Indirect User Guidance by Pedestrians in Virtual Environments

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Introduction

Background
- Supporting users to guarantee a successful and efficient scene exploration (acquiring knowledge of respective, unknown scene)
- Aided wayfinding (e.g., visualization of proposed paths, virtual tours, ...) provide intentional input influencing wayfinding decisions
  → Drawback: artificial and potentially intrusive visualizations embedded, pre-defined routes limiting users' free exploration

Research Objective
- Can we indirectly guide users utilizing social cues in form of virtual pedestrians, plausibly enlivening the scene, as an unaided wayfinding strategy?

Requirements
- Basic *enlivenment* of the entire scene
- Recognizable *pedestrian flows* indirectly guiding to close-by areas of interest (AoIs)
- Avoid perception of pedestrians "running away" from user

Guidance by Pedestrian Flows

Types of Visually Indistinguishable Pedestrians
- Base agents: Enlivening entire scene, representing the background noise
- Guiding agents: Walking to selected, unvisited AoIs
  Remain at AoI for a short time for inspection, before moving on to next AoI
  Flow density indicates importance of AoI


Fig. 1: Guiding agents in different formations.

- Socially compliant navigation in groups: *base groups* with 2-3 base agents; *guiding groups* with 2-5 guiding agents

Unsupervised, Video-Based, Online Study

Between-Subjects Design
- C0: 50 base groups (control condition)
- C1: 15 base groups & 35 guiding groups
  w. uniform flow density (⅓ per AoI)
- C2: 15 base groups & 35 guiding groups
  w. varying flow density (½ for *AoI2*, ¼ for *AoI1&3*)

Participants
- 42 (22 females, 1 non-binary; age M=30.88, SD=14.1)
- Assigned to conditions based on birth month

Study Task
- Watch 1st person clip of traversing a street
- Decide at corner in which direction to proceed
- Next clip resuming simulation based on choice
- Repeated four times

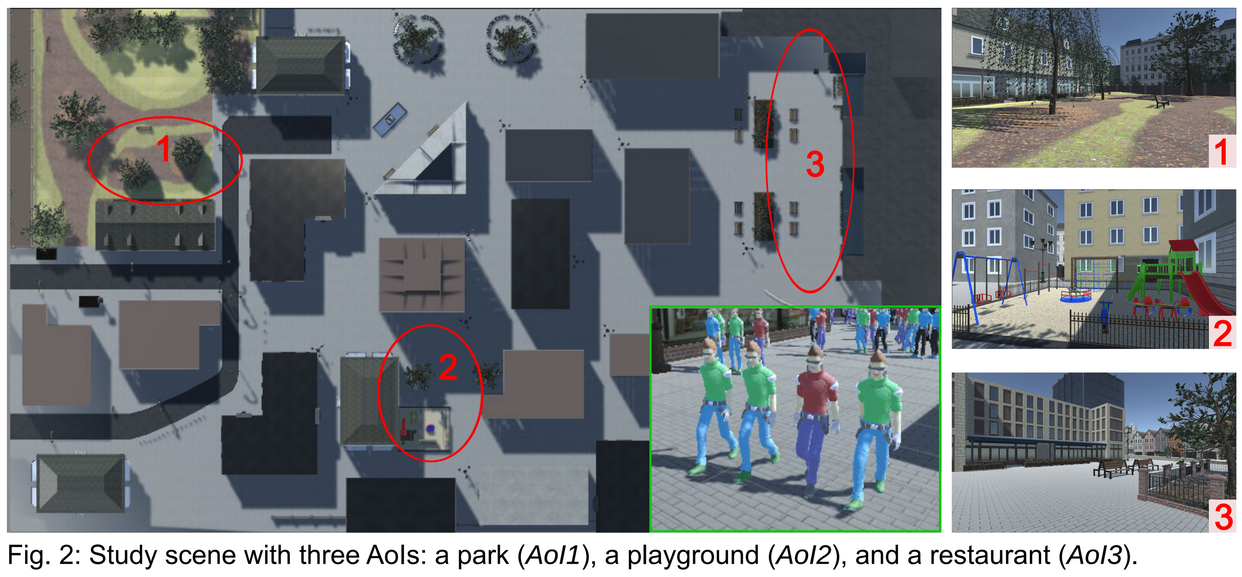
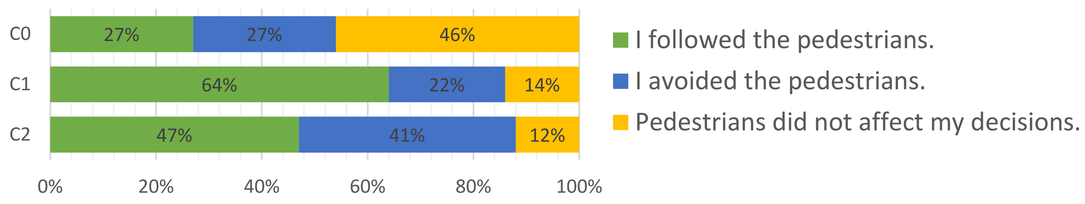


Fig. 2: Study scene with three AoIs: a park (*AoI1*), a playground (*AoI2*), and a restaurant (*AoI3*).

Results
- Wayfinding decisions influenced by pedestrians



- Base agents also perceived as social cues (cp. C0)
- "Herd instinct": Flows/grouping indicated relevant spots
- Too dense flows/groupings raised discomfort, hesitation to meander through, assumption to be faster on emptier route as well as desire for more quiet, but not abandoned, places

Lessons Learned
- Pedestrians as social cues work for unaided wayfinding
- Flow density influences users' wayfinding decisions
- Impact of environment to be considered
  → e.g., brightness, width of streets, ...

Next Steps
- More research on impact of flow density
- Improve environment-aware navigation
  - Adapt density based on available walkable space
  - Make rows to enter small-scale AoIs orderly
  - ...
- Investigating the effect of the pedestrians' appearance
- VR-based evaluation

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