



Does the size-arrival effect occur with an active collision avoidance task in a virtual reality environment?



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Introduction

Background

- Size-arrival effect (DeLucia, 2013)
- Subjects viewed computer simulations of 2 approaching objects and reported which object would arrive first
- The visual information known as tau correctly indicated that the smaller object would arrive first
- The pictorial depth cue of relative size incorrectly indicated that the larger object was closer
- Participants reported that the larger object would reach them first
- Judgements were consistent with relative size, not tau

Purpose

- To replicate the size-arrival effect (SAE) in an immersive virtual reality environment

Method

Participants

- 24 adults recruited across Rice campus through flyers and emails
- They had normal hearing, vision, and motor control
- All passed the Rando Stereo Vision test; mean stereo acuity was 62 seconds of arc
- They were paid \$20 for participation

Design

- Object size: small or large
- TTC of small object: 1.5 s, 3 s, 4.5 s, 6 s
- Task: Ducking, PM, and Relative

Procedure

Ducking Task

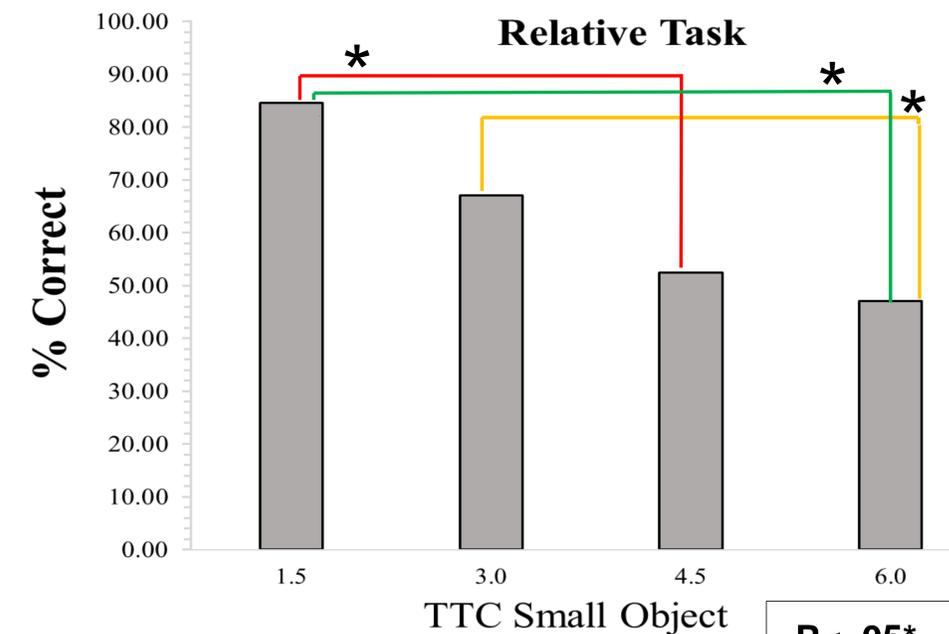
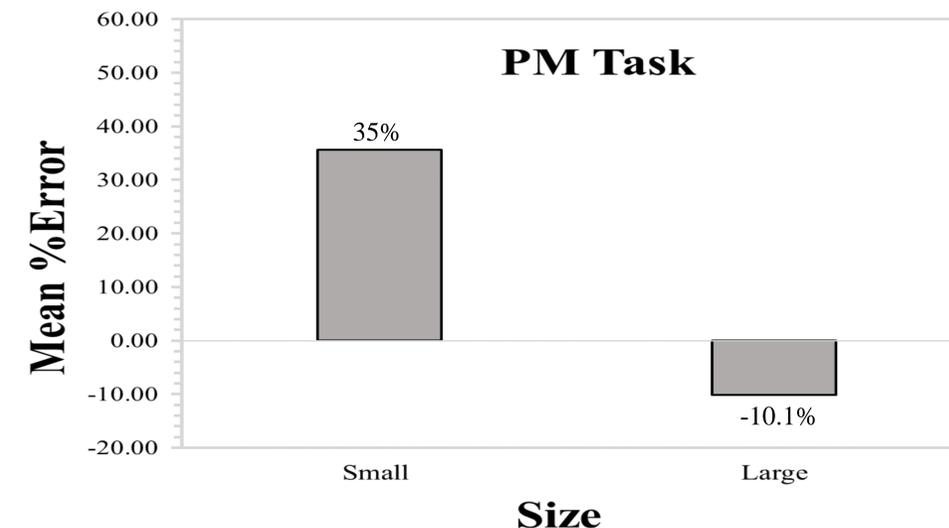
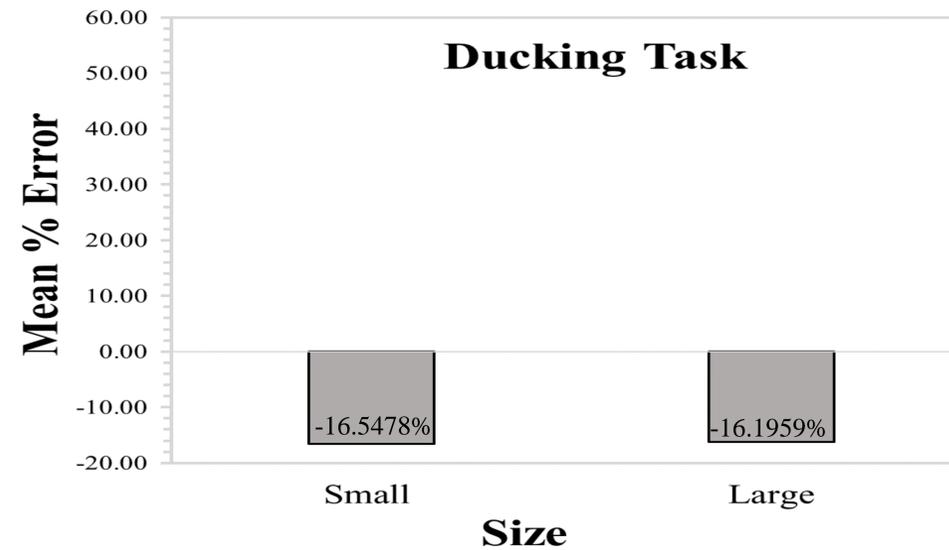
- Participants saw yellow sphere object move toward them
- They had to duck out of the way at the last possible moment before collision
- The object was either small or large on different trials
- The objects moved at the same speeds, but the small object would arrive first
- We measured the time at which participants started to duck and compared it between small and large objects

PM Task

- Participants saw an object (same as in ducking) move toward them and then disappear
- Participants pressed a button on the virtual reality (VR) controller at the exact time they thought the object would hit or pass them had it kept moving after it disappeared
- The object was either small or large on different trials
- The objects moved at the same speeds, but the small object would arrive first
- We measured the time at which participants pressed button-- their TTC estimate-- and compared it between small and large objects

Relative TTC Task

- A small and a large object approached the participants and then disappeared
- These were the same objects used in the ducking and PM tasks
- Participants pressed a button on the VR controller to report which object would reach them first
- The objects moved at the same speeds, but the small object would arrive first
- We measured the percentage of trials in which participants correctly selected the small object



Results

Ducking Task

- The mean percent error was -16.5478% for the small object and -16.1959% for the large object
- Participants started to duck before the actual collision but did so at about the same time for the small and large objects-- the percentage error was comparable
- This SAE did not occur

PM Task

- When the object was small the mean percent error was 35%. When the object was large their mean percent error was -10.1%
- Participants thought the large object would hit them sooner than the smaller object
- This SAE did occur

Relative TTC Task

- At the shortest TTC of 1.5 s, the SAE occurred rarely- on only 16% of the trials- less than chance (50%)
- As actual TTC increased, the strength of the SAE increased but still didn't differ much from chance or guessing- 50%

Conclusion

- The SAE can occur in immersive virtual environments when the task is passive and requires cognitive processes-- the PM task
- The effect does not occur in an immersive virtual environment when the task is active and does not require cognitive processes-- the ducking task
- The effect is weak when the task is a relative TTC judgment and depends on the actual TTC
- The occurrence of the SAE depends on how compelling of the displays and the nature of the task

Implication

- Drivers may need training or technology assistance to avoid effects of size on overtaking tasks

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