

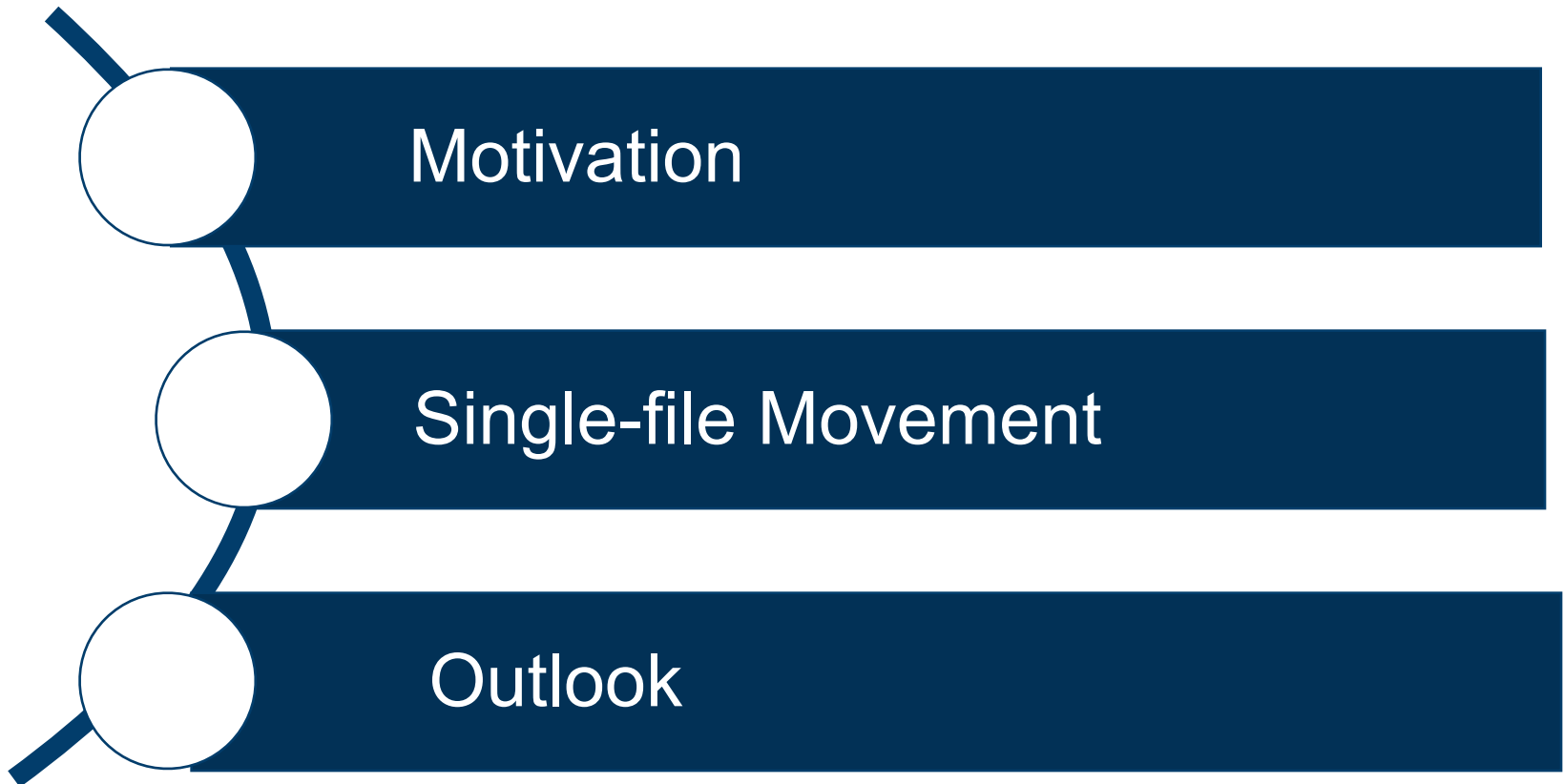


GENDER AND CULTURAL INFLUENCES ON THE FUNDAMENTAL DIAGRAM

31.10.2021 | MOHCINE CHRAIBI

Institute for Advanced Simulation - Civil Safety Research

CONTENT



Motivation

Single-file Movement

Outlook

UNI-DIRECTIONAL FLOW

Restricted movement leads often to dangerous situations



Kobe - Japan



The Great Wall



Duisburg - Germany

MOUNT MERON CROWD CRUSH

100.000 people, 45 dead, 150 injured (30 April 2021)



CNN Mapcreator.io, © OSM.org
Graphic: Natalie Leung, CNN



UNI-DIRECTIONAL FLOW

Quantitative description of the dynamics is essential!

Aims

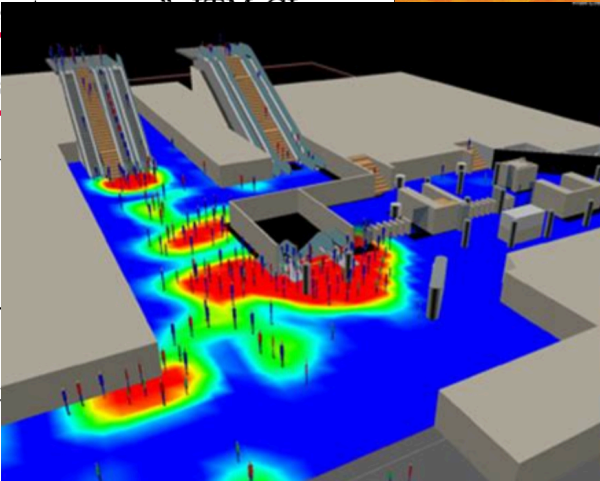
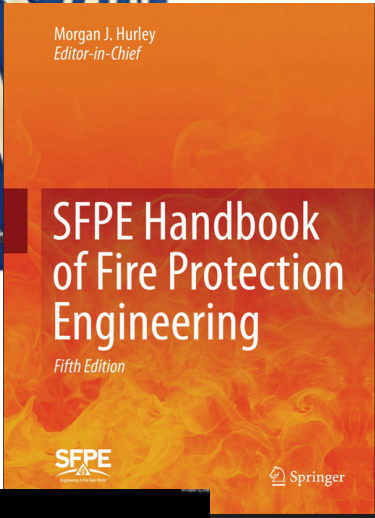
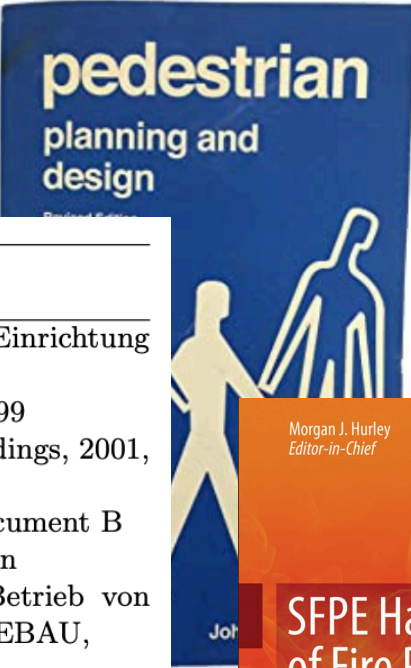
- Design of escape routes (stadiums, theatre, schools, ...)
- Assessment of pedestrians facilities for big events
- Transport infrastructures (stations, airports, trains, ...)
- Understanding of crowd's laws

Tools and methods

- Legal regulations
- Guidelines and handbooks
- Computer simulations

Country	Country code	Source, data
Austria	Aut	Gesetz betreffend Lage, Beschaffenheit, Einrichtung und Betrieb von Veranstaltungsstätten (Wiener Veranstaltungsstättengesetz), 1999
China	Chn	Code for life protection design of tall buildings, 2001, revised edition
England, Wales	GB	Building Regulations 2000, Approved Document B
France	Fra	Code de la Construction et de l'Habitation
Germany	Deu	Musterverordnung über den Bau und Betrieb von Versammlungsstätten (MVStättV), ARGEBAU, 06-2005
Italy	Ita	Approvazione della regola tecnica di prevenzione incendi per la progettazione, costruzione ed esercizio dei locali di intrattenimento e di pubblico spettacolo, Decreto Ministeriale, 19.08.1996
Luxembourg	Lux	Predcriptions de sécurité incendie Dispositions Generales "Bâtiments", 2001
		501.1 Dispositions Spécifiques "Salles de spectacle", 2001
		CL 554.1
Sweden	Swe	Regelsamling för byggande (BBR). Code number: BFS 1993:57 2006:22. 01.07.2006
Switzerland	CH	Brandschutzrichtlinie Flucht- und Rettungswege (VKE), AEAI, 26.03.2003
USA	USA	NFPA 101 Life Safety Code, 1999

Verifiable empirical data are needed



EXPERIMENTS OVER 4 DAYS (8-11 OCT. 2021)

Waiting behaviour on platforms



EXPERIMENTS OVER 4 DAYS (8-11 OCT. 2021)

Boarding and Alighting Passengers Behaviour



EXPERIMENTS OVER 4 DAYS (8-11 OCT. 2021)

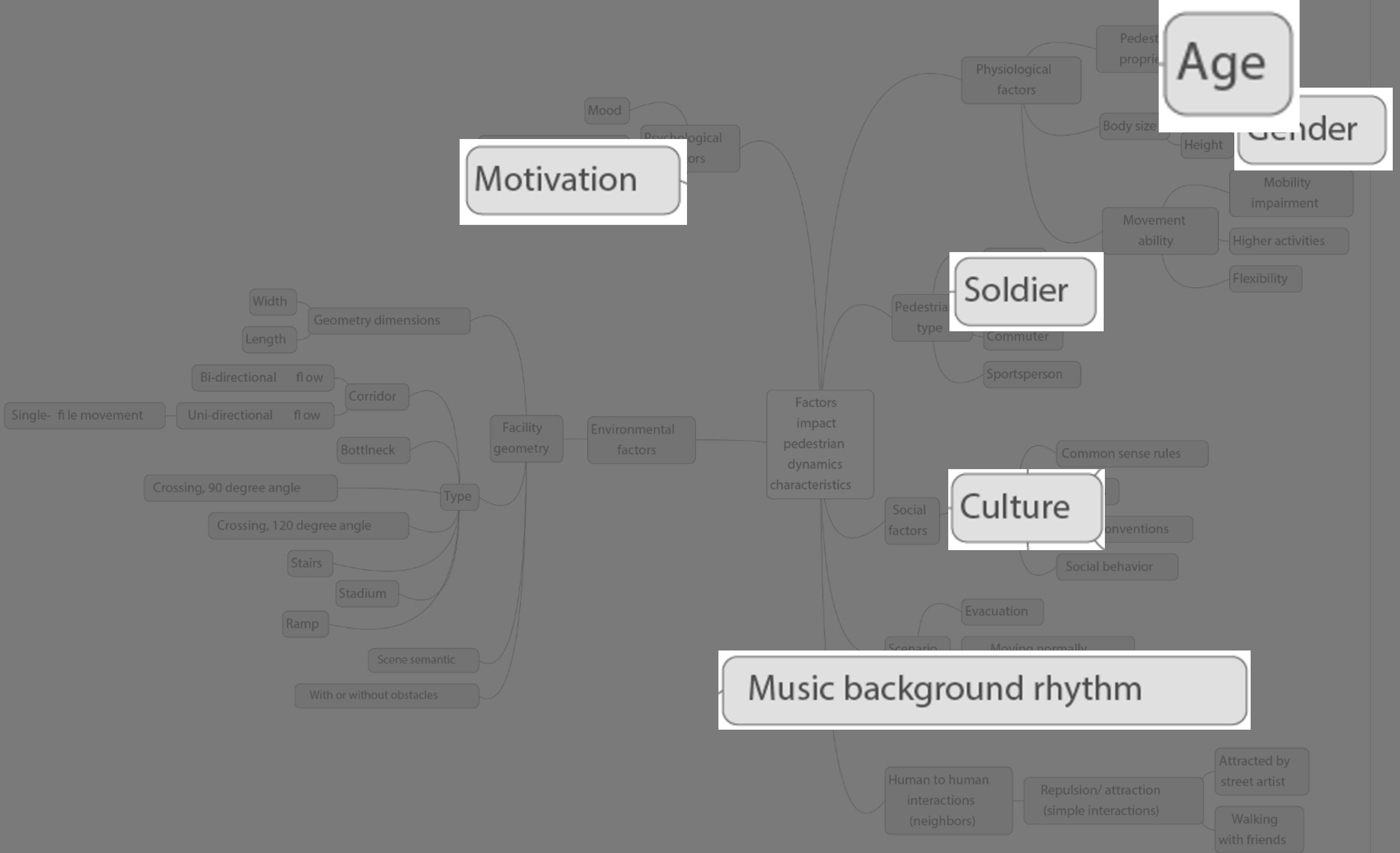
Queueing behaviour



QUALITATIVE OBSERVATIONS

No quantitative analysis yet (any kind of cooperation is welcome!) 

- Motivation of people was very high (almost too dangerous!)
Influence of 2 long lockdowns?
- Some strategies from the literature were observed (more next slides ...)
- Frequent clogging in bottlenecks
- Variation and explicit manipulation of crowd's mood (e.g. annoying people!)
- Measurement of skin and heart signals (—> stress) show that people
do not necessarily feel uncomfortable in high dense situations



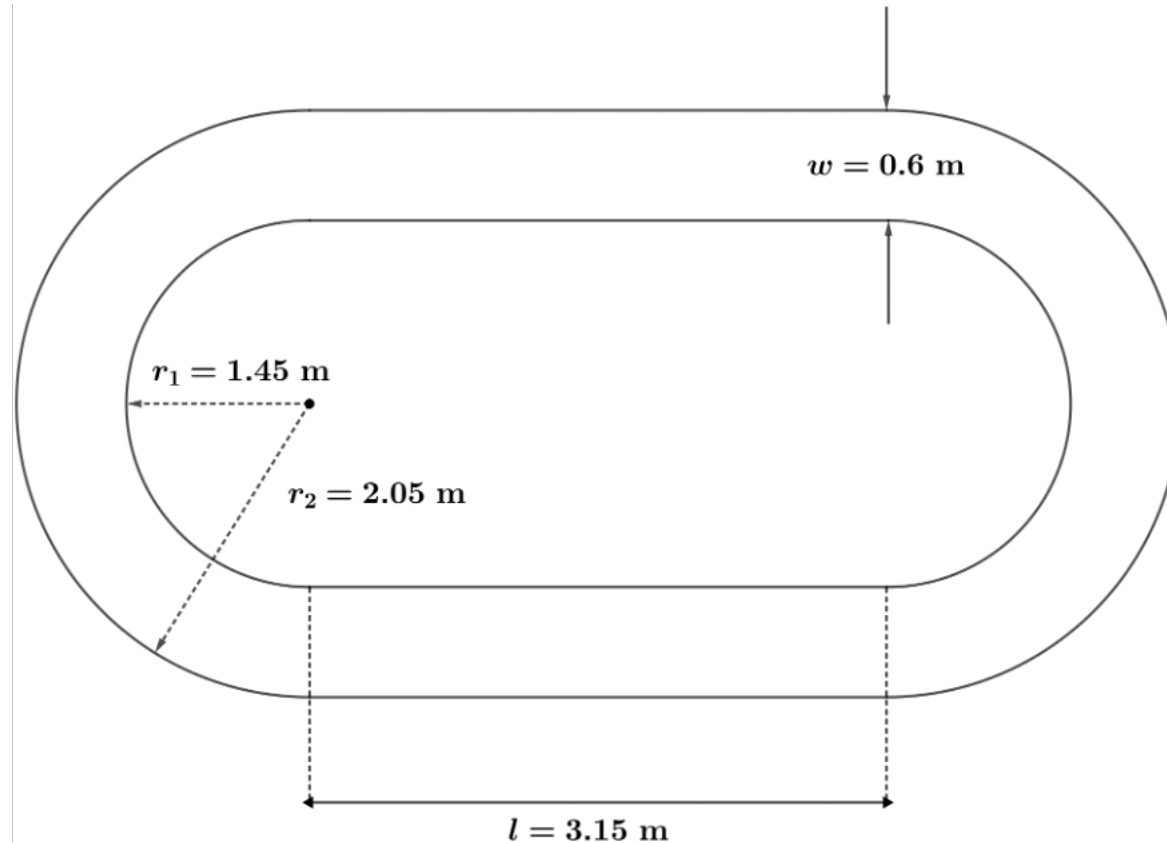
SINGLE-FILE MOVEMENT OF CROWD

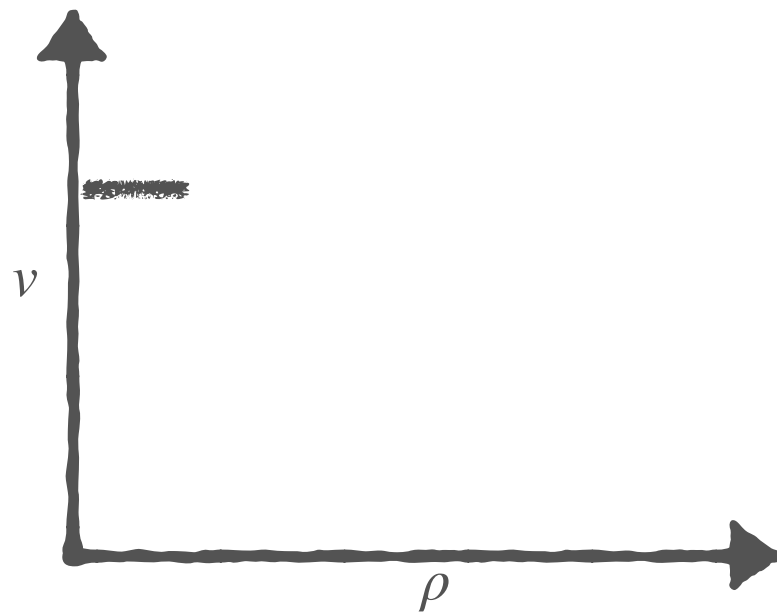
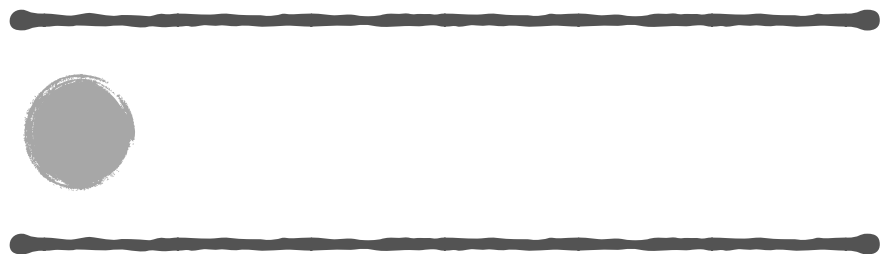
what we know so far

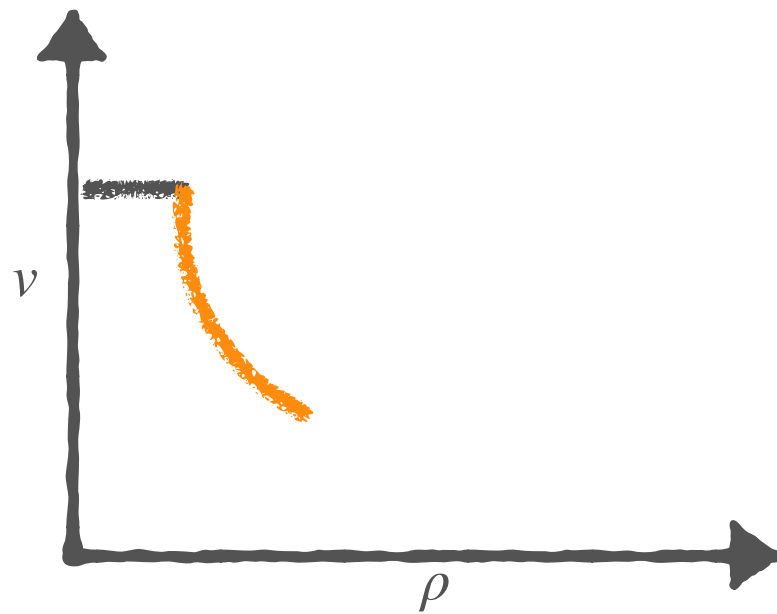
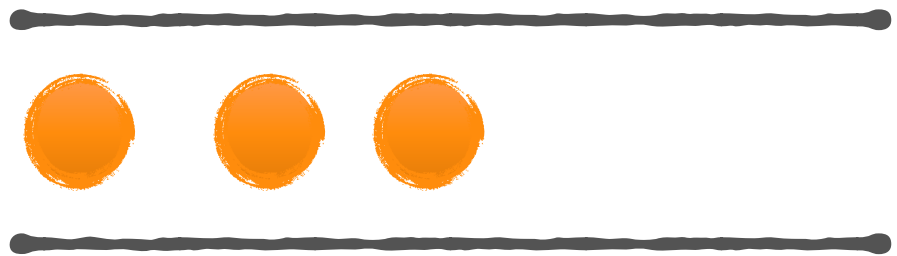
LANE MOVEMENT (1D)

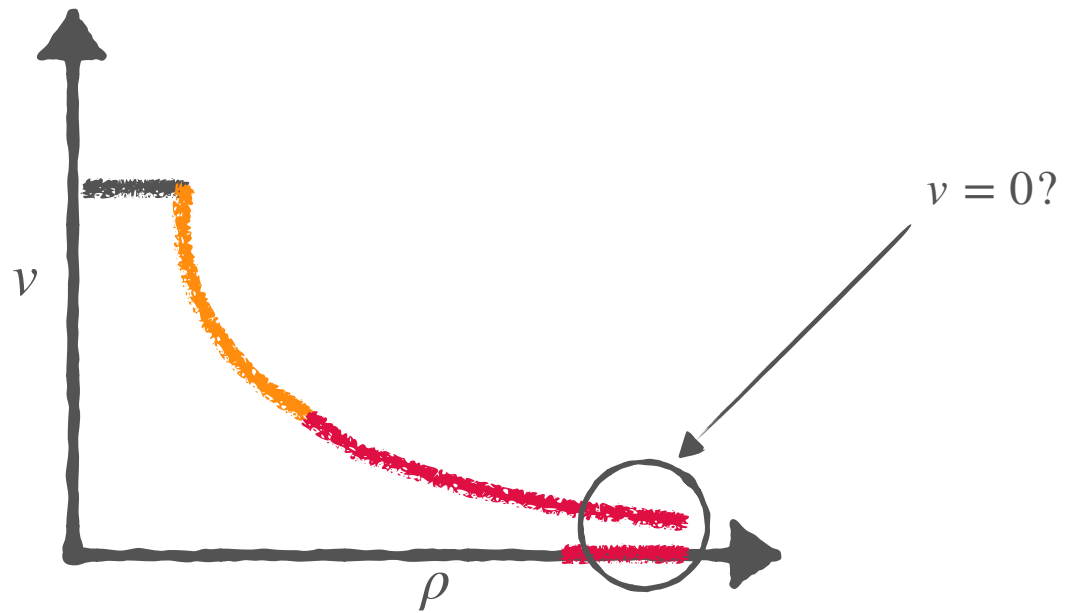
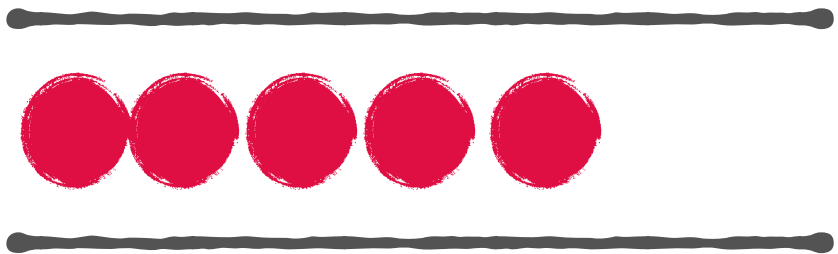
Simple but rich experimental setup (probably the most popular experiment)

- Eliminate noise
- Reduce complexity
- Better control



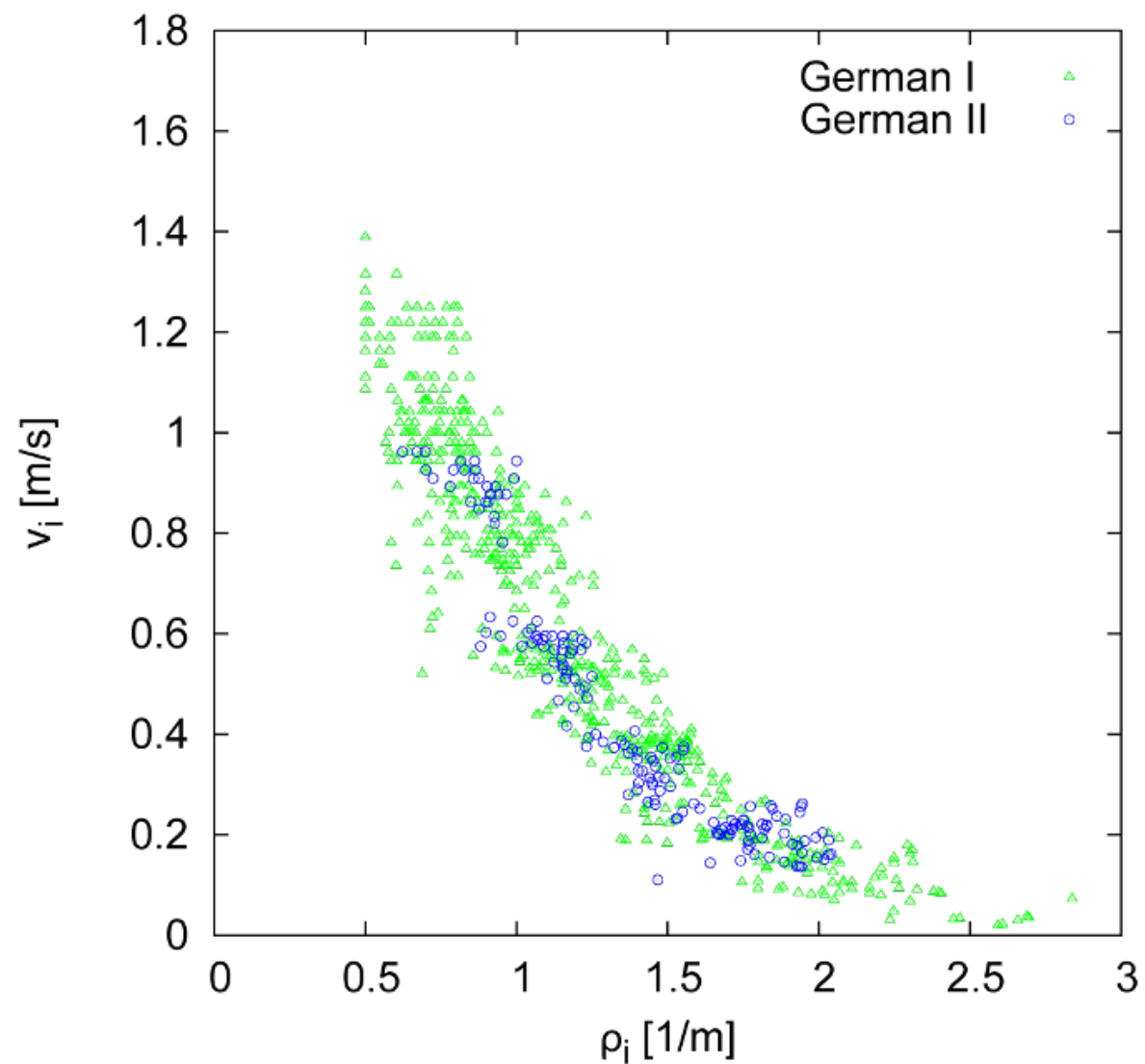
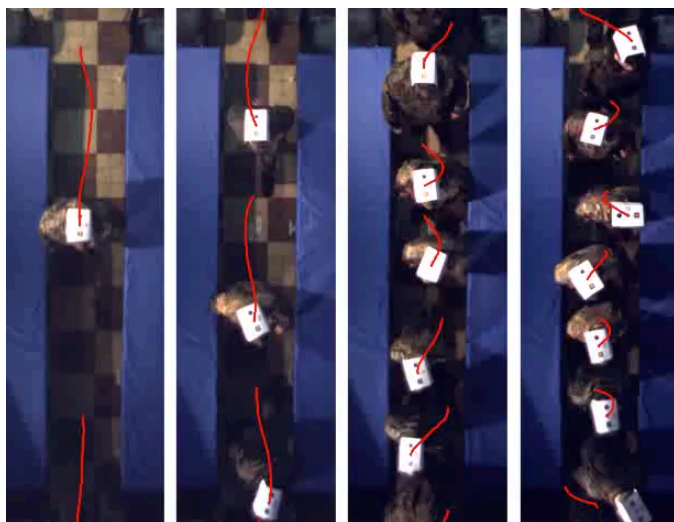
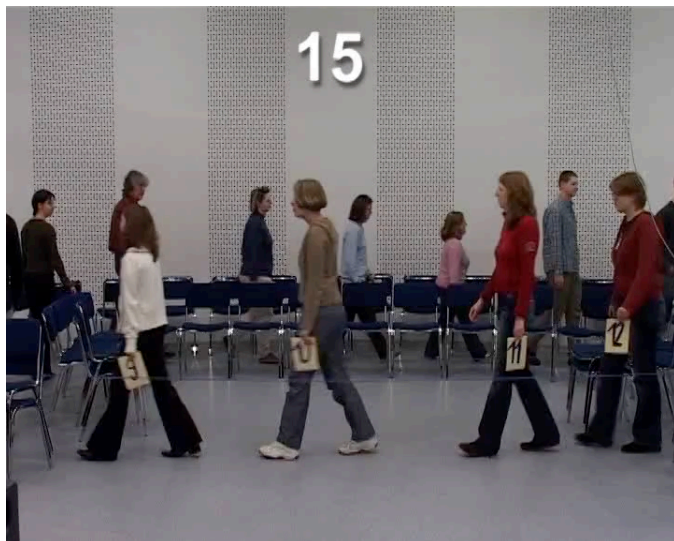






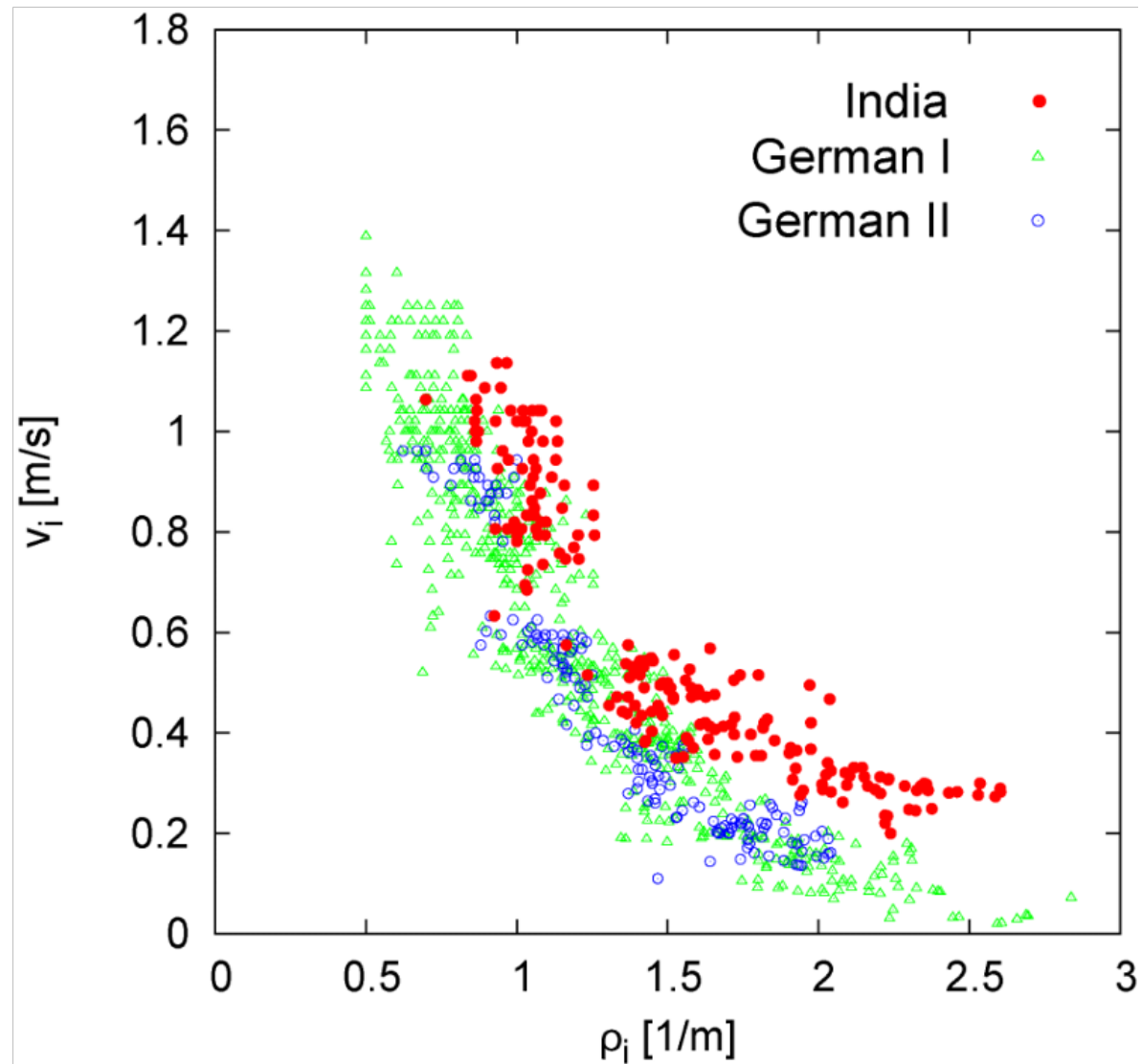
GERMANY

Composition



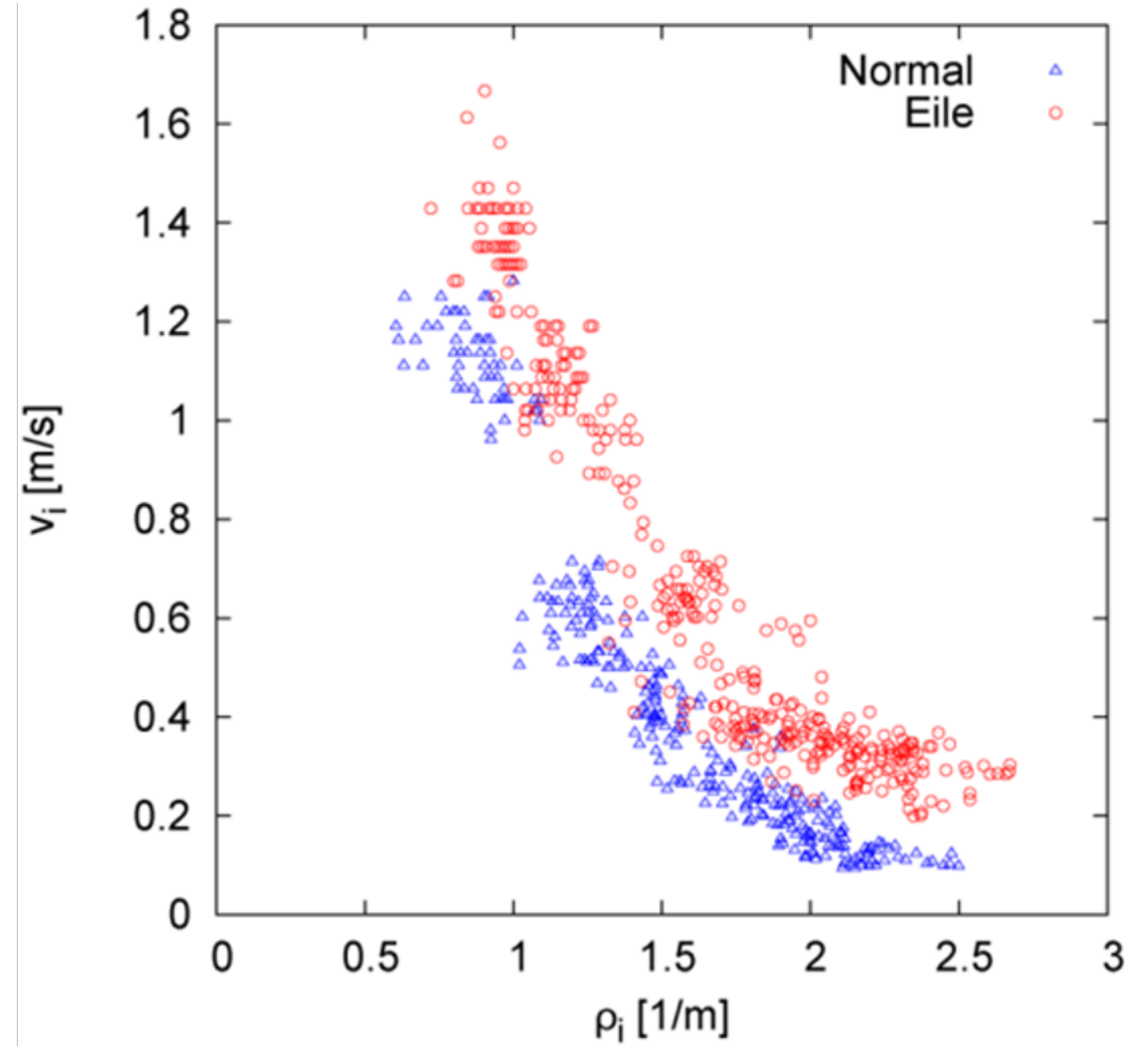
INDIA

Culture



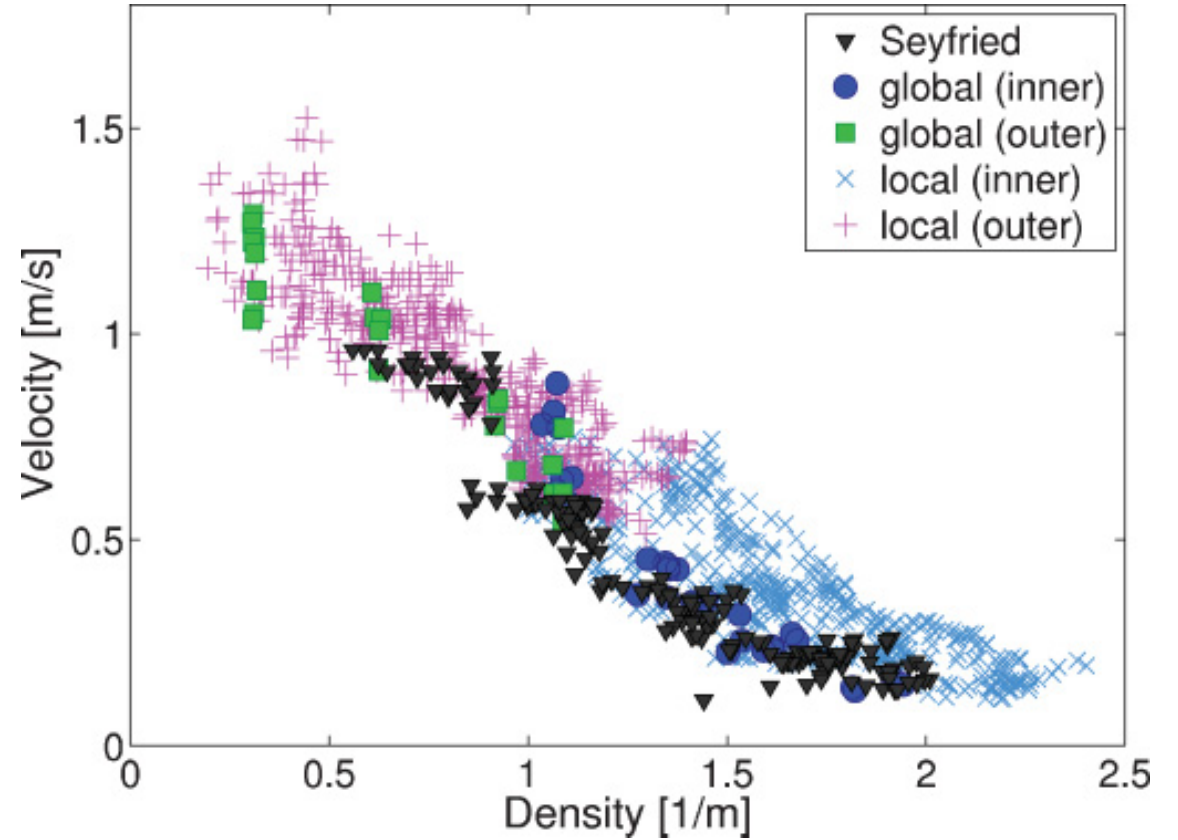
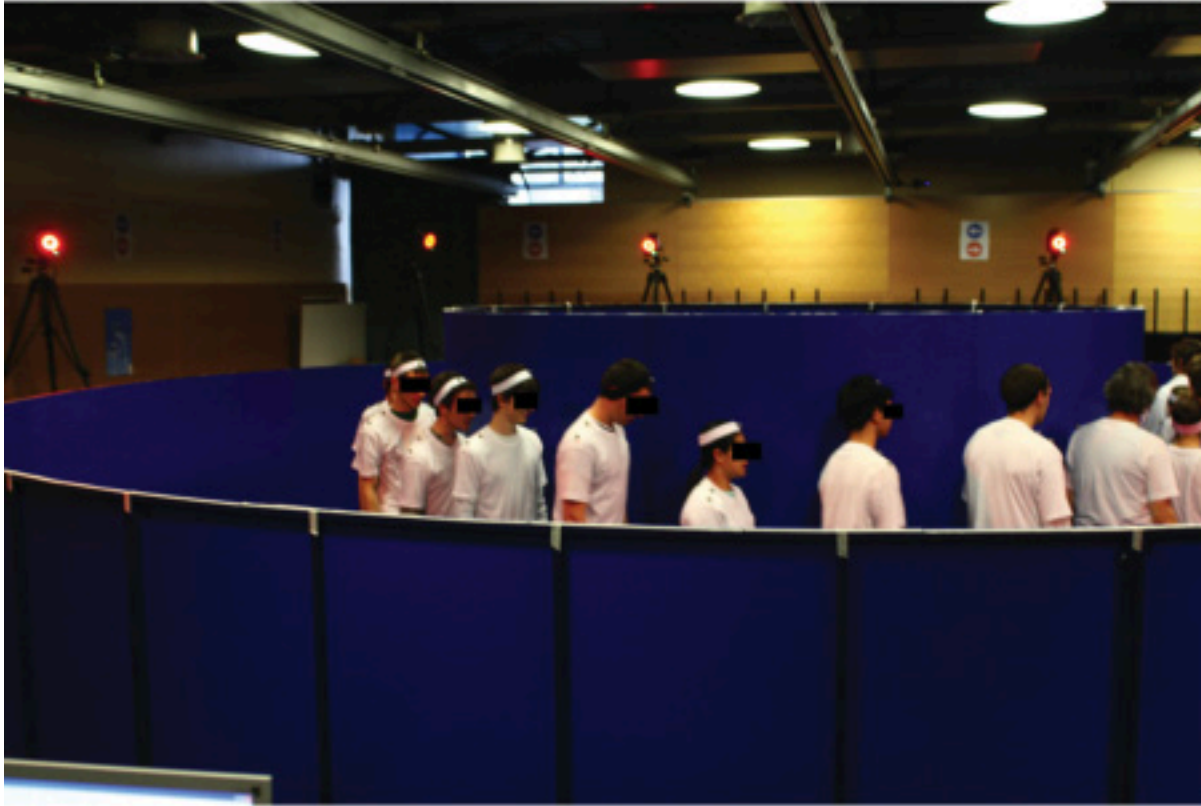
GERMANY

Motivation



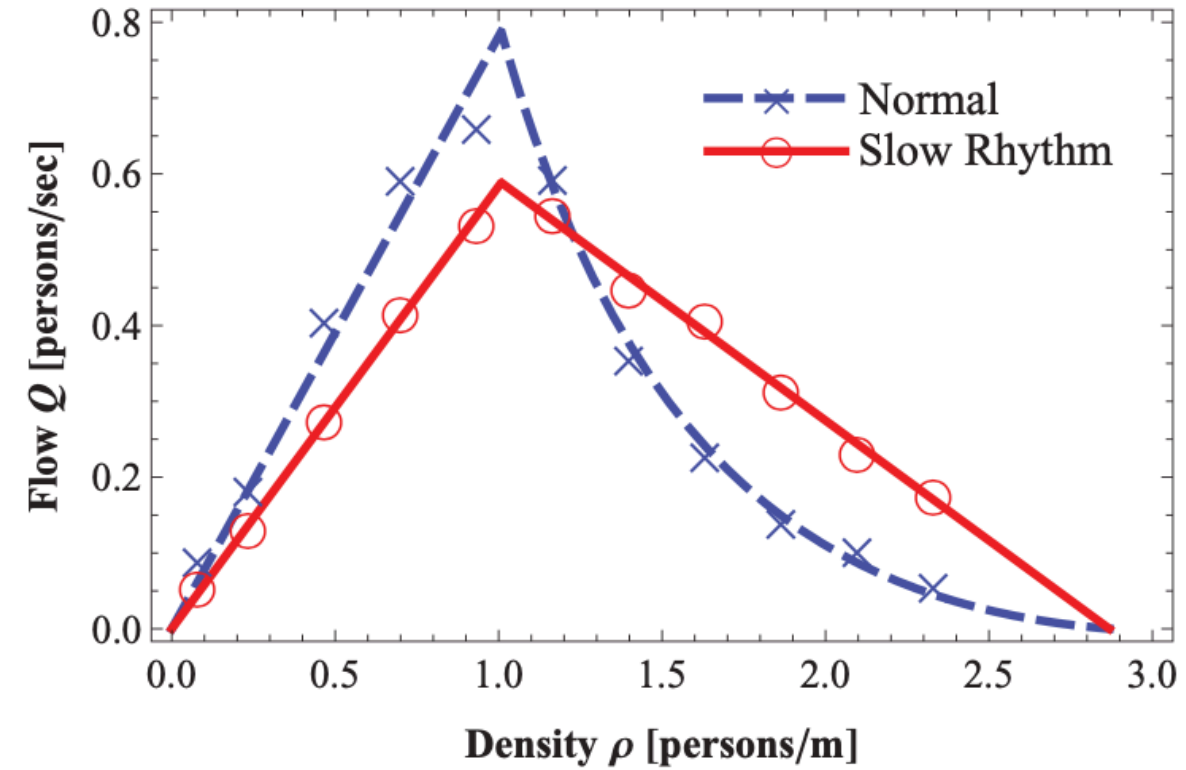
FRANCE

Geometry/culture



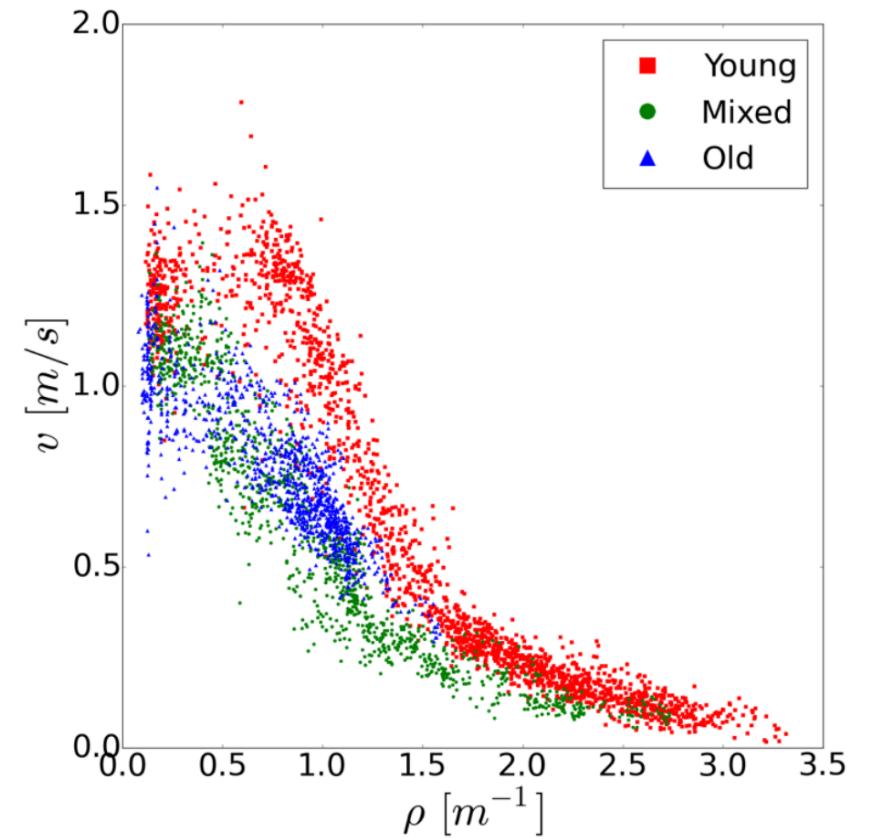
JAPAN

Music



CHINA

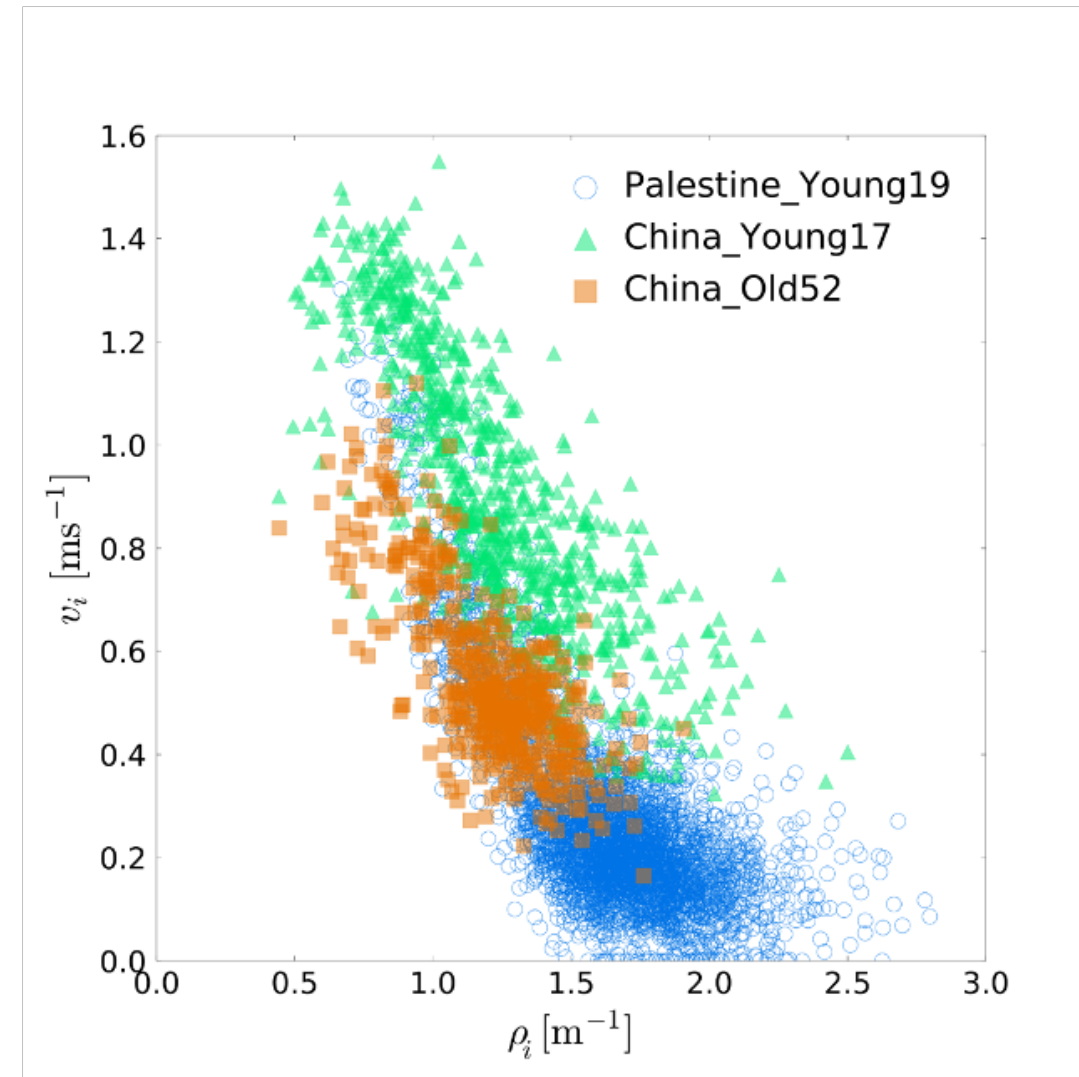
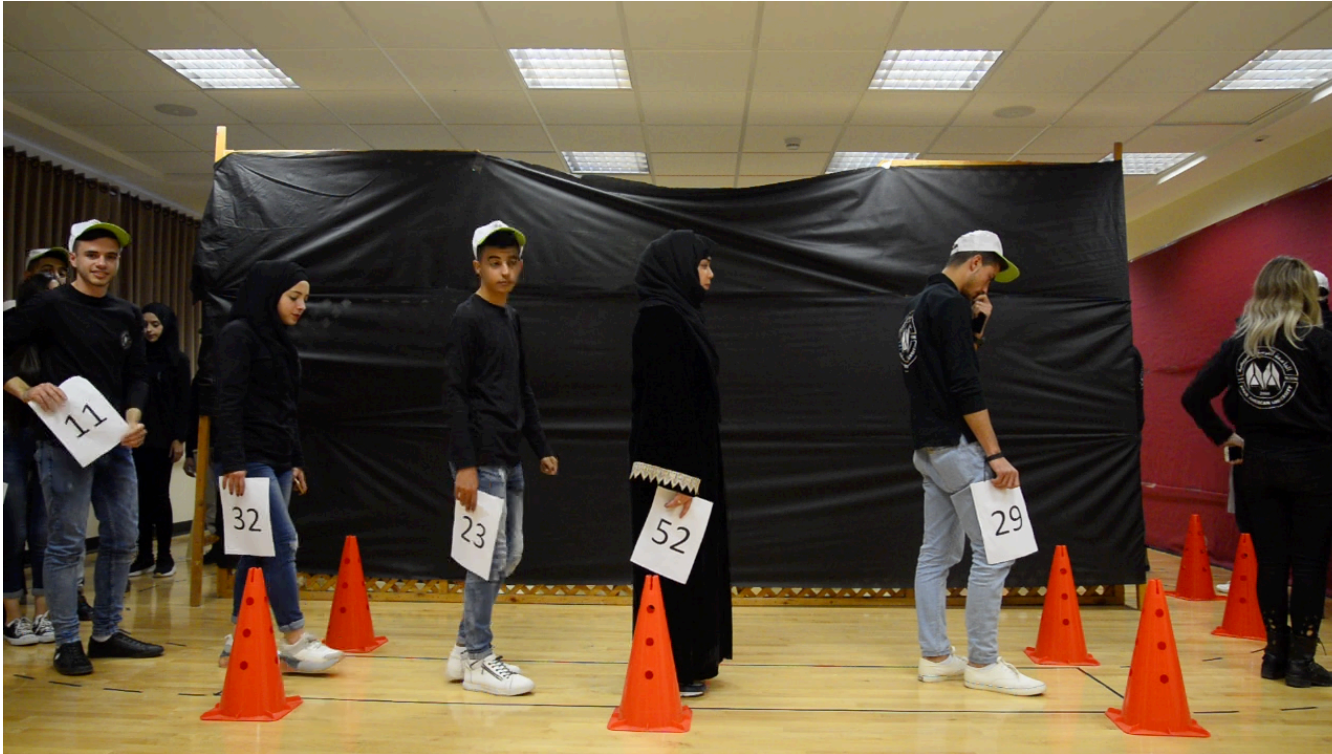
Age



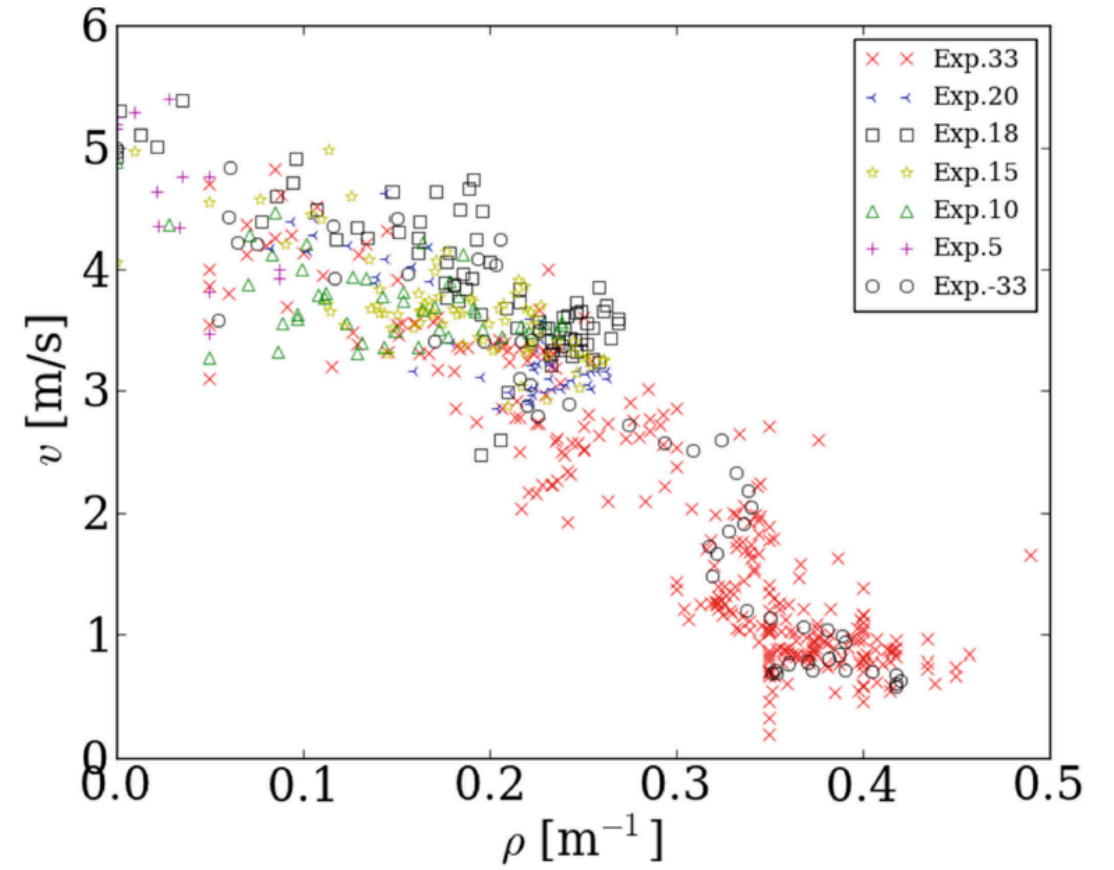
(a) Density-velocity

PALESTINE

Gender

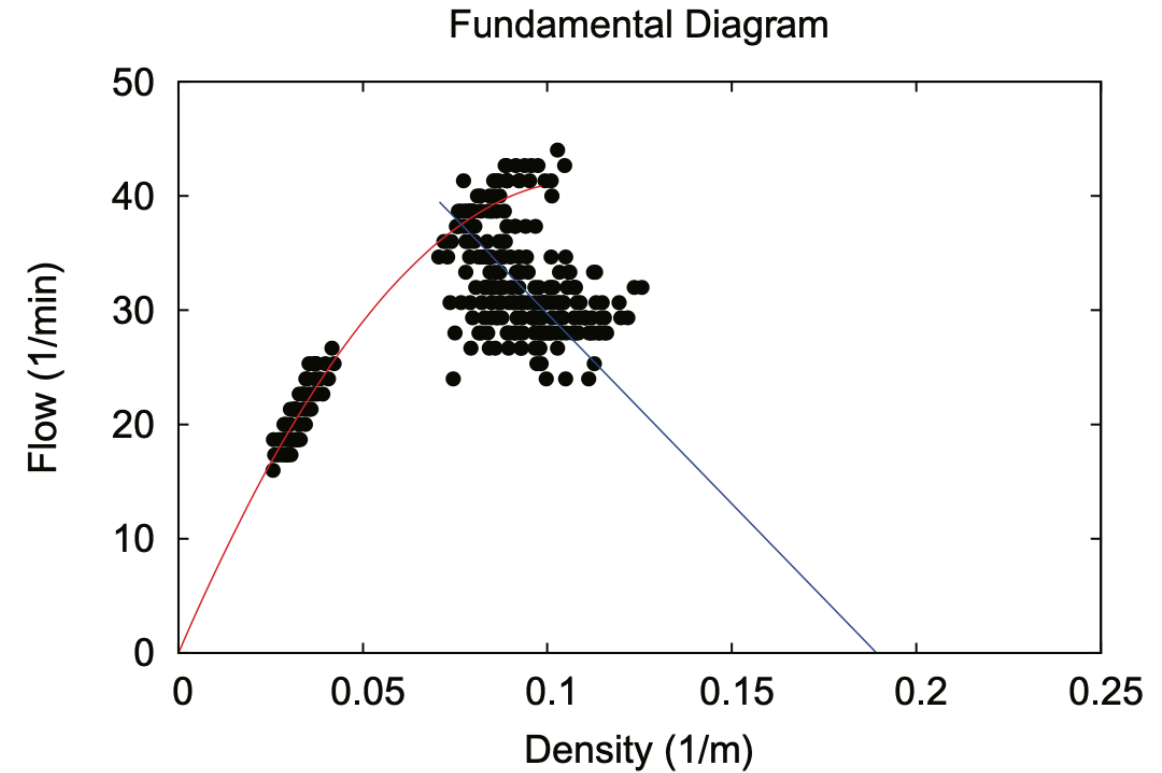
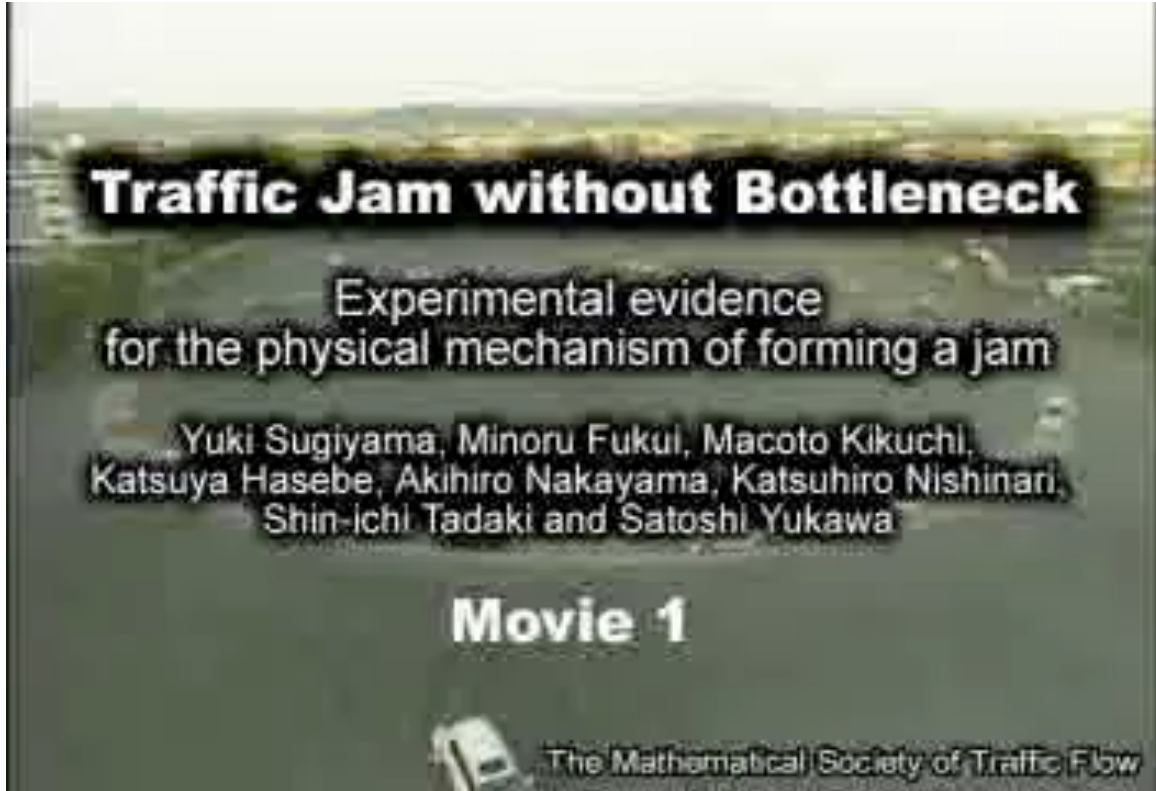


BICYCLE



HEADLINE

Cars

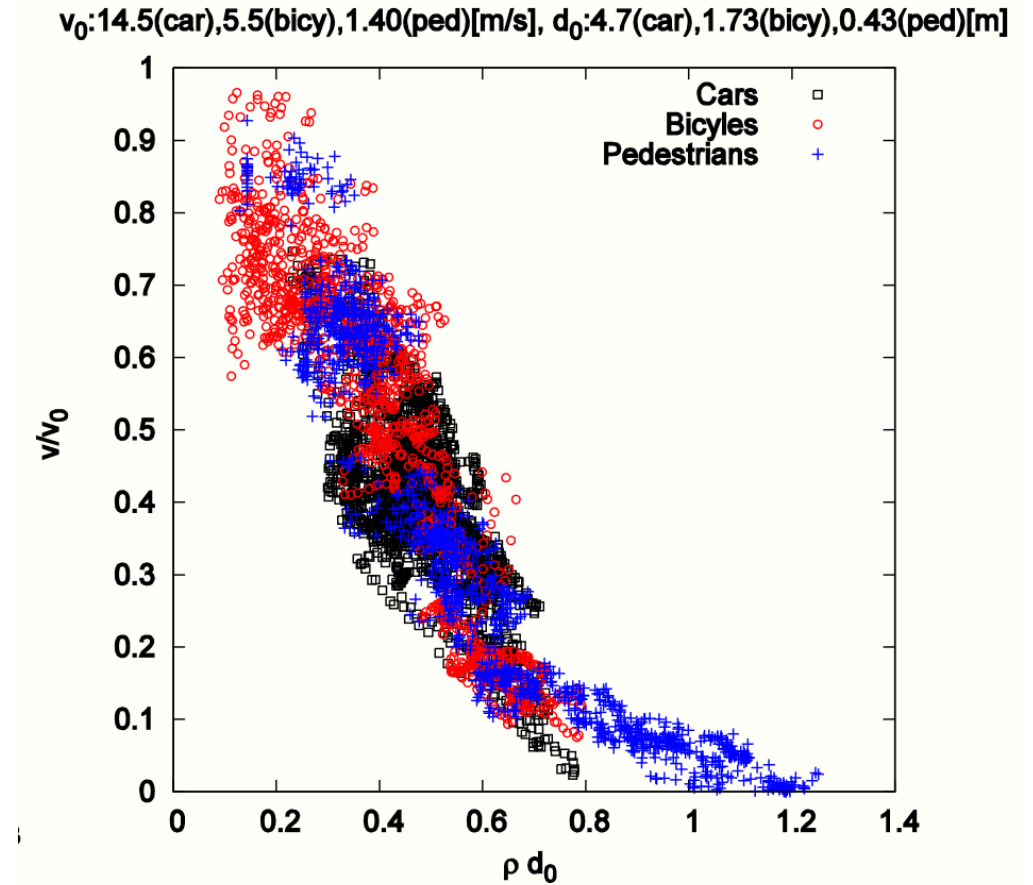
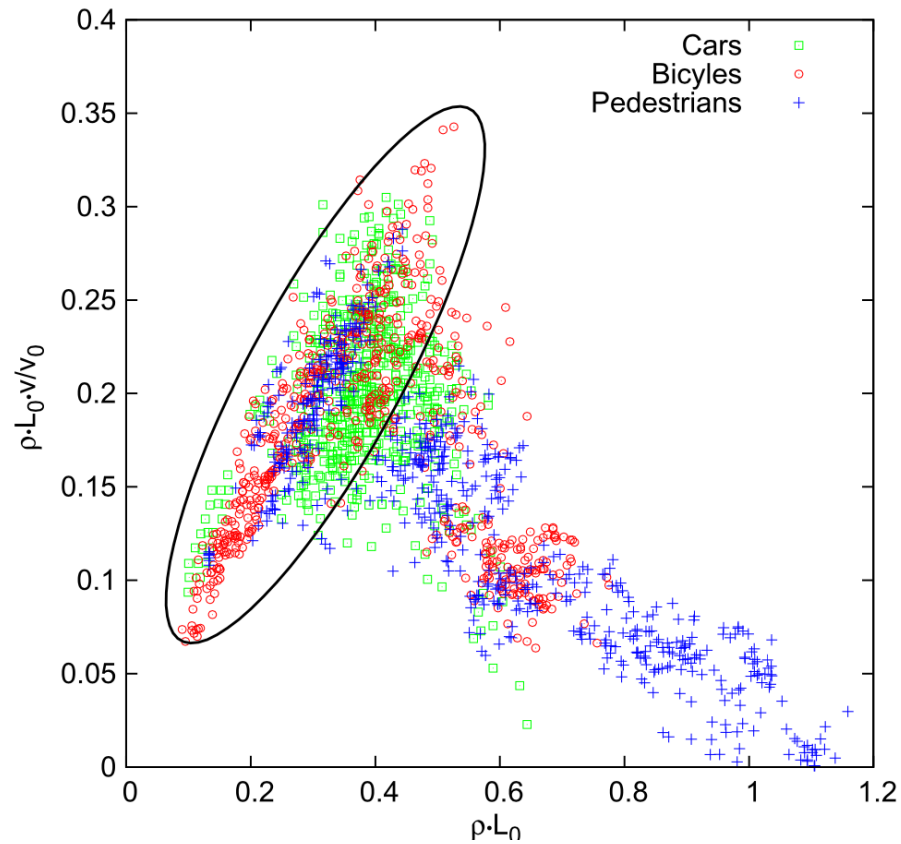


Sugiyama et al, Traffic jams without bottlenecks - Experimental evidence for the physical mechanism of the formation of a jam, New Journal of Physics (2008)

Tadaki et al Phase transition in traffic jam experiment on a circuit, New Journal of Physics (2013)

A UNIVERSAL FUNDAMENTAL DIAGRAM

Cars vs Pedestrians vs Bicycles



Zhang et al, Comparative analysis of pedestrian, bicycle and car traffic moving in circuits, Social and Behavioral Sciences (2013)

Zhang et al, Universal flow-density relation of single-file bicycle, pedestrian and car motion, Physics Letters A (2014)

INTERIM RESULT

What we learnt before?

- At maximum density, with mixed composition (w, m, w, m, ...) the velocity of the “system” was zero.
 - why?
 - was it culture?
 - was it gender?
 - was it age?
 - or maybe something else?

OUTLOOK

consequences for modelling development

GERMANY

Gender experiments - again



GERMANY

Gender experiments - again



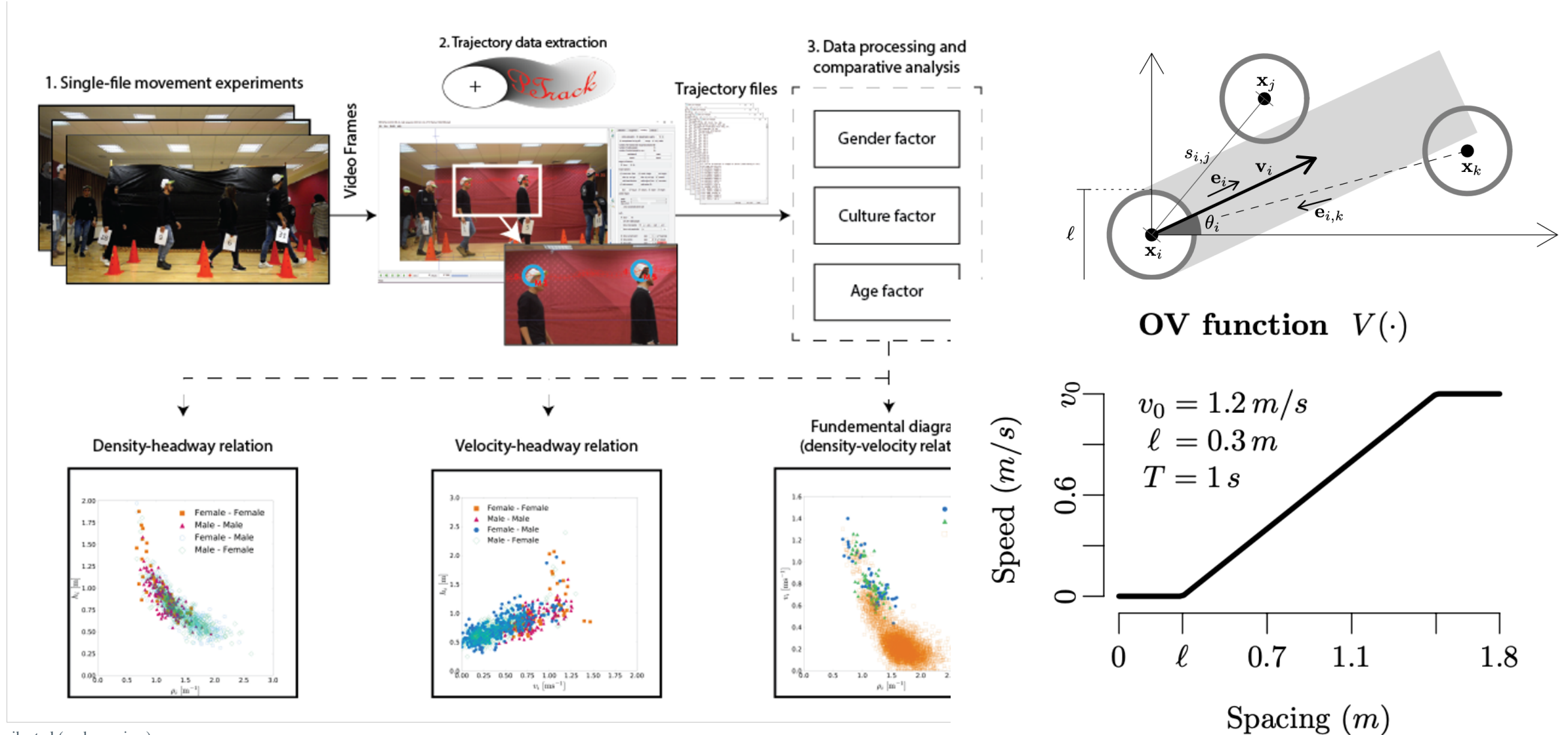
GERMANY

Observations

- First, at maximum density, the “system” stands still (velocity=0)
- Then People developed strategies without external instruction
 - No direct communication (Stepping)
 - Direct communication (synchronisation)
- As a result, the “system” started moving

OUTLOOK

Prediction of Future Pedestrian Movement Characteristics Using Artificial Neural Networks



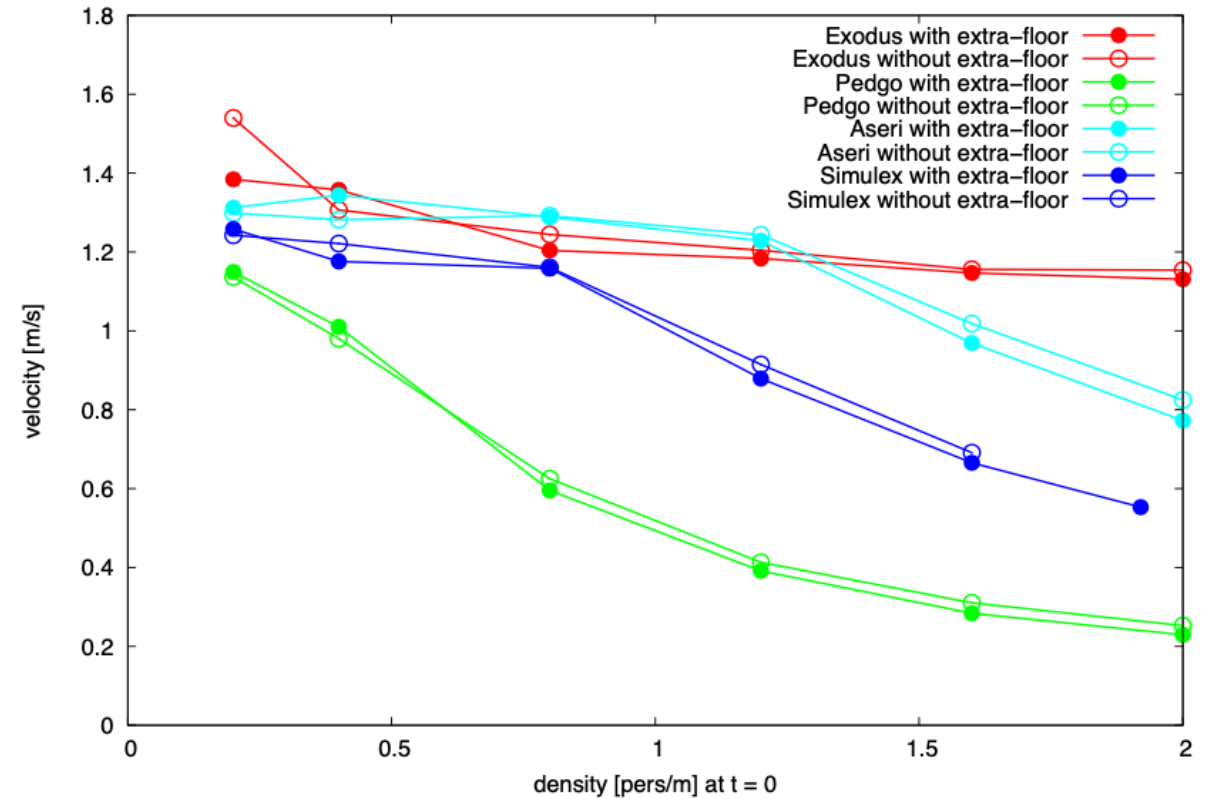
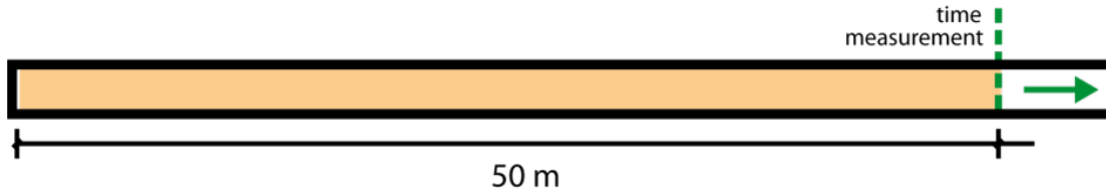
SUMMARY

Single-file movement

- The more data we have from this experiment the richer our knowledge is
- Different factors influencing the dynamics can be separated and investigated
 - Age
 - Culture
 - Gender
- Application for validation and definition of models

VALIDATION OF MODELS IS NECESSARY

A reminder: what happens if not?





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