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# Spatially Perturbed Collision Sounds Attenuate Perceived Causality in 3D Launching Events

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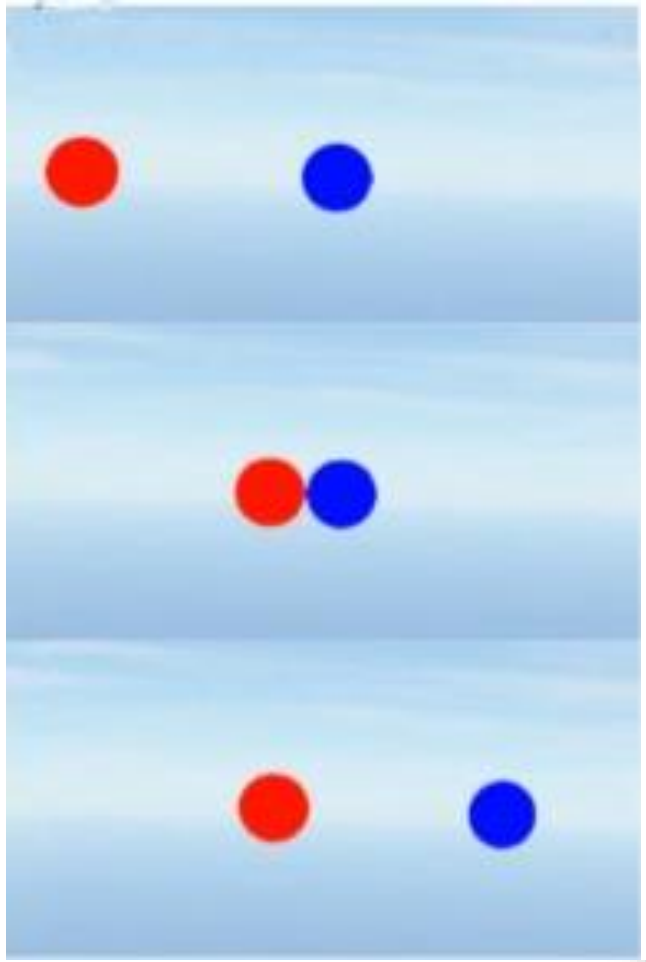
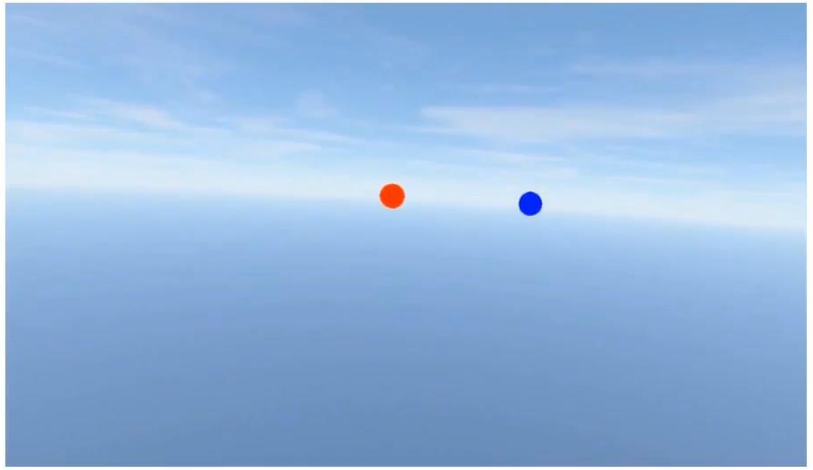
# Perceived Causality in Launching Event



Examples of Launching Events



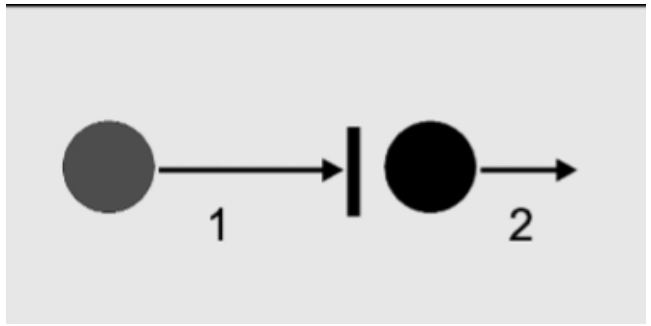
Good launching example
(time delay = 0 msec)

Bad launching example
(time delay = 400 msec)

# Literature

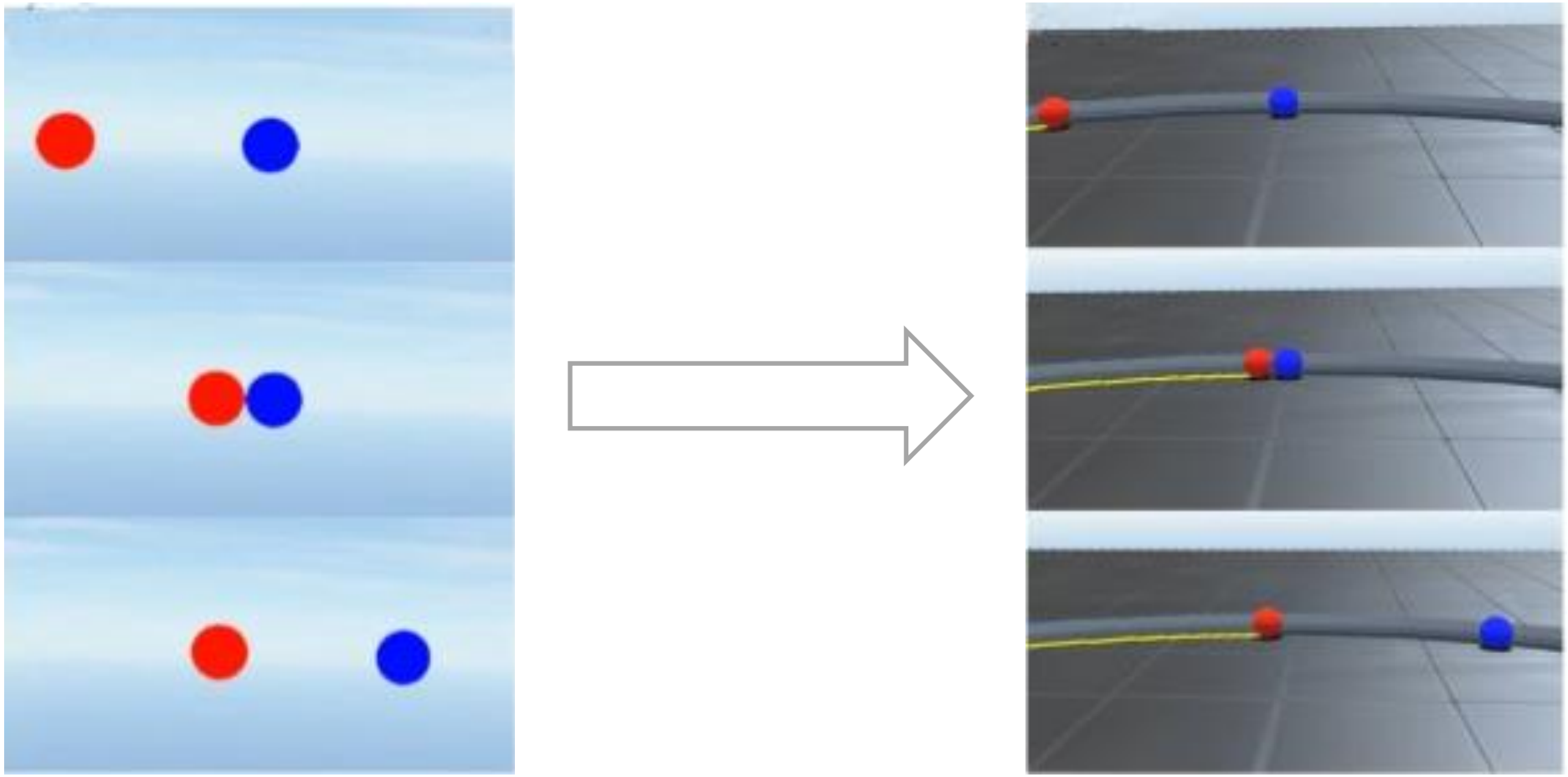
- **Brian Scholl**
- Perceptual causality and animacy, *Trends in Cognitive Sciences*, *4(8)*, 299-309, (2000).

- **Guski and Troje**
- Audiovisual phenomenal causality, *Perception & Psychophysics*, 65(5):789,(2003).

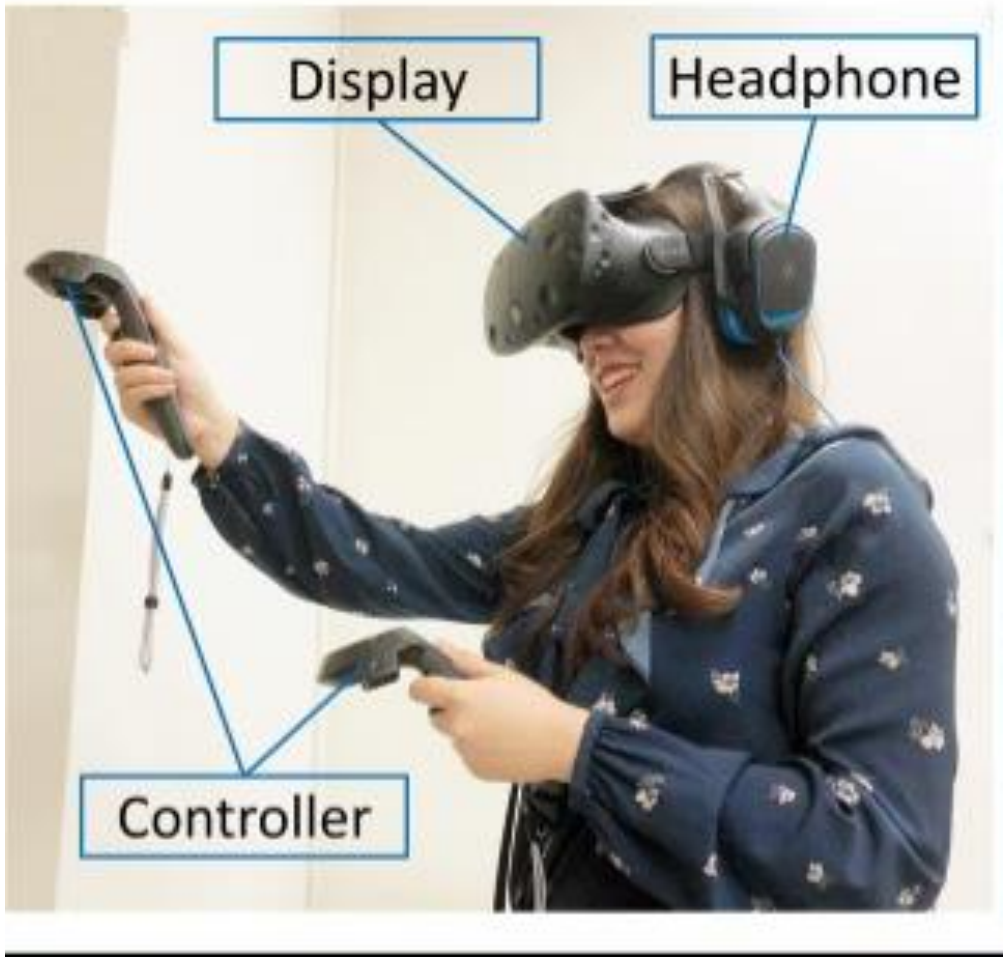



**Previous Work**

# Extend 2D Visual Displays to 3D Virtual Environment



# VR Devices for the Virtual Environment



# Instructions before Experiments

In the following experiment, you will watch videos of two balls in motion.
You will view the videos in an immersive virtual environment.

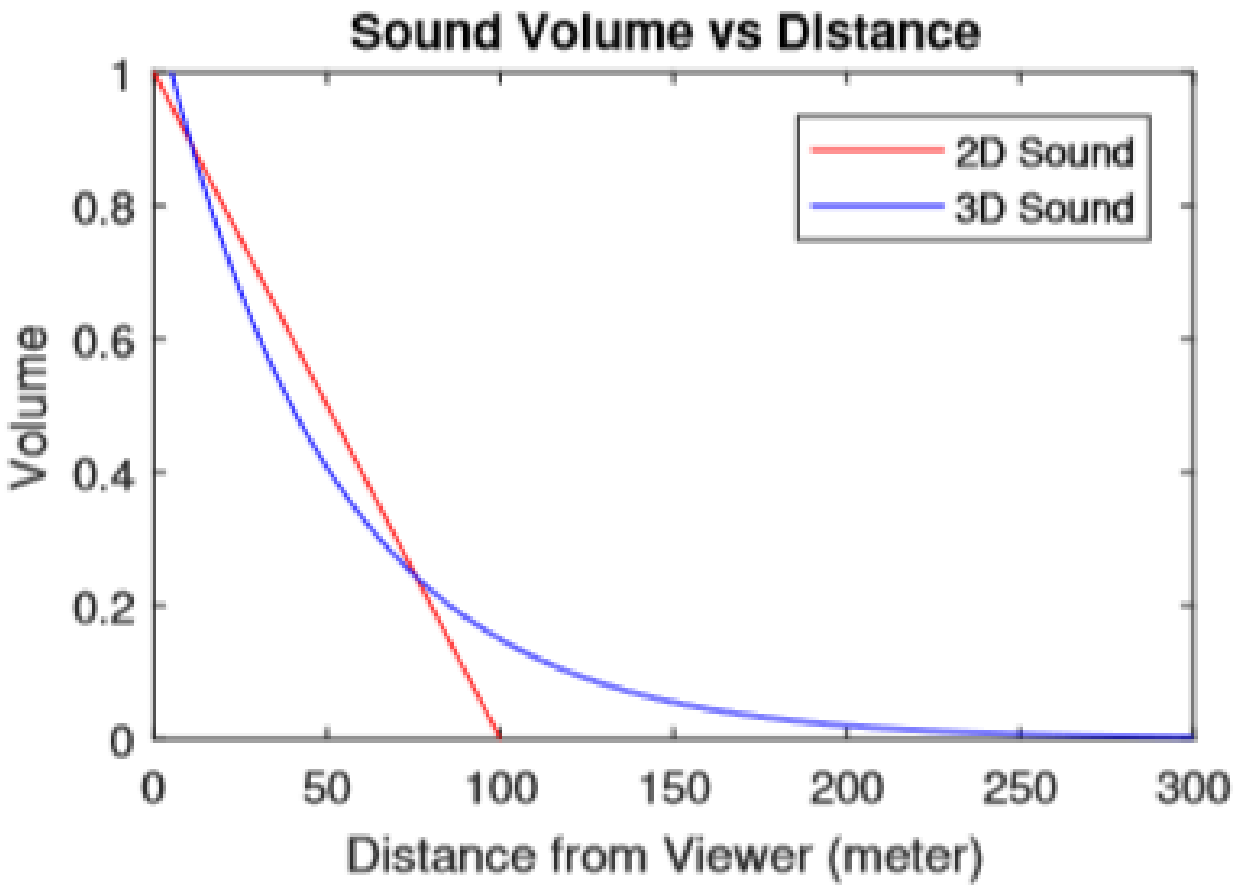
In each video, a red ball moves toward a blue ball.

The red ball moves until it comes into contact with the blue ball.

Afterwards, the red ball stops and the blue ball moves rightward.

Press the ‘Next’ button when you are ready to move to the next page of instructions.

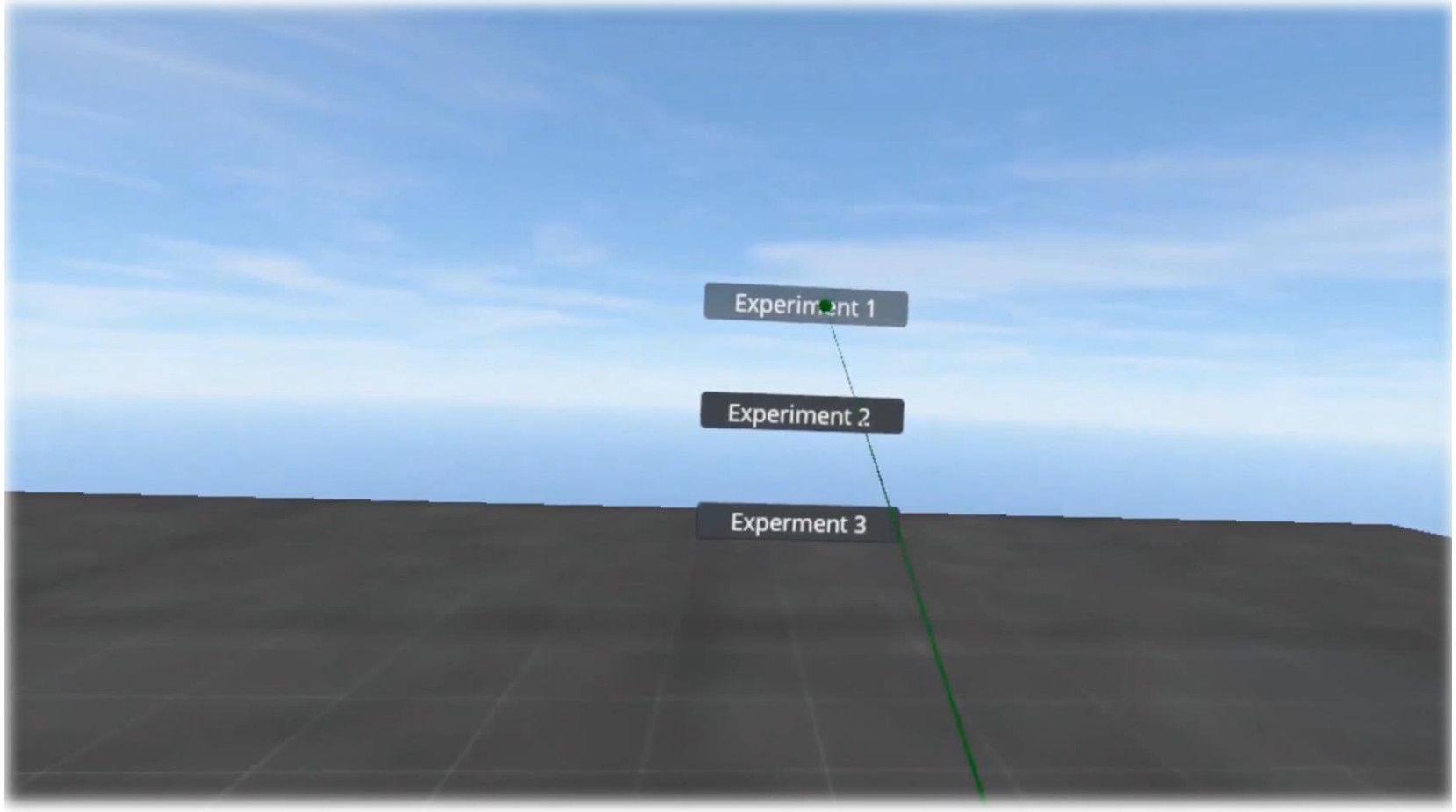
# Sound Synthesis



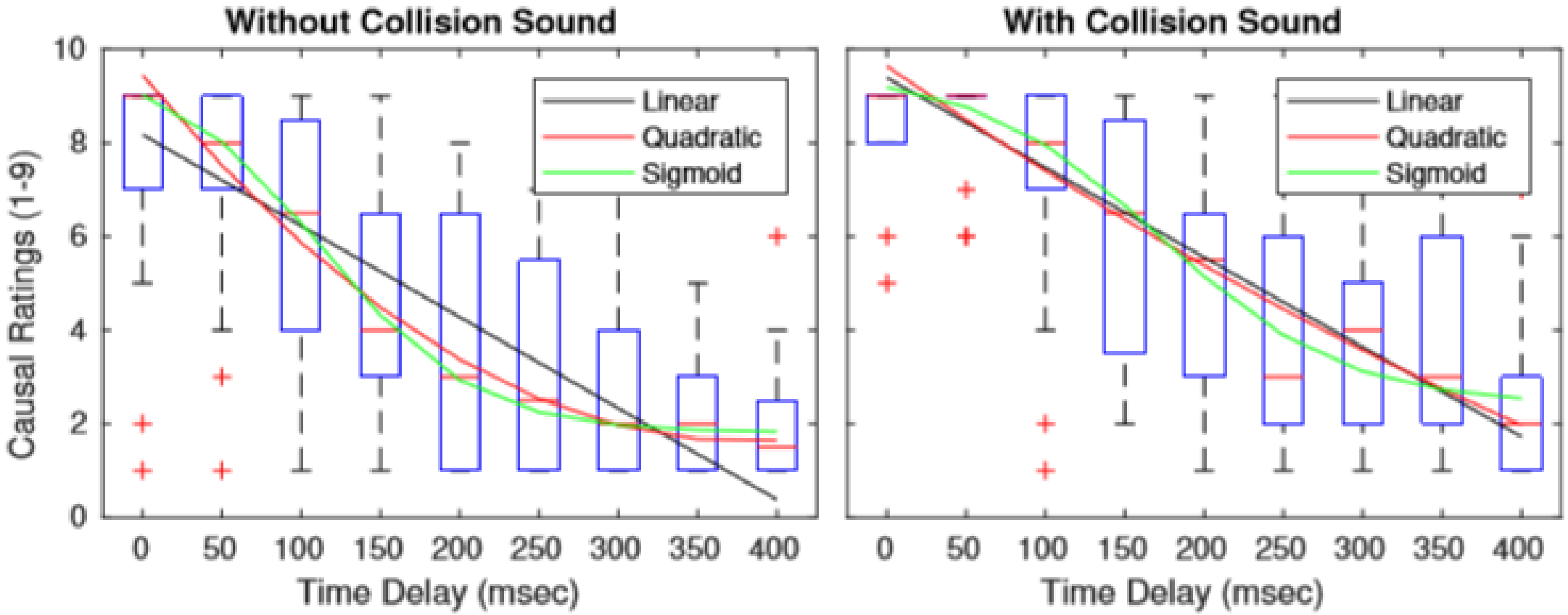
# Experiment Design

- 2D Causal Perception-Exp.1
- 3D Causal Perception-Exp.2
- Spatially Perturbed Collision Sound-Exp.3

# 2D Causal Perception-Exp.1



# Results


Without Collision Sound
With Collision Sound
Causal Ratings (1-9)
Time Delay (msec)
Linear
Quadratic
Sigmoid
0
2
4
6
8
10
0
50
100
150
200
250
300
350
400

# Experiment Design

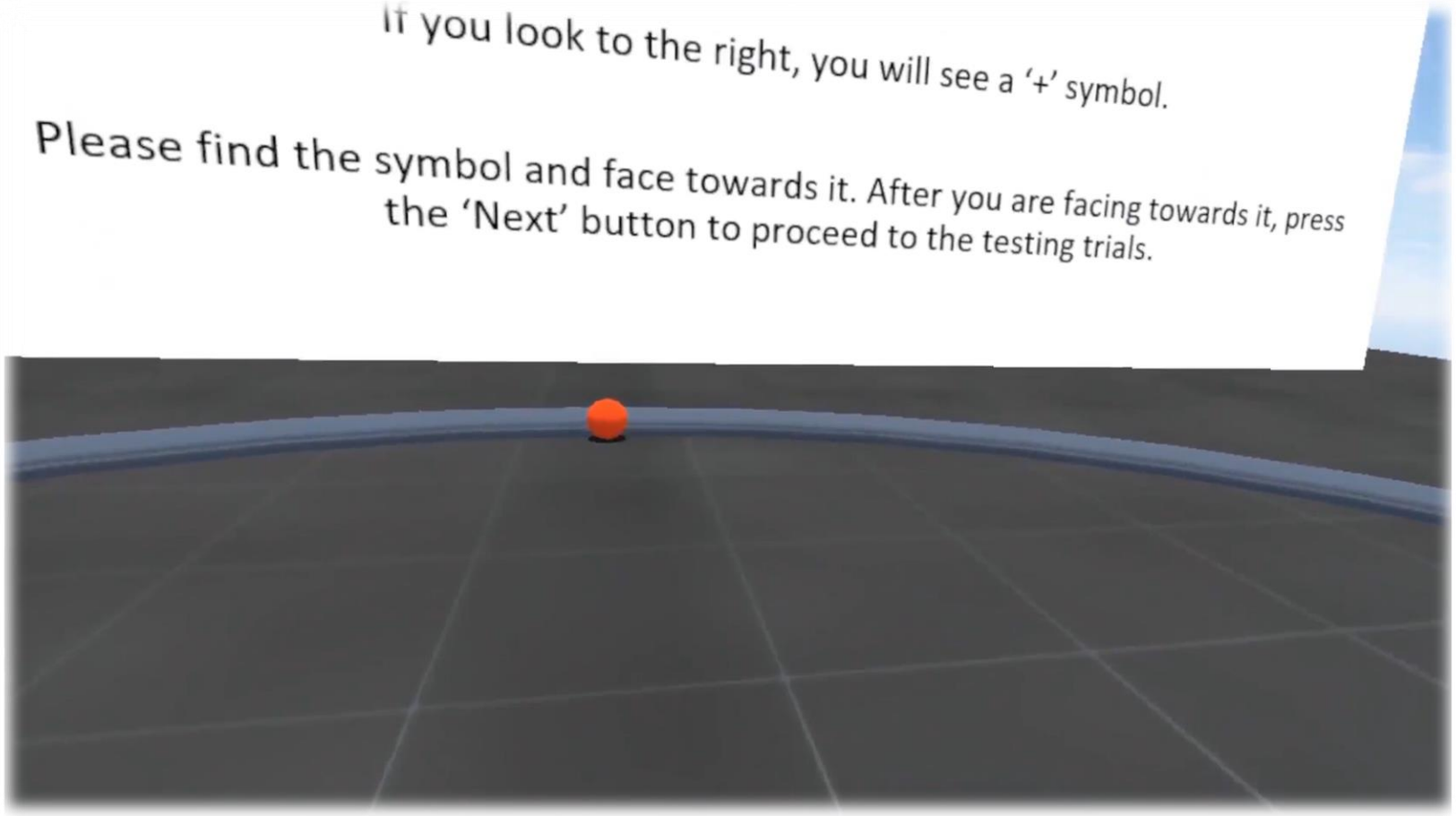
- 2D Causal Perception-Exp.1
- 3D Causal Perception-Exp.2
- Spatially Perturbed Collision Sound-Exp.3

# 3D Causal Perception-Exp.2

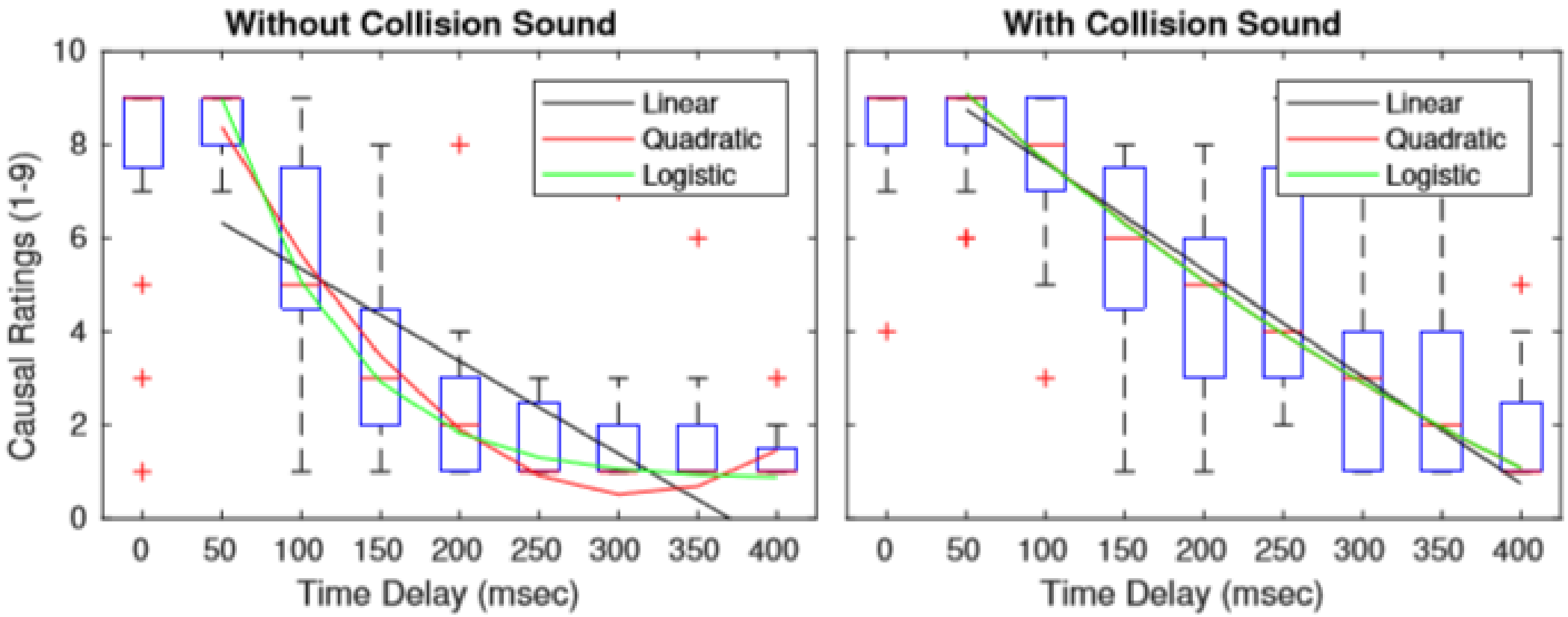
Please look for the symbol “+” to the right of the screen.

After you facing towards it, press the ‘Next’ button to proceed to the testing trials.

# 3D Causal Perception-Exp.2



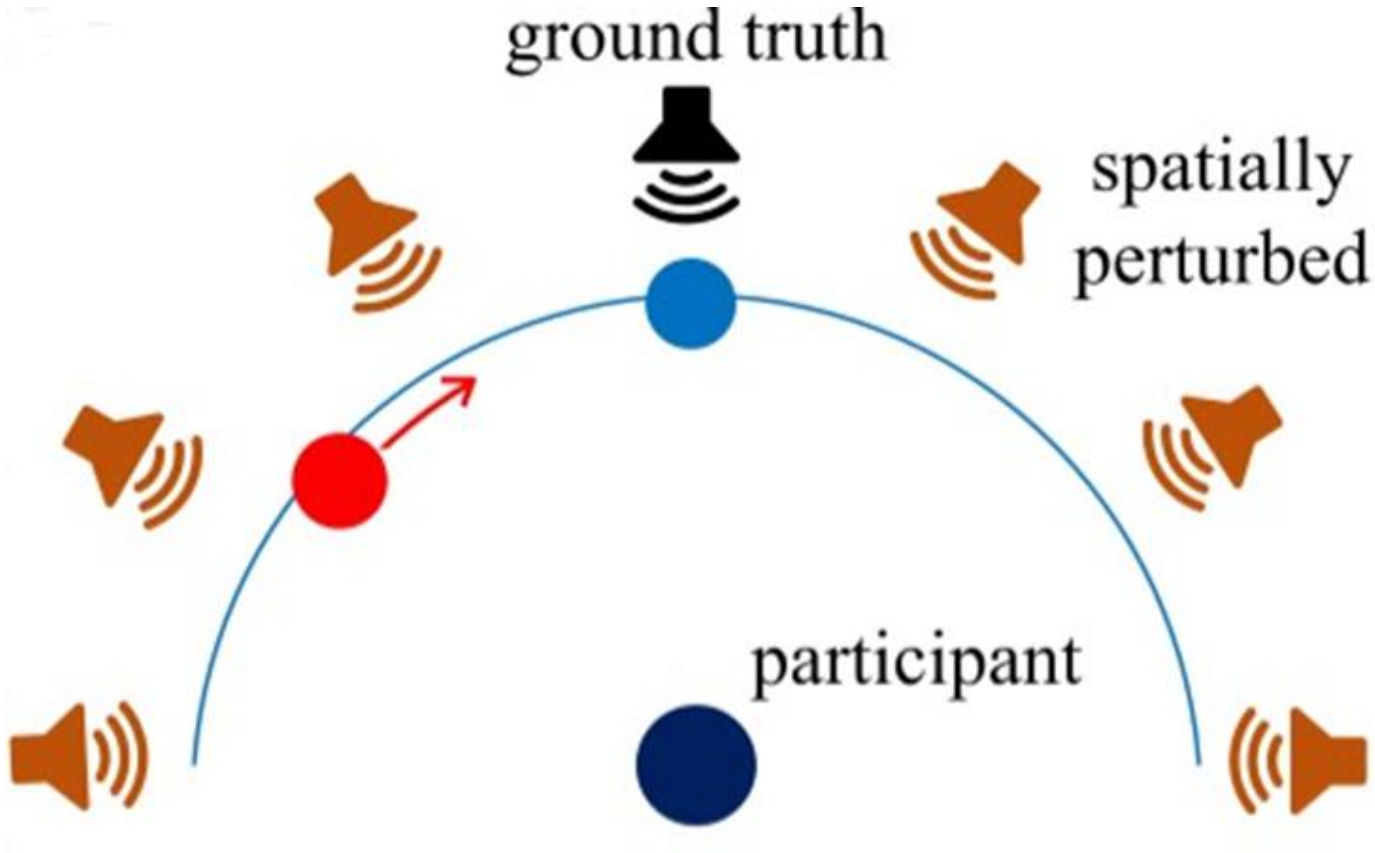
# Results


Without Collision Sound
With Collision Sound
Causal Ratings (1-9)
Time Delay (msec)
Linear
Quadratic
Logistic
0
2
4
6
8
10
0
50
100
150
200
250
300
350
400

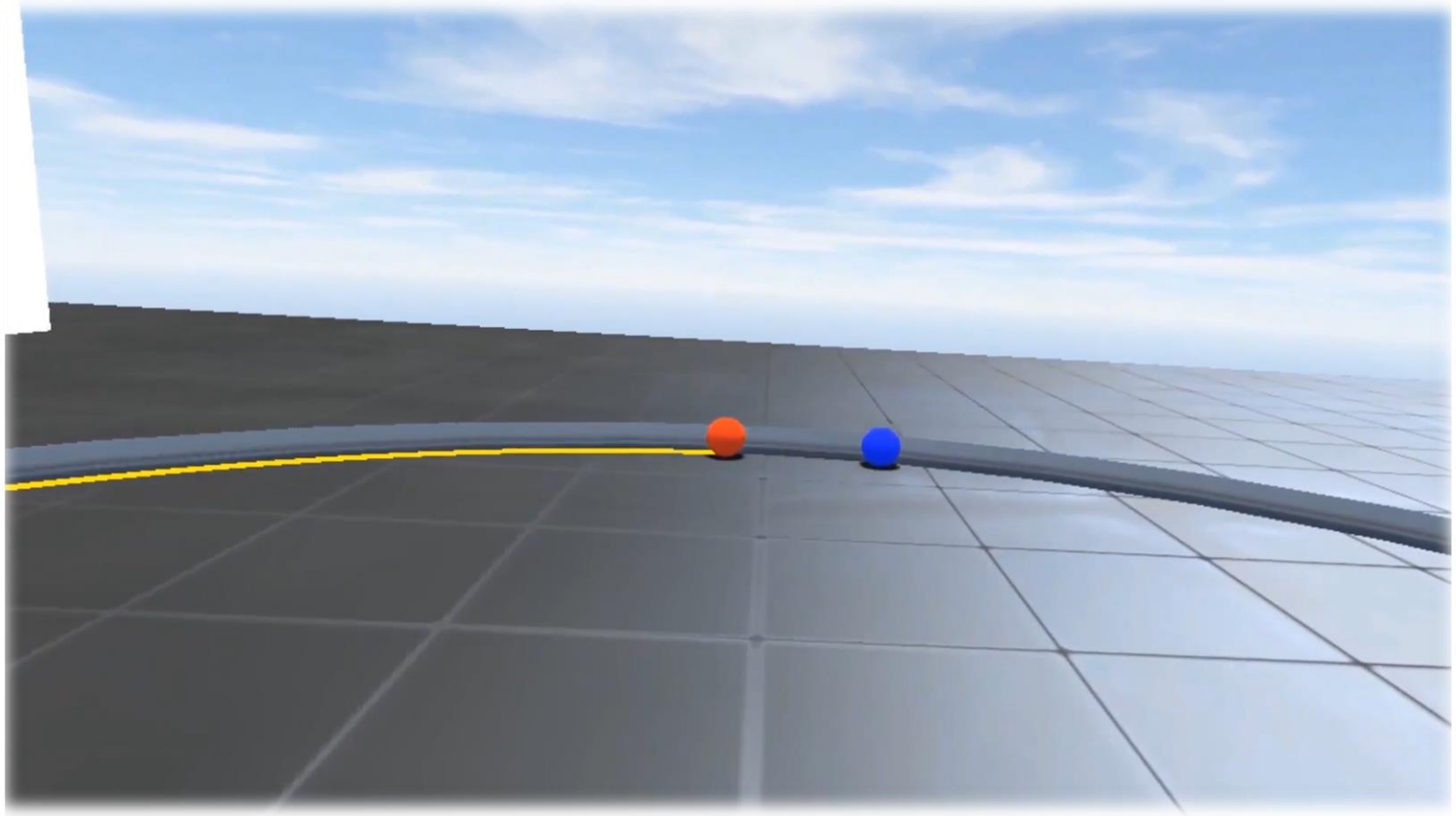
# Experiment Design

- 2D Causal Perception-Exp.1
- 3D Causal Perception-Exp.2
- Spatially Perturbed Collision Sound-Exp.3

# Spatially Perturbed Collision Sound-Exp.3

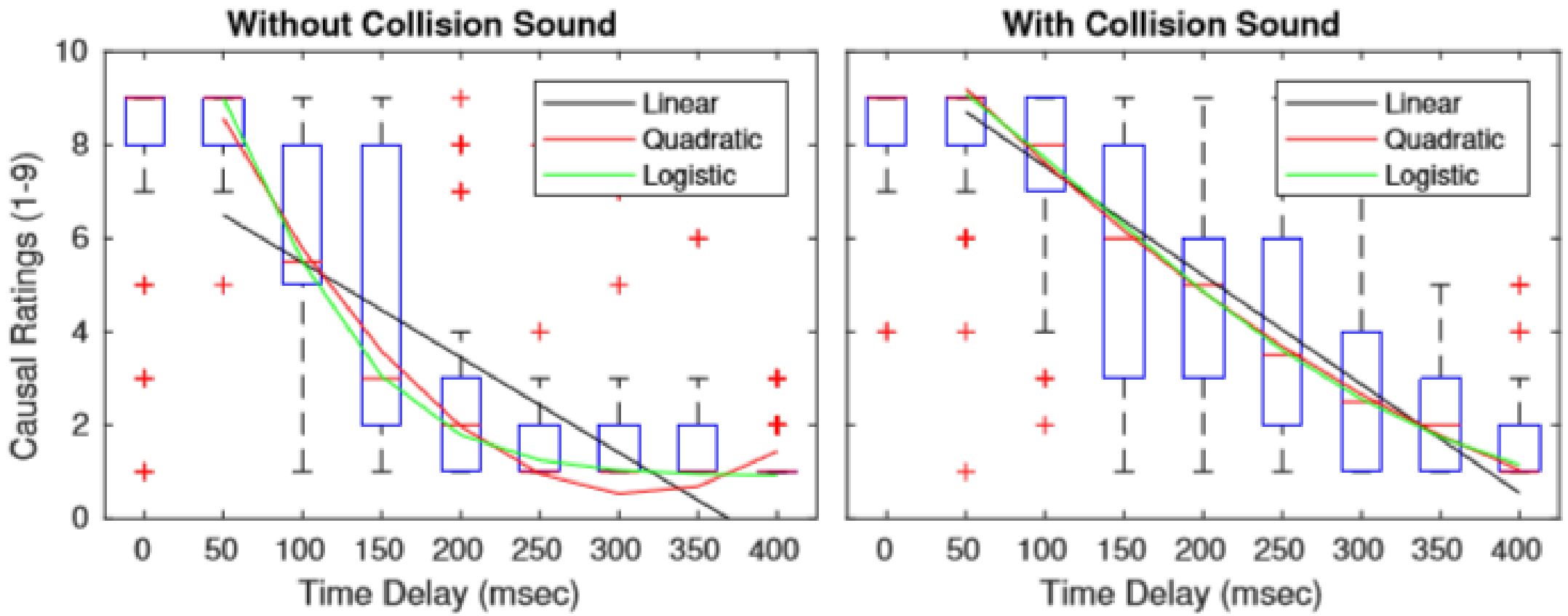


# Spatially Perturbed Collision Sound-Exp.3

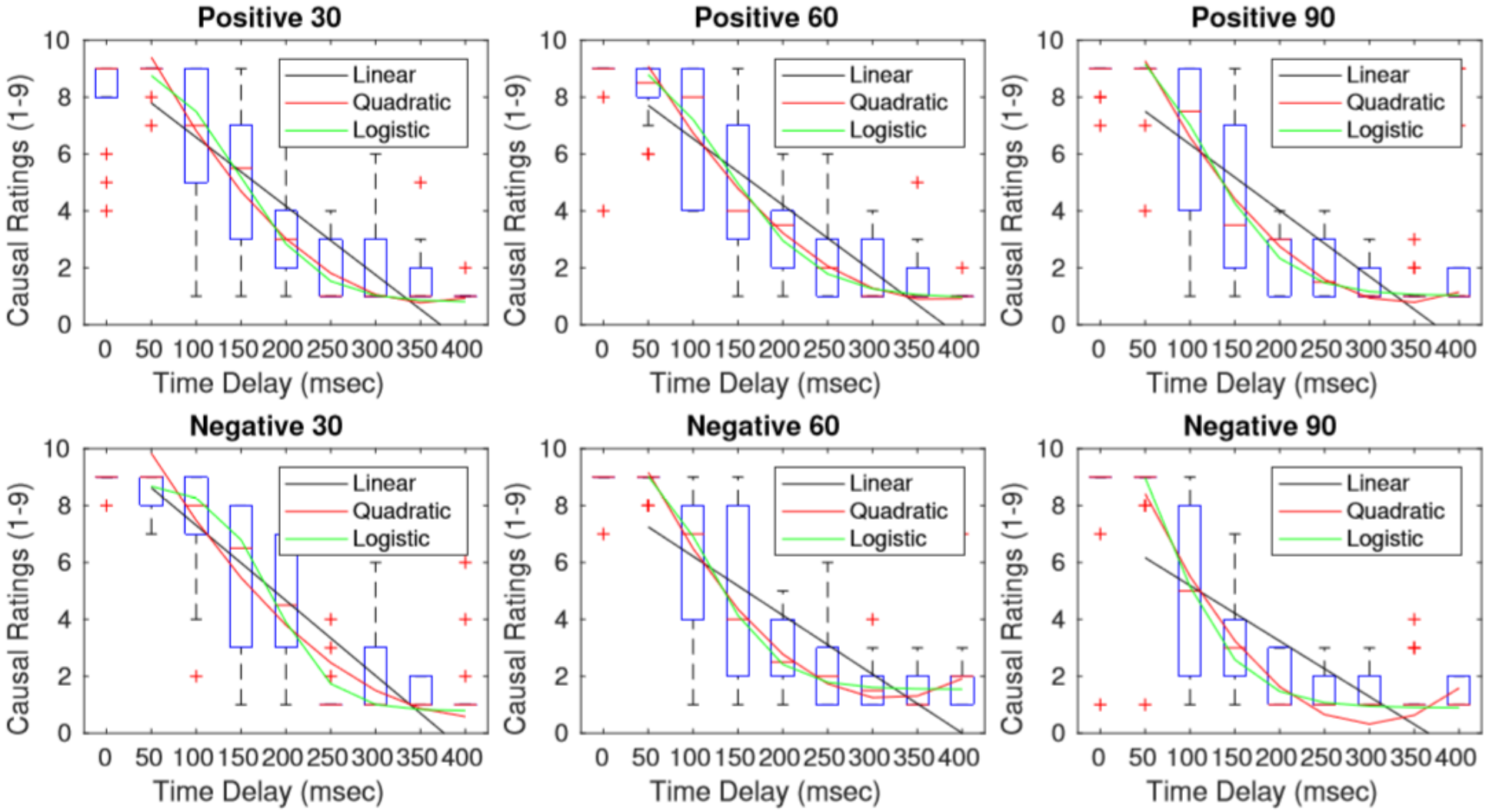


# Spatially Perturbed Collision Sound-Exp.3

# Results


Without Collision Sound
With Collision Sound
Causal Ratings (1-9)
Time Delay (msec)
Linear
Quadratic
Logistic
0
2
4
6
8
10
0
50
100
150
200
250
300
350
400

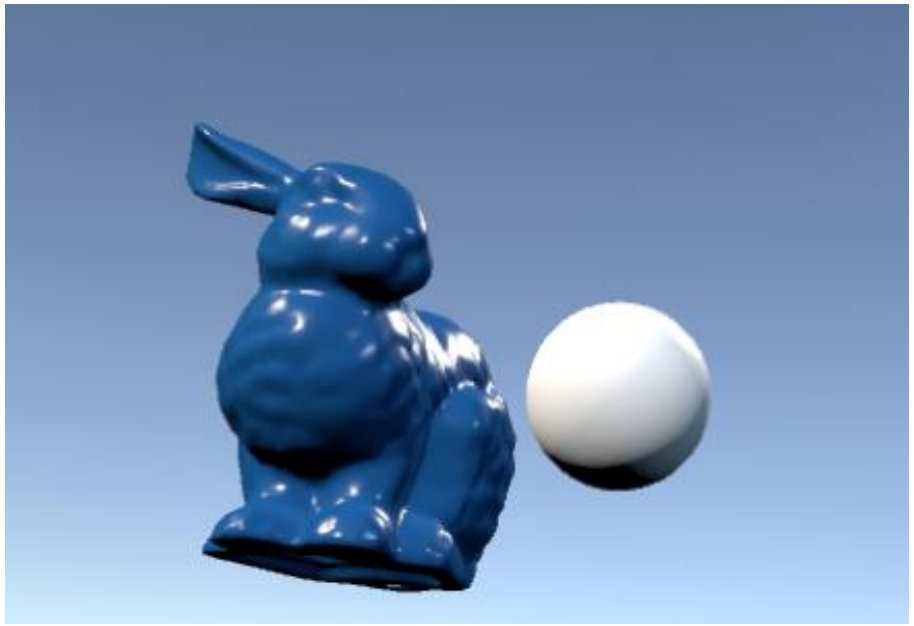
# Results


Positive 30
Positive 60
Positive 90
Negative 30
Negative 60
Negative 90
Linear
Quadratic
Logistic
Causal Ratings (1-9)
Time Delay (msec)
0
2
4
6
8
10
0 50 100 150 200 250 300 350 400

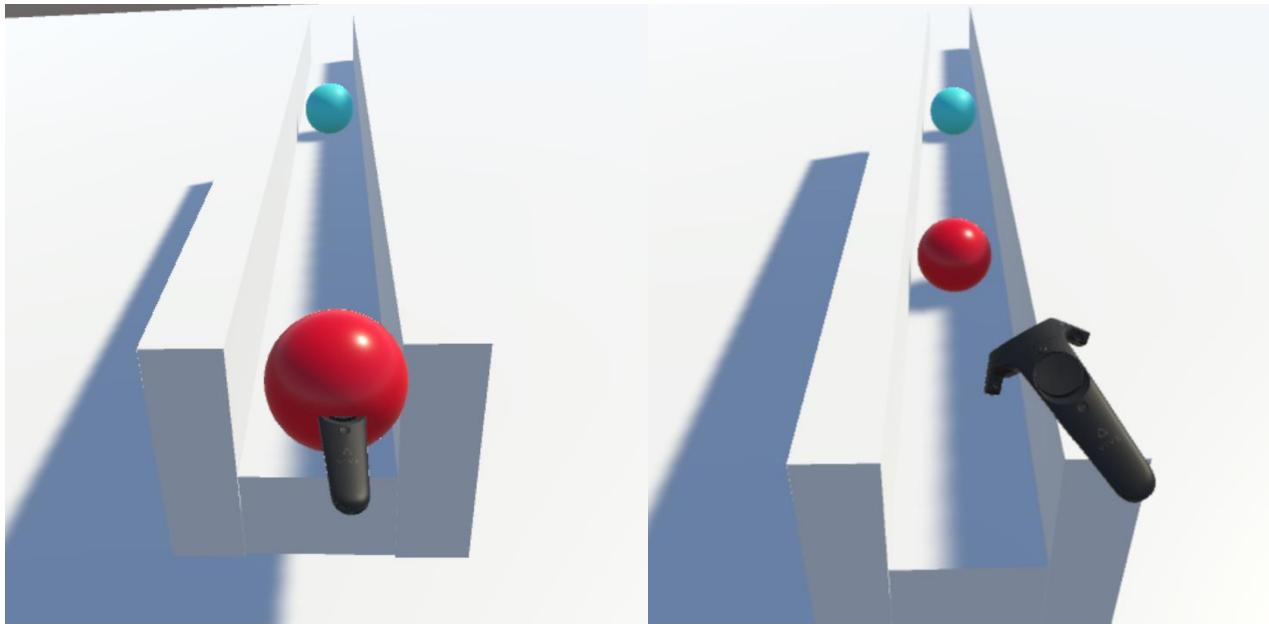
# Contributions

- Replicated previous work of causal perception in a virtual environment
- Examined the effect of spatially perturbed auditory collision indicators
- Measured how well humans can estimate sound location in a VR setup

# Future Works



Irregular Shape



Interaction

# THANK YOU!

**Project Page:**

**https://www.duotun-wang.co.uk/spatially-perturbed-collision-sound**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