Submission ID #: 61116
Scriptwriter Name: Anastasia Gomez
Project Page Link: https://www.jove.com/account/file-uploader?src=18640428

Title: Using a Virtual Reality Walking Simulator to Investigate Pedestrian Behavior

Authors and Affiliations:

Hyun Chae Chung[1], Soon Ho Kim[2], Jong Won Kim[3], Gyoojae Choi[4], MooYoung Choi[2], Hui Li[1]

[1]Department of Sports Science, Kunsan National University, Gunsan, Republic of Korea
[2]Department of Physics and Astronomy, Seoul National University, Seoul, Republic of Korea
[3]Department of Healthcare Information Technology, Inje University, Gimhae, Republic of Korea
[4]School of Mechanical and Automotive Engineering, Kunsan National University, Gunsan, Republic of Korea

Corresponding Authors:

Hyun Chae Chung (hcx@kunsan.ac.kr)

Email Addresses for All Authors:

soonhokim@snu.ac.kr
jongwonkim@inje.ac.kr
gjchoi@kunsan.ac.kr
mychoi@snu.ac.kr
hui416@kunsan.ac.kr
hxc@kunsan.ac.kr

Author Questionnaire

1. **Microscopy**: Does your protocol involve video microscopy, such as filming a complex dissection or microinjection technique? **No**

2. **Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **YES, all done**

3. **Filming location:** Will the filming need to take place in multiple locations? **I guess NO**

Introduction

1. Introductory Interview Statements

REQUIRED:

1.1. **Hyun Chae Chung:** This highly immersive virtual reality protocol allows us to investigate how people adjust their motion during crossing.

1.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. NOTE: This author is not happy with his delivery of the interview statements, please try your best to select the most flattering takes. He's considering refilming them, but perhaps there is a take that will be satisfactory.

1.2. **Hyun Chae Chung:** Actual walking on the treadmill makes it possible to fully capture the reciprocal relationship between perception and action.

1.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

OPTIONAL:

1.3. **Gyoojae Choi:** This method can provide insight into the field of behavioral ecology, as well as allow researchers to explore questions in pedestrian safety and autonomous vehicle development.

1.3.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

1.4. **Soon Ho Kim:** It is helpful to use diagrams to visualize the crossing situation so that the researcher may calibrate the parameters correctly to suit the purpose of his or her study.

1.4.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

Introduction of Demonstrator on Camera

1.5. **Hyun Chae Chung:** Demonstrating the procedure will be Hui Li, a graduate student from my laboratory.

1.5.1. INTERVIEW: Author saying the above.

1.5.2. The named demonstrator(s) looks up from workbench or desk or microscope and acknowledges the camera.

Ethics Title Card

1.6. Procedures involving human subjects have been approved by the Kunsan National University Research Board.

Protocol

2. Preparation of Walking Simulator Configurations

2.1. Begin by setting the parameters on the walking simulator using the "Config" directory **[1]**. In the **Car** section, set the parameters for the first vehicle. Set "Type" to "1" for sedan, "2" for bus, or "0" for no vehicle. Next, set "Speed" in kilometers per hour and "Distance" to the desired value in meters **[2]**.

2.1.1. WIDE: Establishing shot of talent at the computer.

2.1.2. SCREEN: 61116_screenshot_1 - 2.3 0000-0015.mp4. "Type" being set.

2.2. Complete the **Second Car** section by setting the same parameters **[1]**.

2.2.1. SCREEN: 61116_screenshot_2 - 2.4 0000-0012.mp4. Speed and distance being entered, then [SECONDCAR] parameters being set.

2.3. The **Road** section contains parameters for lane selection. Set the parameter "lane" to "1" to use the lane closer to pedestrian's starting position or "2" for the lane further away **[1]**.

2.3.1. SCREEN: 61116_screenshot_3 - 2.6 0000-0018.mp4. Lane parameter being set in the [ROAD] section.

2.4. In the **Save** section, which contains the parameter related to sampling frequency, set the parameter "number per second" to the desired value in Hertz, then save the configuration file and exit **[1]**.

2.4.1. SCREEN: 61116_screenshot_4 - 2.7 0000-0011.mp4. "number per second" parameter being set in the [SAVE] section.

2.5. Prepare three practice trial configuration files and create a separate sheet with the list of configurations to be used in the experiment, in a randomized order **[1]**.

2.5.1. SCREEN: 61116_screenshot_7 - 2.10 0000-0621.mp4. 4:20 – 4:50.

3. Participation Screening and Preparation

3.1. Recruit participants with normal or corrected-to-normal vision and ask them to sign a written informed consent form before each experiment **[1]**. Play an audio recording with verbal instructions of the task to the participant **[2]** and encourage them to ask questions **[3]**.

3.1.1. Talent instructing the participant to sign the consent form and participant signing it.

3.1.2. Talent playing an audio recording and participant listening.

3.1.3. Talent talking to participant.

3.2. When ready, lead the participant to the treadmill **[1]** and harness the stabilizing belt to the participant's waist **[2]**. Instruct them to hold the handrails at all times during the experiment **[3]**.

3.2.1. Talent instructing the participant to get on the treadmill and participant getting on.

3.2.2. Talent harnessing the belt to the participant's waist.

3.2.3. Talent instructing participant to hold the handrails and participant holding them.

4. Practice Trials and Virtual Walking Experiment

4.1. Ask the participant to practice walking on the treadmill, with the belt on, while holding the handrails **[1]**. Once the participant is able to walk on the treadmill comfortably, double-click the executable simulator to begin the walking simulator program **[2]**.

4.1.1. Participant walking on the treadmill.

4.1.2. Talent at the computer clicking the executable simulator.

4.2. Instruct the participant to wear the headset, providing assistance as needed **[1]**. Check for both comfort and stability with respect to head turns **[2]**. Calibrate the headset so that the black and white cartoon crosswalk is properly aligned with the participant's view **[3]**.

4.2.1. Participant putting on the headset.

4.2.2. Talent making sure that the headset is on properly.

4.2.3. Talent calibrating the

4.3. Inform the participant that the first practice trial will occur without any vehicles and begin the trial **[1]**. Enter the first practice trial's configuration number in the text box on the bottom of the screen and click the **Start** button **[2]**.

4.3.1. Talent at the computer preparing to begin the trial and letting the participant know that there are no vehicles in this trial.

4.3.2. SCREEN: 61116_screenshot_8 - 4.5.2 0000-0005.mp4. Practice trial's configuration number being entered and Start clicked.

4.4. Instruct the participant to look straight ahead, get ready when they hear "Ready", and begin walking when they hear "Go" **[1]**. Then, give the verbal cues "Ready" and "Go" **[2]**. When finished with the first practice trial, perform the second practice trial that introduces vehicles without walking **[3]**.

4.4.1. Talent instructing the participant.

4.4.2. Participant beginning to observe.

4.4.3. SCREEN: 61116_screenshot_9 - 4.7.2 0000-0009.mp4. Simulation with vehicles.

4.5. For the third practice trial, inform the participant that it will involve two vehicles coming from the left side, and that he or she should attempt to cross the road between the two vehicles **[1]**. Enter the third practice trial number in the text box and click the **Start** button **[2]**.

4.5.1. Talent instructing the participant.

4.5.2. Talent at the computer starting the practice trial.

4.6. To perform the virtual walking experiment, type in the first configuration number from the data sheet on the text box and click **Start [1]**. Perform the simulation in the same way as the final practice trial **[2]** and record the result next to the configuration number on the experiment sheet **[3-TXT]**.

4.6.1. SCREEN: 61116_screenshot_10 - 5.2 0000-0010.mp4. Number being typed in and Start clicked.

4.6.2. Participant walking on the treadmill, performing the task in the experiment.

4.6.3. SCREEN: 61116_screenshot_12 - 5.4 0000-0009.mp4. Result being recorded.
TEXT: Repeat for all configurations in the randomized list

Results

5. Results: Velocity Dependence on Initial Distance and Vehicle Size

5.1. The walking simulator was used to determine if the initial distance from the curb to the interception point affects the approach velocity of participants **[1]**.

5.1.1. LAB MEDIA: Figure 5.

5.2. The velocity of young adults increased throughout the approach **[1]**. However, when the initial distance was short, they slowed down at the beginning of the trial and sped up continuously **[2]**.

5.2.1. LAB MEDIA: Figure 5, just the Young Adult graph. *Video Editor: Emphasize the Far data line.*

5.2.2. LAB MEDIA: Figure 5, just the Young Adult graph. *Video Editor: Emphasize the Intermediate and Near data lines.*

5.3. For children, vehicle size affected the velocity profiles and crossing position induced by the initial distance **[1]**. Post-hoc analysis showed that children sped up throughout the approach **[2]**. However, when they crossed between cars, they slowed down at the beginning of the approach for the near initial distance **[3]**.

5.3.1. LAB MEDIA: Figure 6.

5.3.2. LAB MEDIA: Figure 6, just the car graph.

5.3.3. LAB MEDIA: Figure 6, just the car graph. *Video Editor: Emphasize the Far data line.*

5.4. When children crossed between the buses, their speeds neither increased nor decreased at the beginning of the approach for the near initial distance **[1]**.

5.4.1. LAB MEDIA: Figure 6, just the bus graph.

5.5. It was found that children's times of intercept increased significantly as the initial distance increased from near to far **[1]**. However, when crossing between buses, children's times of interception were not significantly different between near and intermediate initial distances **[2]**.

5.5.1. LAB MEDIA: Figure 7. *Video Editor: Emphasize the car data.*

5.5.2. LAB MEDIA: Figure 7. *Video Editor: Emphasize the bus data.*

Conclusion

6. Conclusion Interview Statements

6.1. **Soon Ho Kim:** In order for this method to provide accurate information about crossing behavior, the visual field seen through the virtual reality headset must be properly calibrated.

6.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 4.3.2.*

6.2. **Soon Ho Kim:** This technique allowed researchers to develop mathematical models of pedestrian behavior, which were used to study concepts such as bearing angle and affordance.

6.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.