Pedestrian collision avoidance on narrow sidewalk: a meeting between psychology and virtual reality

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PEDESTRIAN COLLISION AVOIDANCE ON NARROW SIDEWALK: A MEETING BETWEEN PSYCHOLOGY AND VIRTUAL REALITY

**Context: NARROW SIDEWALKS**

- Pedestrians manage social interpersonal distances
- Encounter of two pedestrians is impossible when we encounter a pedestrian walking in the opposite way

**Goal:** to simulate a social virtual pedestrian (non player character) in order to study this kind of situation in virtual environment

**Problem:** why do we choose to step down or stay on the narrow sidewalk when we encounter a pedestrian walking in the opposite way?

**Impact of 3 personal factors were studied**

- Speed (fast – slow)
- Sex (Male – Female)
- Distraction (texting – non texting)

**First Experiment – Questionnaire**

- 64 videos of pre-jousting, before any modification of trajectory
  - 32 videos of non-counterbalanced videos
  - 32 videos of counterbalanced videos

- Participants told who was to step down: pedestrian at left or right in the jousting

- Participants said why the virtual pedestrian stepped down (speed, sex, distraction) with Likert scales
  
**Participants said if the jousting is credible**

- One of 8 videos is a fake video
  - 8x8 counterbalanced videos

- Overall ranking of the model-based videos and fake videos according to the subjects’ answers

**Social Perception Model**

- Speed and attention influence the decision to step down from the narrow sidewalk
- Virtual pedestrian decides to step down if his detection time is greater than the other pedestrian involving in the jousting

**Assumption:**

- speed and attention increase the detection time in the ORCA model
- Detection time is then a score of 1-8

**Second Experiment – Results**

- CRQA Model used
  - different types of collision avoidance (anticipative, reactive)
  - Collision avoidance behaviors are a function of the walking speed, the detection time
  - ORCA Model used

- N.B.: the virtual pedestrian sees pedestrian in the public space, and detects him in the social space

**Personal characteristics (psychological and physical)**

- to keep a safety zone
- to anticipate the collision
- We avoid the collision by modifying our trajectory

**First Experiment – Results**

- influence of speed and attention
  - Pedestrian is expected to step down when
    - he walks fast, he is attentive
    - For the participants, no gender effects

**Discussion**

- To use Social Pedestrian Non Player Characters in VR environment is feasible
- Needs to take into account the empowerment/authority

**Pedestrians manage social interpersonal distances**

**To keep a safety zone**

**To anticipate the collision**

**We avoid the collision by modifying our trajectory**

**Direction**

**Speed**

**Collaborative effort (YN)**

**Perception model for the virtual pedestrian**

- ORCA Model used
  - different types of collision avoidance (anticipative, reactive)

**Collision avoidance behaviors simulation (Orca model)**

- Needs to take into account the empowerment/authority

**Experiment – Results**

- Credibility of model-based videos and fake videos according to the subjects’ answers

**Experiment – Results**

- Speed and attention influence the decision to step down from the narrow sidewalk

- Virtual pedestrian decides to step down if his detection time is greater than the other pedestrian involving in the jousting

**Overall ranking of the model-based videos; Median = 4**

**First Experiment – Questionnaire**

- 64 videos of complete jousting with the new model
  - 32 videos of complete jousting with the opposite of the model result
  - Participants said if the jousting is credible
  - 64 videos of pre-jousting, before any modification of trajectory
  - 32 videos of non-counterbalanced videos
  + One of 8 videos is a fake video
  - Counterbalanced videos

**Participants said why the virtual pedestrian stepped down (speed, sex, distraction) with Likert scales**

- 64 videos of complete jousting with the new model
  - 32 videos of complete jousting with the opposite of the model result

**Participants said if the jousting is credible**

- One of 8 videos is a fake video
  - Participants said if the jousting is credible

**N.B.: the virtual pedestrian sees pedestrian in the public space, and detects him in the social space**

**CRQA Model used**

- different types of collision avoidance (anticipative, reactive)

- Collision avoidance behaviors are a function of the walking speed, the detection time