
UCL
Crowd Spatial Patterns at Bus Stops: security implications and effects of warning messages
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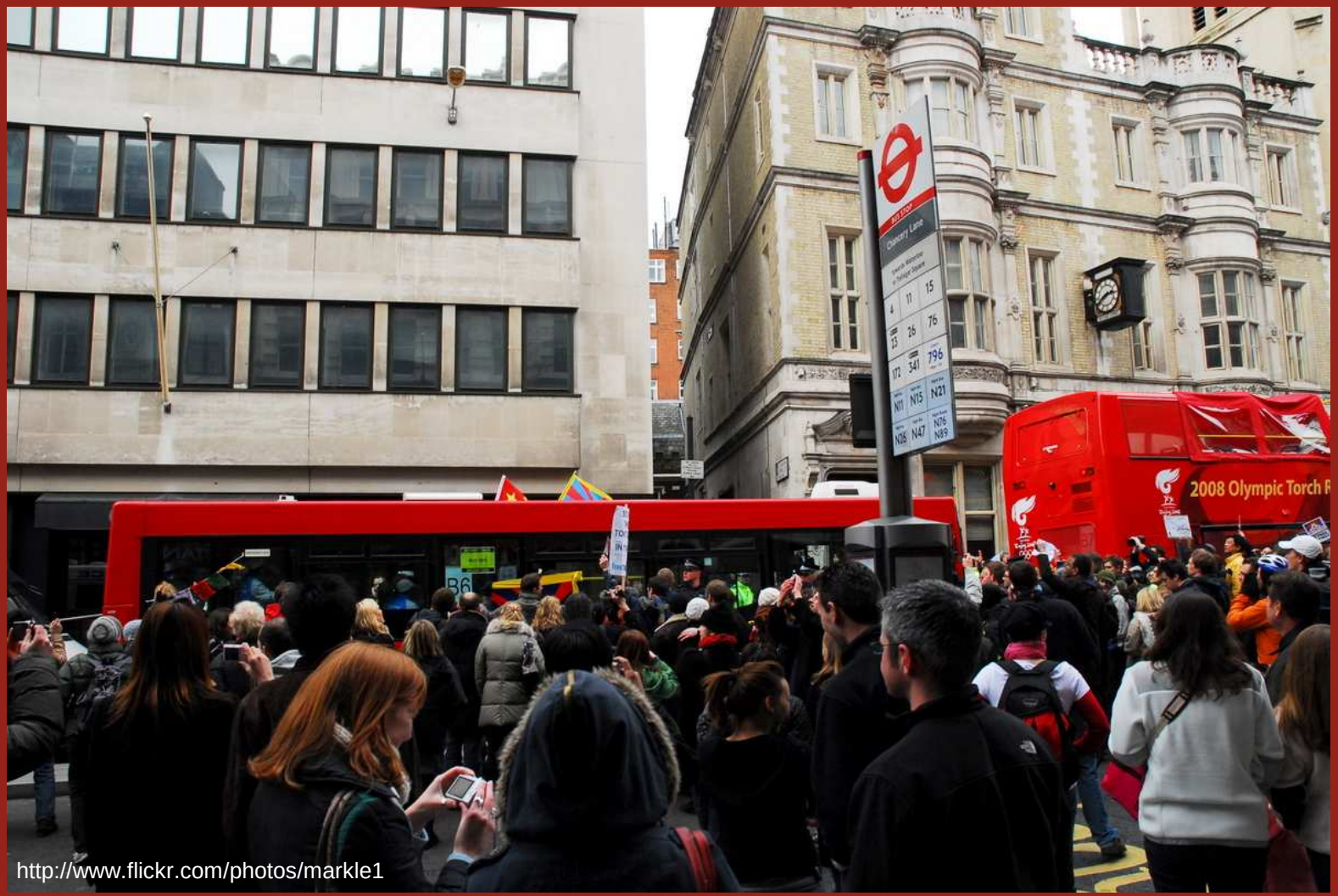


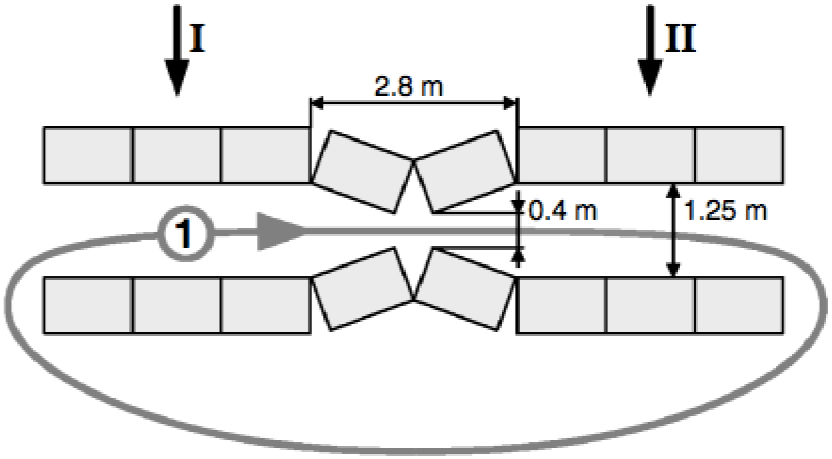
http://www.flickr.com/photos/markle1

Link between pickpocketing and crowding

Crime Data	Observations
Correlate crime incidences with peak travel times	Study pickpockets as they operate in busy bus stops
e.g.: Kabundi & Normandeau 1987; Smith & Clarke 2000; Loukaitou-Sideris & Liggett 2000	e.g.: Poyner 1986, Loukaitou-Sideris 1999

Pedestrian analysis field

- Bottlenecks
- Greater detail about crowd dynamics
- Use of laboratory experiments to gain insight into real-world phenomena



Helbing, D., Buzna, L., Johansson, A., & Werner, T. (2005). Self-organized pedestrian crowd dynamics: Experiments, simulations, and design solutions. Transportation science, 39(1), 1-24.

Warning Messages

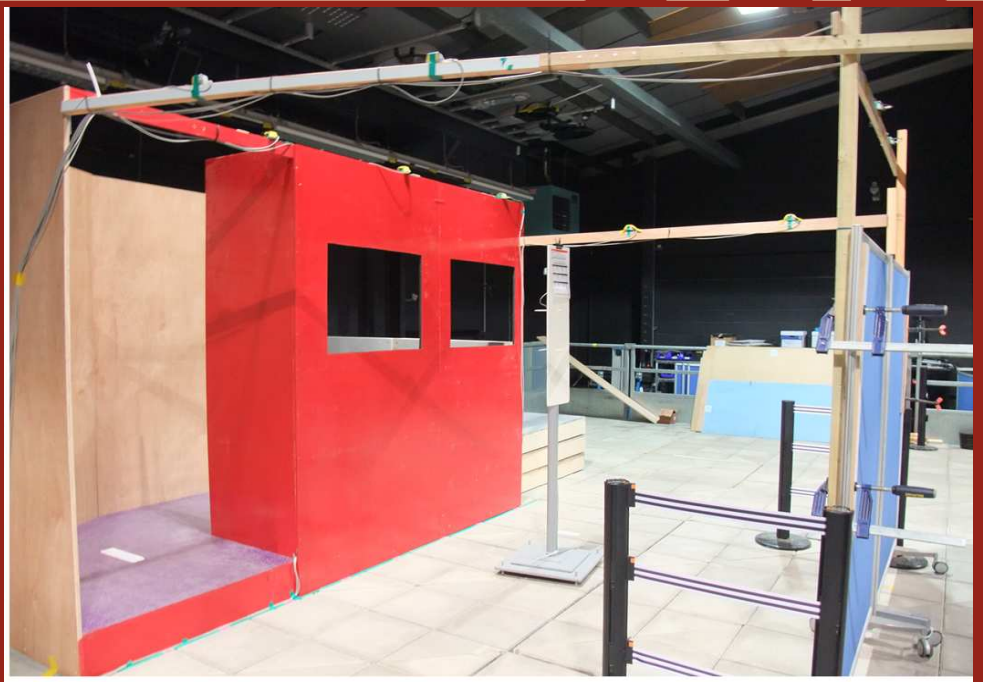
- Encourage passengers to modify behaviour to take care of their belongings
- Informative v. persuasive

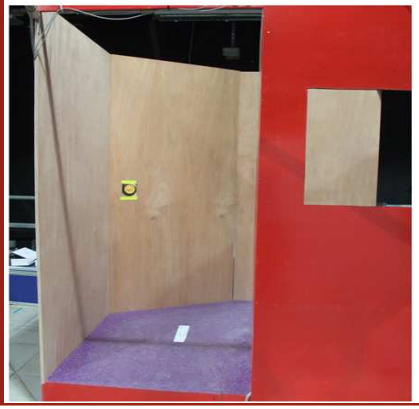
Research Questions

- Is there a difference in the distance passengers keep from those immediately around them between waiting, boarding, and on bus phases of crowding at bus stops?

- Can passengers alter their behaviour if exposed to auditory warning messages about the presence of a pickpocket, despite having to carry out their primary goal of completing a bus journey?

Experiment set up



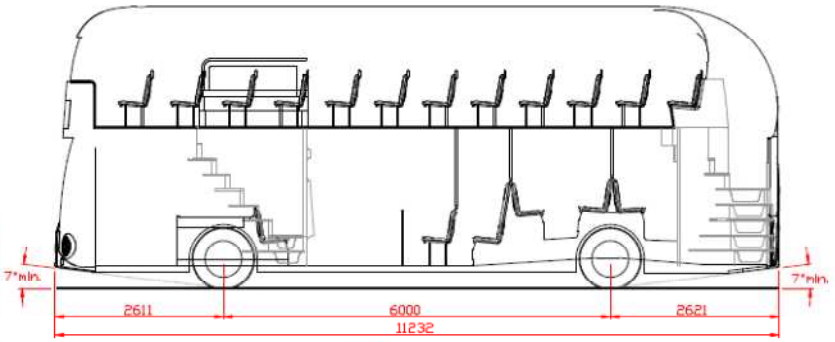


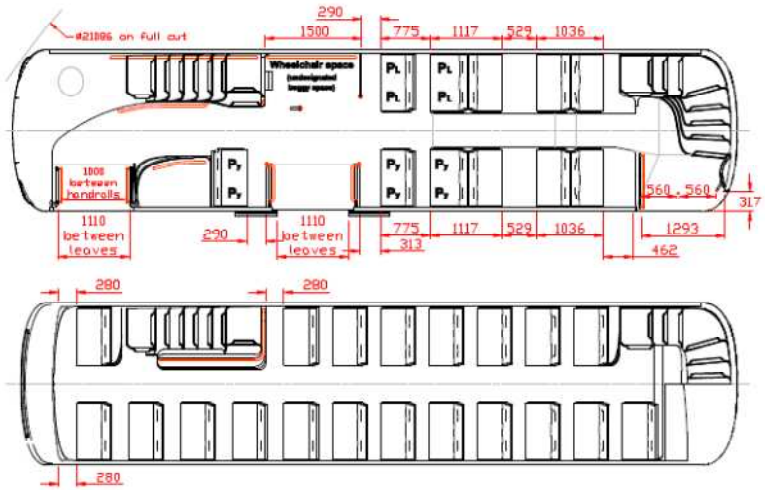
Wrightbus New Bus for London

SPECIFICATION LAYOUT

CUSTOMER DRAWING No. CUS-02328-1

Provisional drawing
Uncontrolled document





P_Y = Priority seat
P_L = Preferential seat

- Maximum Capacity — 87
- Maximum Seated — 40 Top
- Maximum Seated — 22 Btm
- Maximum Standees — 25
- Body Length — 11232mm
- Body Width — 2520mm
- Overall Vehicle Height (unladen) — 4395mm
- Wheel base — 6000mm
- Front Overhang — 2611mm
- Rear Overhang — 2621mm
- Entrance step height at door 1 & 2 — 315mm
- Entrance step height at door 3 — 330mm
- Aisle Width (between seats) — 590mm btm, 535mm top
- Seat Manufacturer — TBA
- Seat Type — TBA
- Both decks to EC Regulation 107

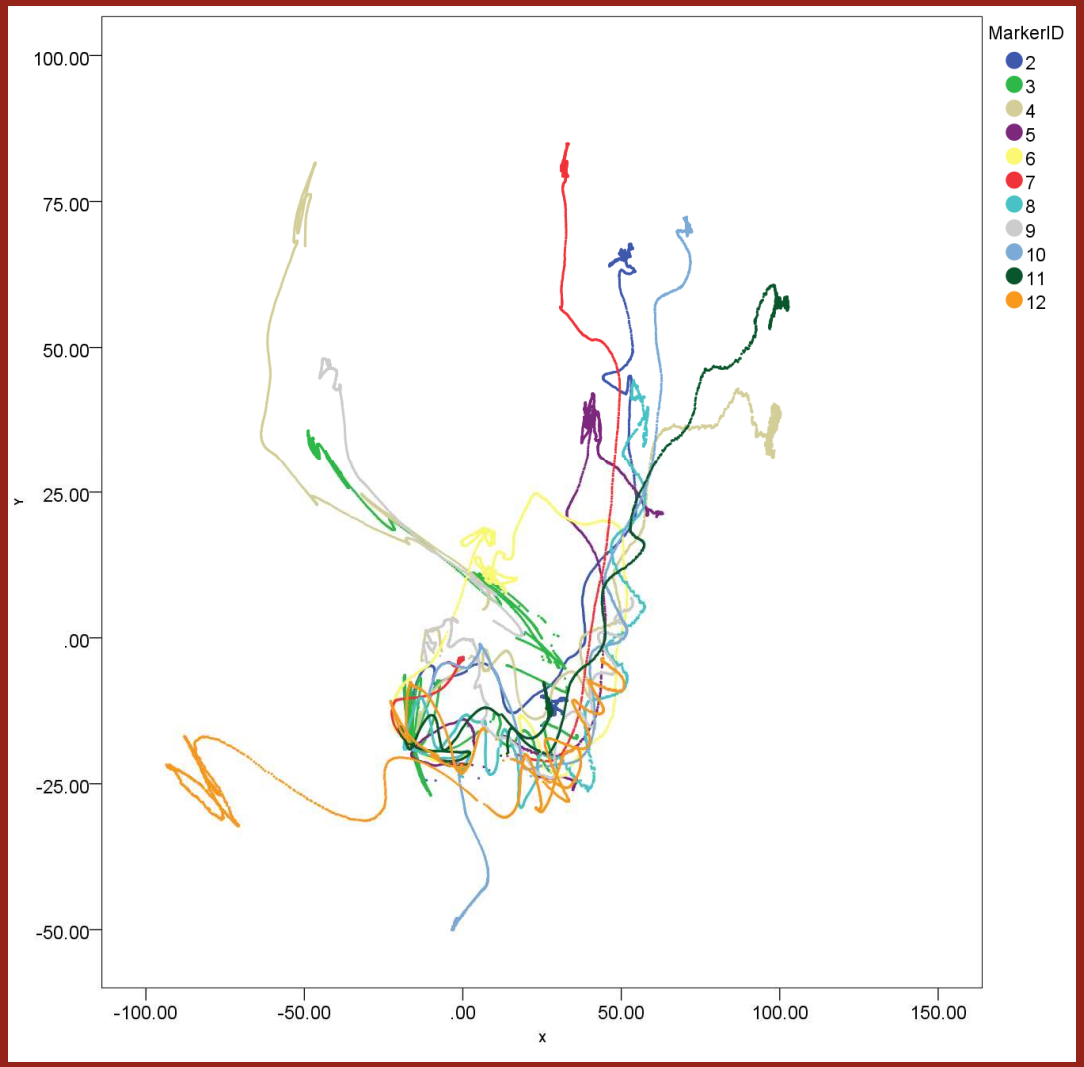
- This Version Drawn By / Date — S.McC. 05/Jul/10

Experiment set up

Experiment set up

Experiment set up

First look at the data



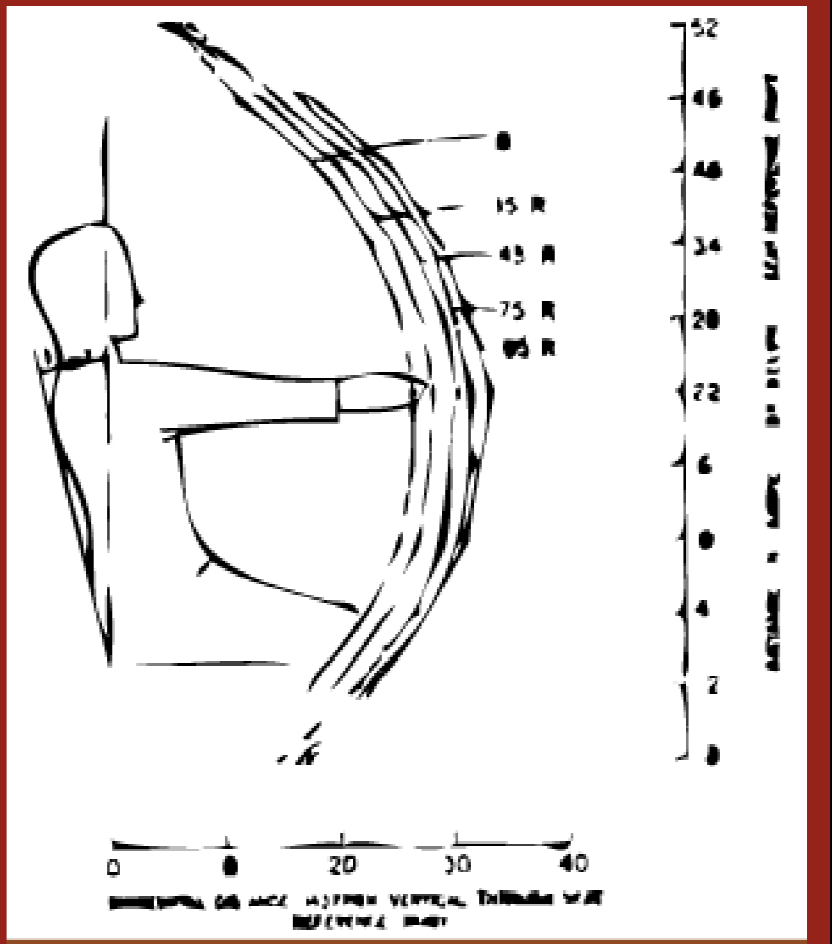
Control	Warning	Pickpocket
Wait for bus as normal. Ambient traffic sound and bus noises	Ambient traffic sound is supplemented with auditory warning message	A context-specific warning from a credible and believable source is given to participants personally
None	Automated voice: "*May I have your attention please: would customers please note that pickpockets operate on this station. Please do not leave any item of luggage unattended at any time. Please make sure your personal items are secure*"	Personal communication: Participants told by the experimenter of a "pickpocket" in their midst.

Hypotheses

- H1: There is a difference in distances people keep from one another between waiting, boarding, and on bus phases.
- H2: There is a difference in the distances people keep from one another between control, warning, and pickpocket scenarios.

For analysis, threshold measure of arm's reach was developed.

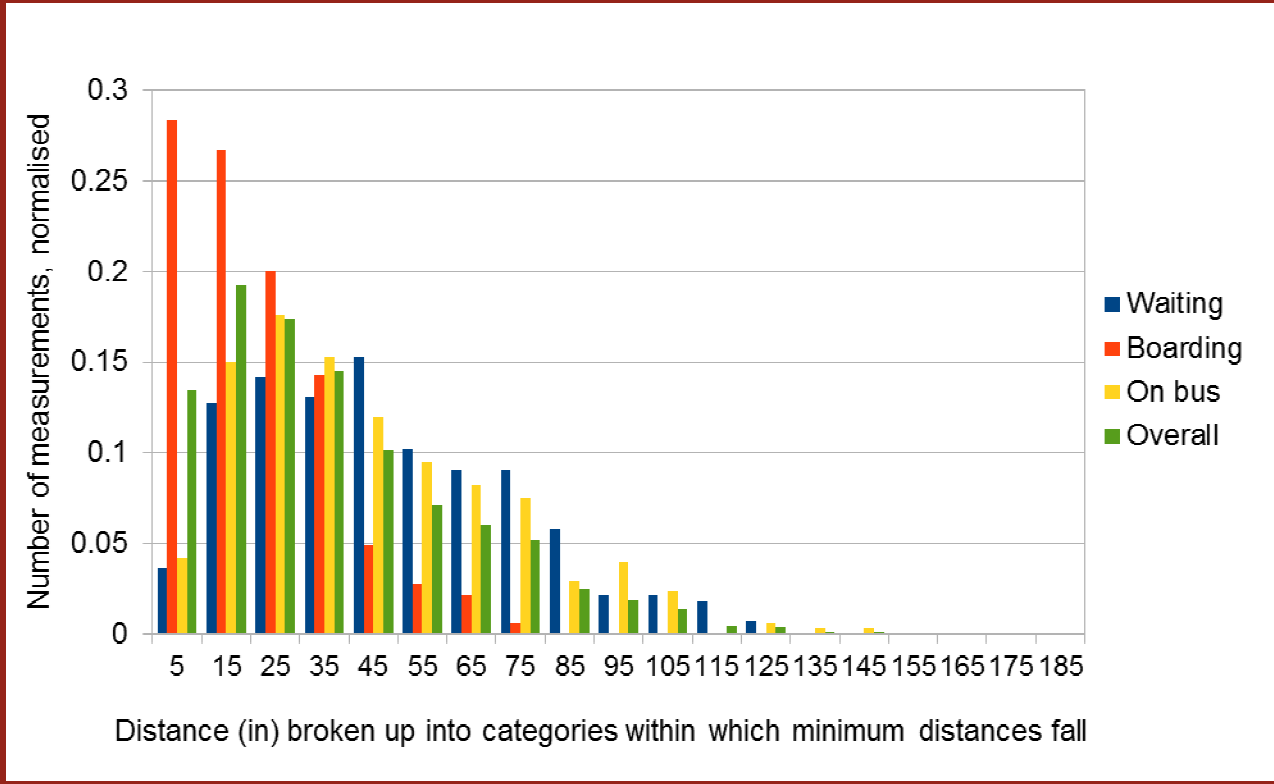
http://www.flickr.com/photos/ladytracy



King, B.G., 1948. Measurements of man for making machinery. American journal of physical anthropology, 6(3), pp.341–51

Results: Distance between people

- Smallest distance between people (closest 2 people came to one another)
- Distribution of smallest distances
- Broken down by phase (waiting, boarding, on bus)



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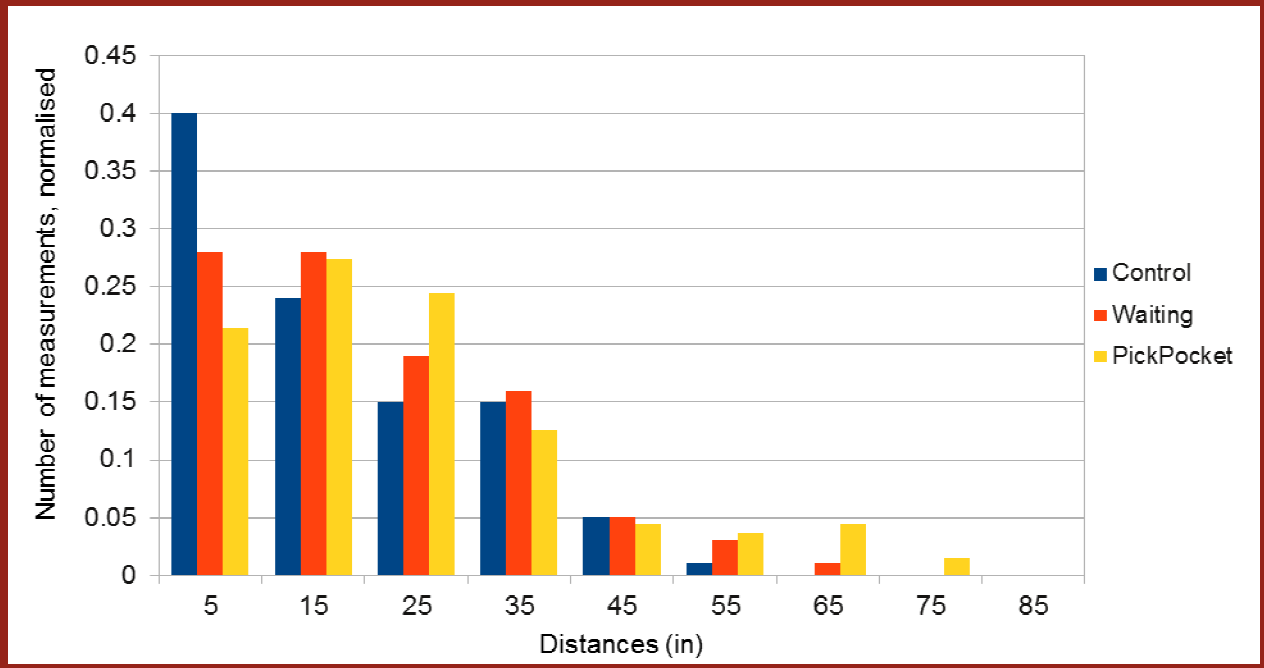
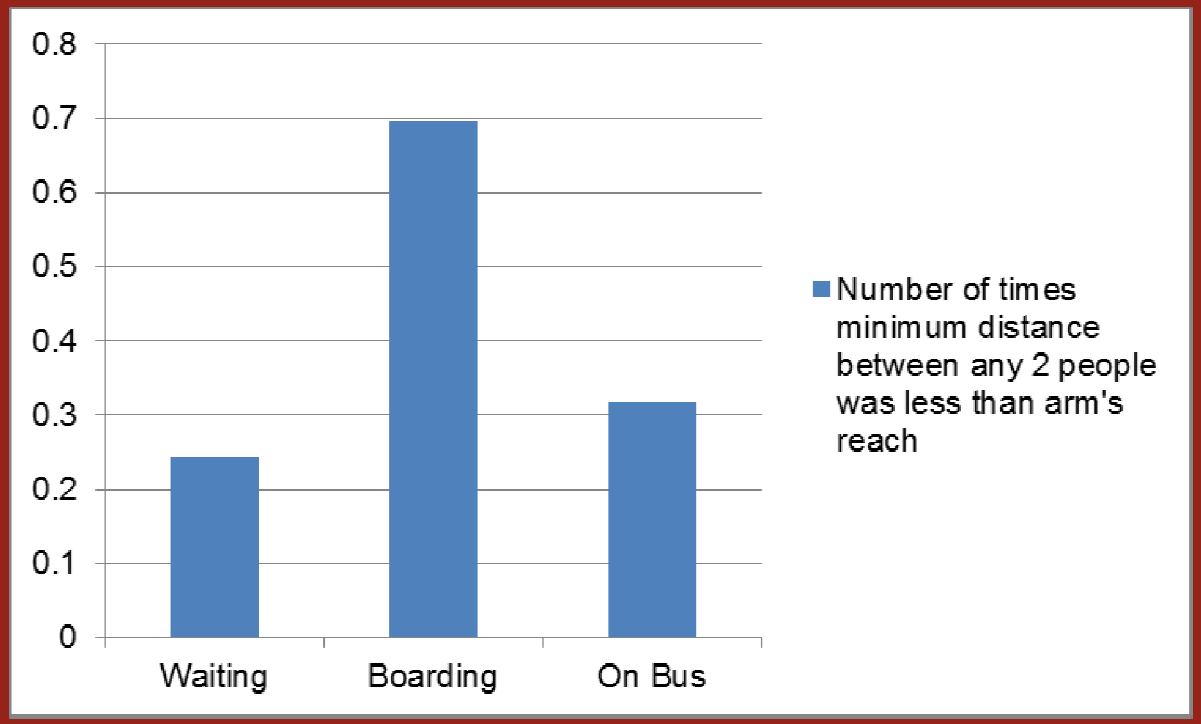


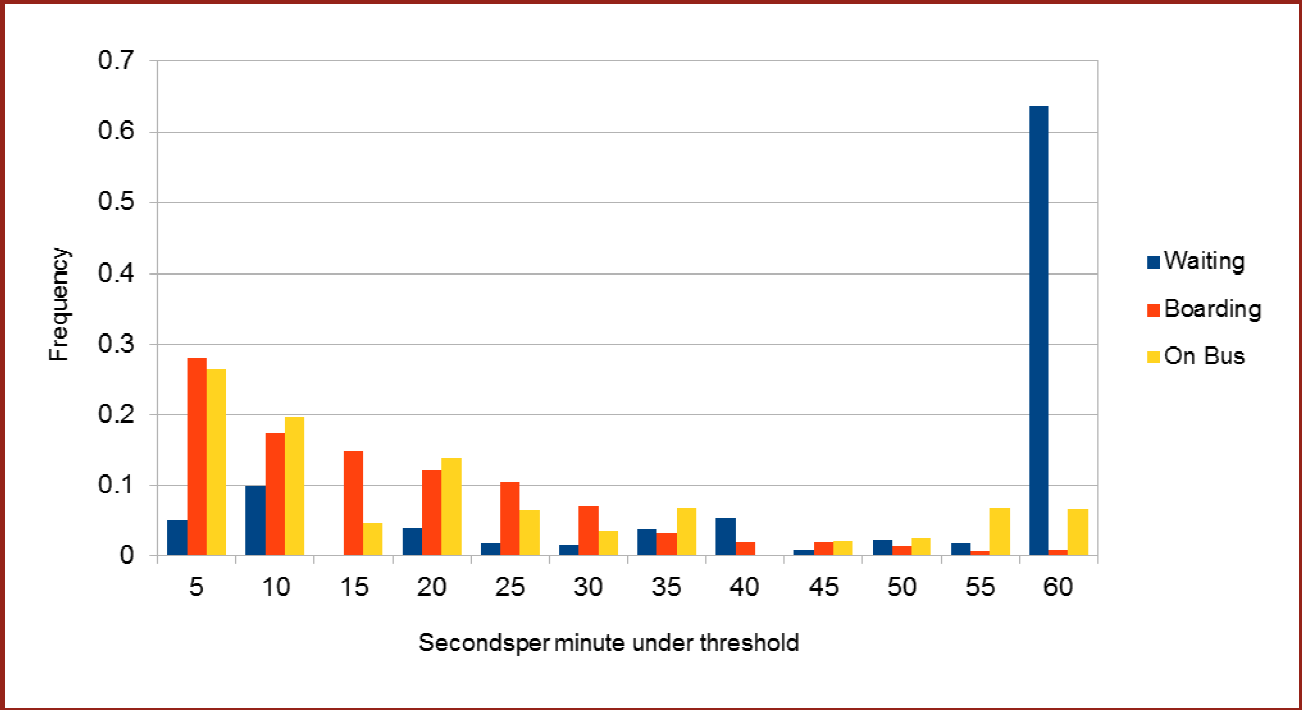
Results: Distance between people

- Arms' reach threshold
- Number of smallest distances within threshold
- Broken down by phase (waiting, boarding, on bus)



Results: Time people spend close to others

- Time spent ‘close enough’ may be a factor
- Time spent within threshold
- Broken down by phase (waiting, boarding, on bus)



Discussion: Answers

- More people come closer to one another when boarding the bus than while waiting for it, or while on the bus; the bus door creates a bottleneck effect

- Given an ideal warning message, people keep greater distance from one another, despite having to pass through the bottleneck created when boarding a bus in a crowded environment.

Discussion: Immediate implications

- Interventions should be targeted to the bottleneck created when people board the bus
  - CCTV
  - Situational crime prevention measures (queue marshaling barriers)
- Warning messages can encourage passengers to alter their behaviour, therefore might be a possible intervention to reduce pickpocketing

Discussion: Further implications

- Transferability of method from pedestrian motion analysis to criminology problems
- Laboratory setting > study specifics to complement real world observation studies. Study group behaviour and situational factors, and move beyond ‘psychology studies’ and ‘hypothetical scenarios’
- This project illustrates one possible application of this method to transport crime
- Further examples:

Discussion: Further implications

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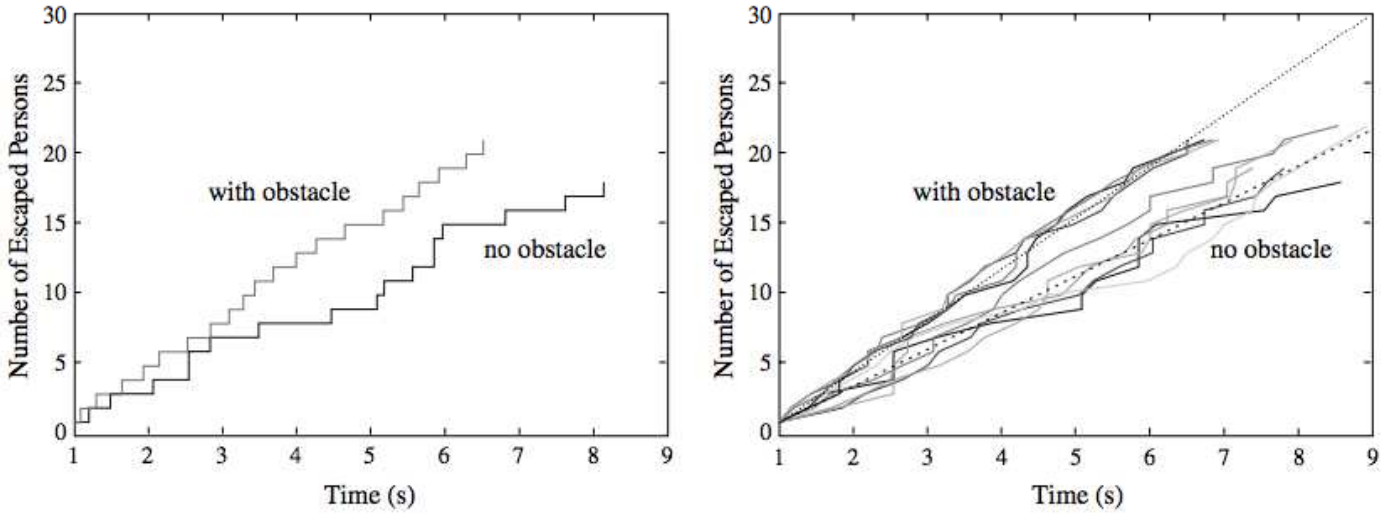

Figure 21 **Escape Times and Number of Escaped Persons in Experiments Imitating Conditions of Escape Panic With and Without an Obstacle in Front of the Exit**

Discussion: Further implications

- Warning messages had an effect on the bottleneck, creating a more staggered boarding movement, where people kept larger distances (did not press so close together) in the most extreme warning condition than in control conditions
- Similarly to obstacles in stadium entrances, experimenting with obstacles such as queue marshaling barriers proposed by Poyner (1986) at bus stops / bus entrances, may provide situational solutions to prevent contact crimes

Discussion: Further implications

- Data on micro level behaviour of pedestrians can be used to inform Agent Based Models (ABMs)
    - ABMs rely on rules given to “agents”
    - These rules can be empirically assessed in such a laboratory setting
    - E.g. by assigning rules based on data from this experiment, simulation with a larger crowd and full-scale bus could be run, and further variables could be introduced (different waiting times, etc.)
- Data on micro level behaviour of pedestrians can also be used to inform CCTV pattern analysis, used in a variety of security applications e.g. counter terrorism strategies

Overall with this paper I hope to provide a useful stepping stone to using a controlled laboratory environment on crowd dynamics to inform, inspire and complement studies in field contexts in the domain of crime and transport

Thank you for your attention!

Questions?

Comments?