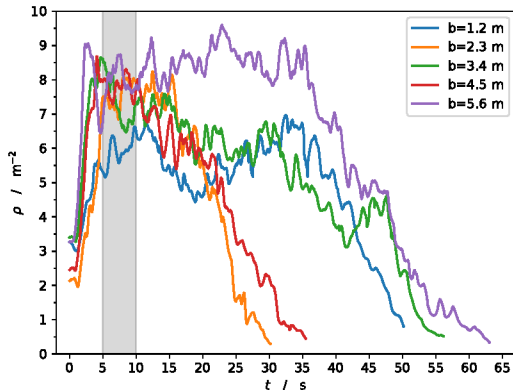


Density Time-Series

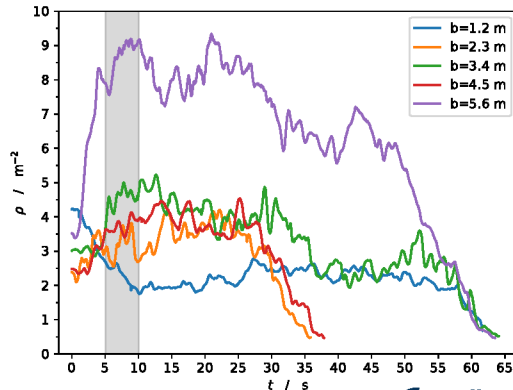
Mean density within the measurement area



high motivation

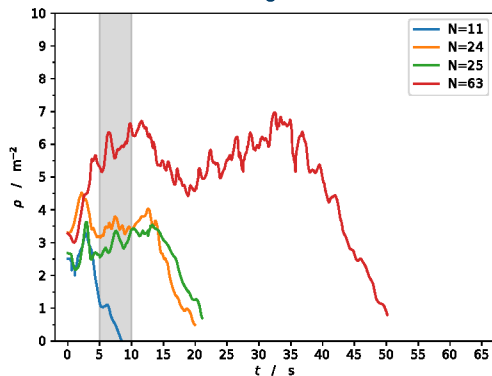


low motivation

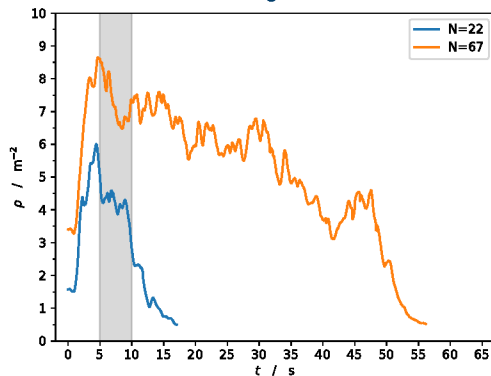


Density Time-Series

$b = 1.2$ m, high motivation

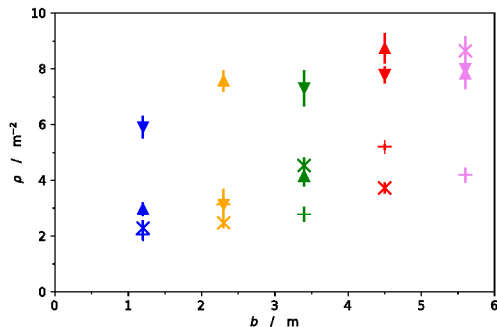


$b = 3.4$ m, high motivation



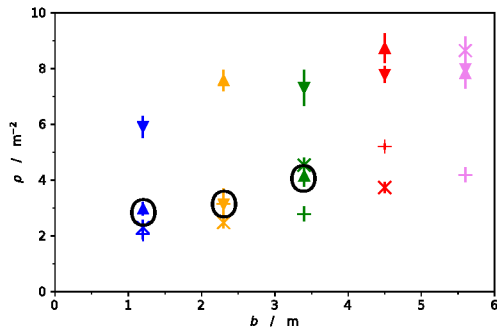
Corridor Width and Number of Participants

▼ b=1.2m, N=63, h0	✕ b=1.2m, N=63, h-	▲ b=1.2m, N=25, h0	+ b=1.2m, N=25, h-
▼ b=2.3m, N=20, h0	✕ b=2.3m, N=20, h-	▲ b=2.3m, N=42, h0	+ b=2.3m, N=42, h-
▼ b=3.4m, N=67, h0	✕ b=3.4m, N=67, h-	▲ b=3.4m, N=22, h0	+ b=3.4m, N=22, h-
▼ b=4.5m, N=42, h0	✕ b=4.5m, N=42, h-	▲ b=4.5m, N=42, h0	+ b=4.5m, N=42, h-
▼ b=5.6m, N=75, h0	✕ b=5.6m, N=75, h-	▲ b=5.6m, N=57, h0	+ b=5.6m, N=57, h-



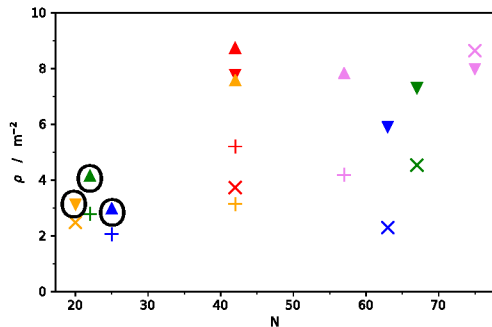
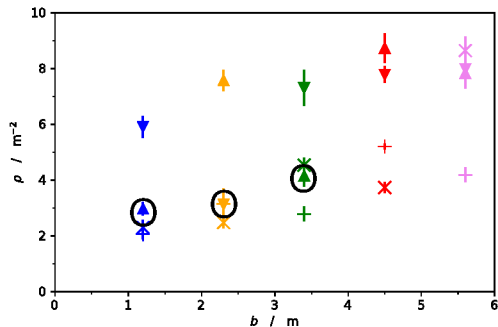
Corridor Width and Number of Participants

▼ b=1.2m, N=63, h0	✕ b=1.2m, N=63, h-	▲ b=1.2m, N=25, h0	✚ b=1.2m, N=25, h-
▼ b=2.3m, N=20, h0	✕ b=2.3m, N=20, h-	▲ b=2.3m, N=42, h0	✚ b=2.3m, N=42, h-
▼ b=3.4m, N=67, h0	✕ b=3.4m, N=67, h-	▲ b=3.4m, N=22, h0	✚ b=3.4m, N=22, h-
▼ b=4.5m, N=42, h0	✕ b=4.5m, N=42, h-	▲ b=4.5m, N=42, h0	✚ b=4.5m, N=42, h-
▼ b=5.6m, N=75, h0	✕ b=5.6m, N=75, h-	▲ b=5.6m, N=57, h0	✚ b=5.6m, N=57, h-



Corridor Width and Number of Participants

▼ b=1.2m, N=63, h0	✕ b=1.2m, N=63, h-	▲ b=1.2m, N=25, h0	✚ b=1.2m, N=25, h-
▼ b=2.3m, N=20, h0	✕ b=2.3m, N=20, h-	▲ b=2.3m, N=42, h0	✚ b=2.3m, N=42, h-
▼ b=3.4m, N=67, h0	✕ b=3.4m, N=67, h-	▲ b=3.4m, N=22, h0	✚ b=3.4m, N=22, h-
▼ b=4.5m, N=42, h0	✕ b=4.5m, N=42, h-	▲ b=4.5m, N=42, h0	✚ b=4.5m, N=42, h-
▼ b=5.6m, N=75, h0	✕ b=5.6m, N=75, h-	▲ b=5.6m, N=57, h0	✚ b=5.6m, N=57, h-



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



Ruhr-University Bochum
Chair of Social Theory and Social Psychology



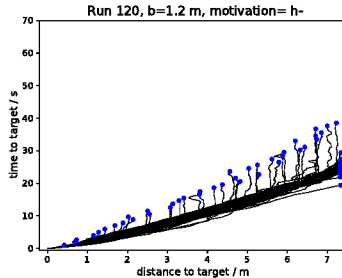
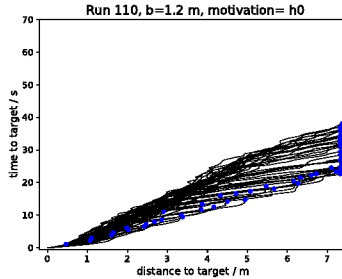
BERGISCHE
UNIVERSITÄT
WUPPERTAL

University of Wuppertal
School of Architecture and Civil engineering

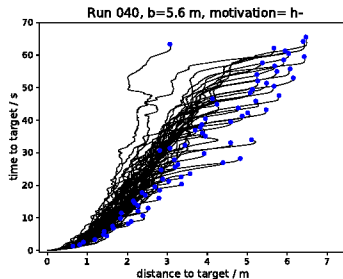
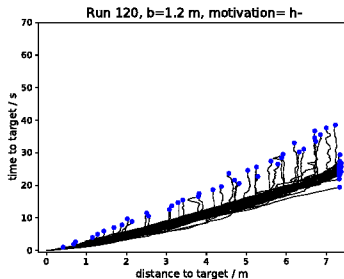
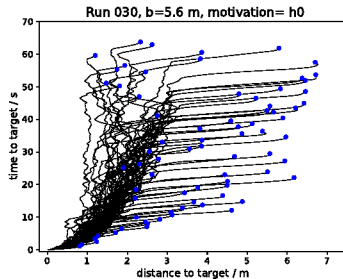
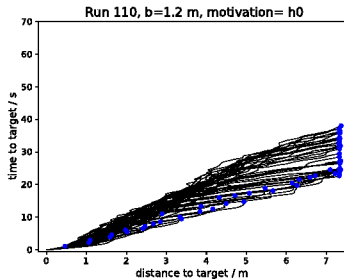


Forschungszentrum Jülich
Institute of Advanced Simulation,
IAS-7: Civil Safety Research

Waiting Time and Distance to Target



Waiting Time and Distance to Target



Bottleneck Experiments

$b = 1.2$ m, $N = 63$, high motivation



$b = 5.6$ m, $N = 67$, high motivation



Voronoi Density

