How do we wait? Fundamentals, characteristics and modeling implications

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Outline

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.
Relevance in pedestrian simulations

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).
Spatial social interactions

- 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”
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Spatial social distances

- 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

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.
Summary

- 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


