

How do we wait? Fundamentals, characteristics and modeling implications

Conference on Traffic and Granular Flow 2015

Michael J. Seitz^{1,2}, Stefan Seer³, Silvia Klettner³,
Oliver Handel², Gerta Köster¹

¹Munich University of Applied Sciences

²Technische Universität München

³AIT Austrian Institute of Technology



28 October 2015



1. waiting behavior
2. background from social sciences
3. observation of a train platform
4. heuristic decision rules
5. future directions
6. summary

What is waiting behavior?

Definition

Waiting is the behavior of individuals remaining at a position in order to pass time until an event they expect occurs.

Where do people wait?



Waiting behaviors are observed in transportation systems, events, all gatherings that include delays, etc.

- ▶ Davidich et al. (2013) studied waiting zones in a cellular automaton.
- ▶ Johansson et al. (2015) introduced waiting pedestrians in the social force model.
- ➡ The relevance of waiting pedestrians has been recognized.
- ➡ However, how real pedestrians choose their waiting position has been neglected.

The meaning of space

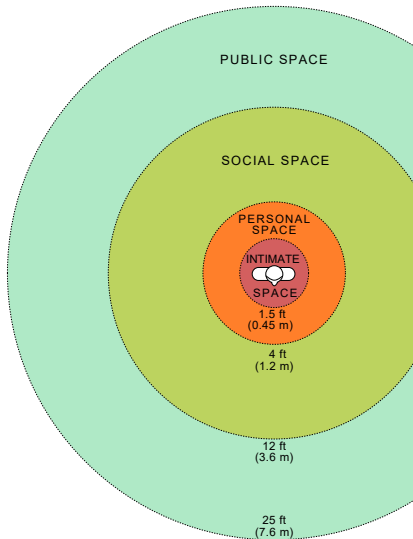
- ▶ Both objects and spaces convey information (Ruesch and Kees, 1956).
- ▶ What distinguishes one environment from another is “the nature of the rules embodied or encoded in it” (Rapoport, 1977, p.14).
- ▶ The environment provides possibilities for choices by increasing or decreasing the probability for activities and behaviors (Rapoport, 1977).

- ▶ Individuals regulate their behaviors more in public environments (Matsumoto, 2012).
- ▶ The whereabouts of an individual depend on the social characteristics of the surrounding environment (Schelling, 1978).

Spatial social distances

- ▶ It is the social environment and cultural accepted norms that regulate behavior and social interactions.
- ▶ Hall (1966) proposed four characteristic distances (see figure).

Figure Source: Wikimedia – “Personal_Space.svg”
Author: “WebHamster”
License: Creative Commons (CC BY-SA 3.0)
creativecommons.org/licenses/by-sa/3.0/deed.en



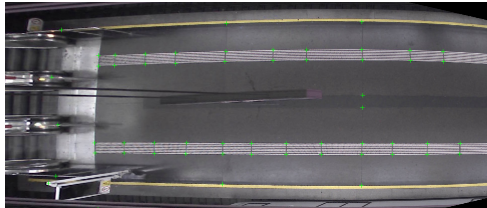
- ▶ Influences may be grouped into two categories:
push and pull factors.
- ▶ Examples are:
 - ▶ interpersonal distances to social group members (pull factors)
or to non-social group members (push factors)
 - ▶ safety distance to an arriving train or a road (push factors) or
positions close to an information screen (pull factors)

Observation of a train platform

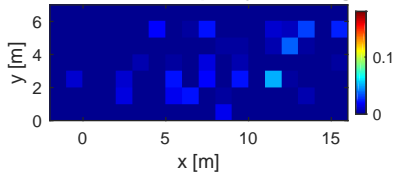
- ▶ A train station platform in Vienna was observed in the morning (7:00 am) and evening (6:30 pm).
- ▶ Video recordings were taken from an oblique view above the platform.
- ▶ The waiting positions of 38 (morning) and 91 (evening) passengers were annotated manually.



Spatial occupancy



Measure of occupancy - Morning



Measure of occupancy - Evening

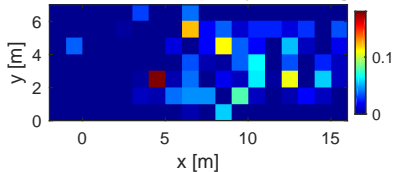


Figure: Percentage of time spent by passengers at positions.

Distances kept

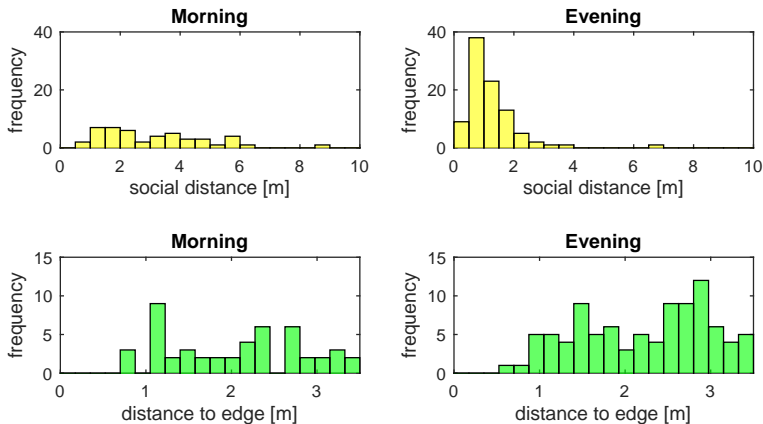


Figure: Top: distance to the next waiting passenger. Bottom: distance to the platform edge of the chosen position.

Time remained

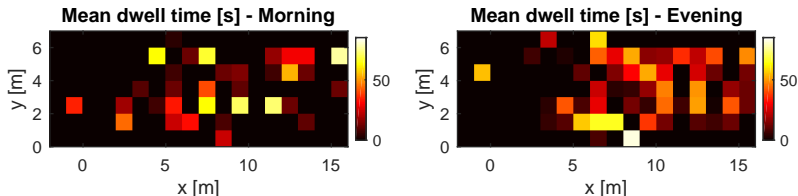


Figure: Mean time remained at positions of the platform.

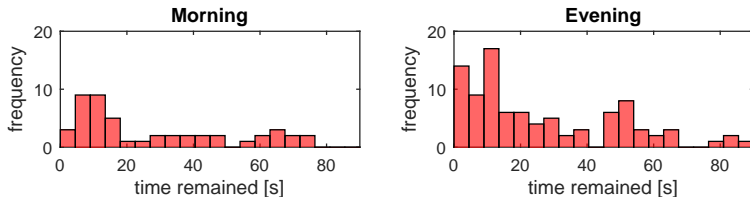
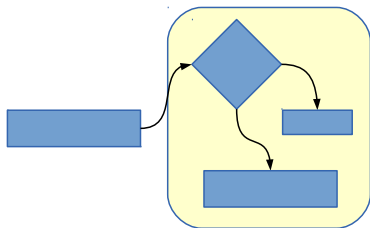


Figure: Time remained at one position.

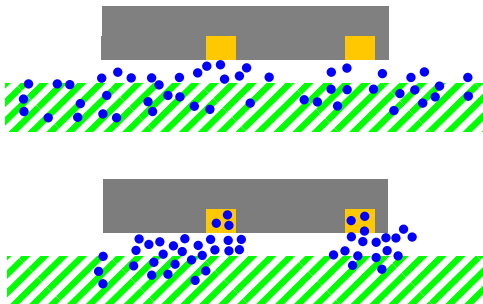
Heuristic decision making



1. Get close to where the train arrives.
2. Keep a safety distance to the platform edge.
3. Keep a social distance to other passengers.
4. Stay away from the escalators.

Future directions

- ▶ Collect more data and compare behavior in different scenarios.
- ▶ Formalize and implement heuristic decision making.
- ▶ Validate the model with empirical data.
- ▶ Study the resulting emergent behavior in pedestrian simulations.



- ▶ Waiting behavior is important for several pedestrian scenarios.
- ▶ Simulation approaches lack a model of where pedestrians wait.
- ▶ Social science gives some insights on how humans distribute in the environment.
- ▶ The empirical observation revealed several features of waiting behavior.
- ▶ We proposed heuristic rules that capture this behavior.

References

- Davidich, M., Geiss, F., Mayer, H. G., Pfaffinger, A., and Royer, C. (2013). Waiting zones for realistic modelling of pedestrian dynamics: A case study using two major german railway stations as examples. *Transportation Research Part C: Emerging Technologies*, 37:210–222.
- Hall, E. T. (1966). *The Hidden Dimension*. Doubleday.
- Johansson, F., Peterson, A., and Tapani, A. (2015). Waiting pedestrians in the social force model. *Physica A: Statistical Mechanics and its Applications*, 419:95–107.
- Matsumoto, D. (2012). The psychological dimensions of context. *Acta de Investigación Psicológica*, 2(2):611–622.
- Rapoport, A. (1977). *Human Aspects of Urban Form: Towards a Man Environment Approach to Urban Form and Design*. Pergamon Press, Oxford.
- Ruesch, J. and Kees, W. (1956). *Nonverbal Communication: Notes on the Visual Perception of Human Relations*. University of California Press, Berkley and Los Angeles.
- Schelling, T. C. (1978). *Micromotives and macrobehavior*. FELS Lectures on Public Policy Analysis. WW Norton & Company.