

Smart Helmet and Wristbands

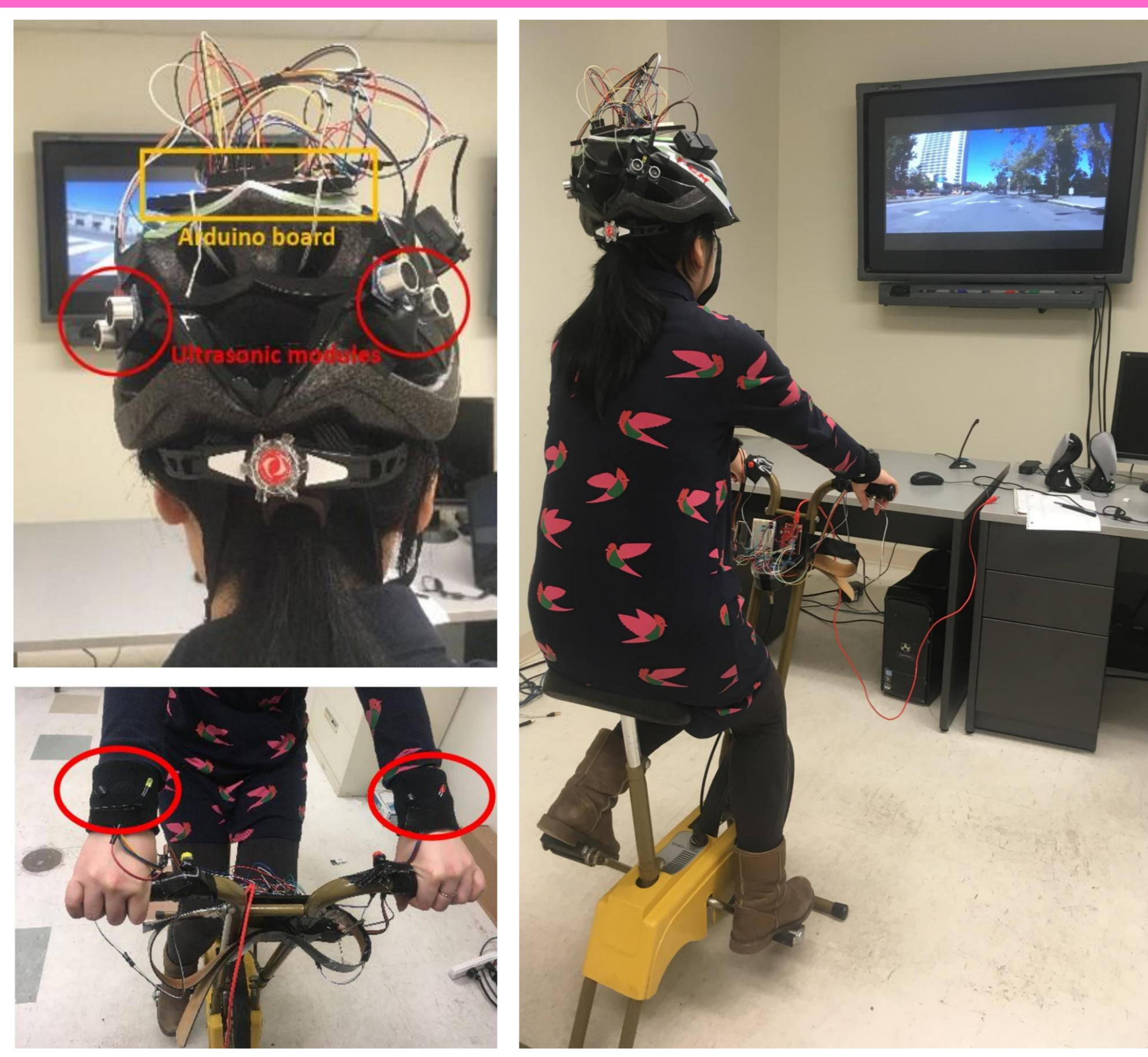
Design and testing of a new wearable safety system for cyclists

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A bike helmet that senses approaching vehicles and alerts the cyclist through notifications on both wrists:

Haptic **Auditory** **Visual**



In-Lab Testing

- Stationary bike + virtual bike ride
- Participants pedalled while watching screen
- 2 response buttons, 1 per direction
- We manually obstructed both helmet sensors at ~1m distance (within participant's blind spots)
- Participants pressed button for direction of obstruction (awareness of direction), or opposite direction of obstruction (turning decision)

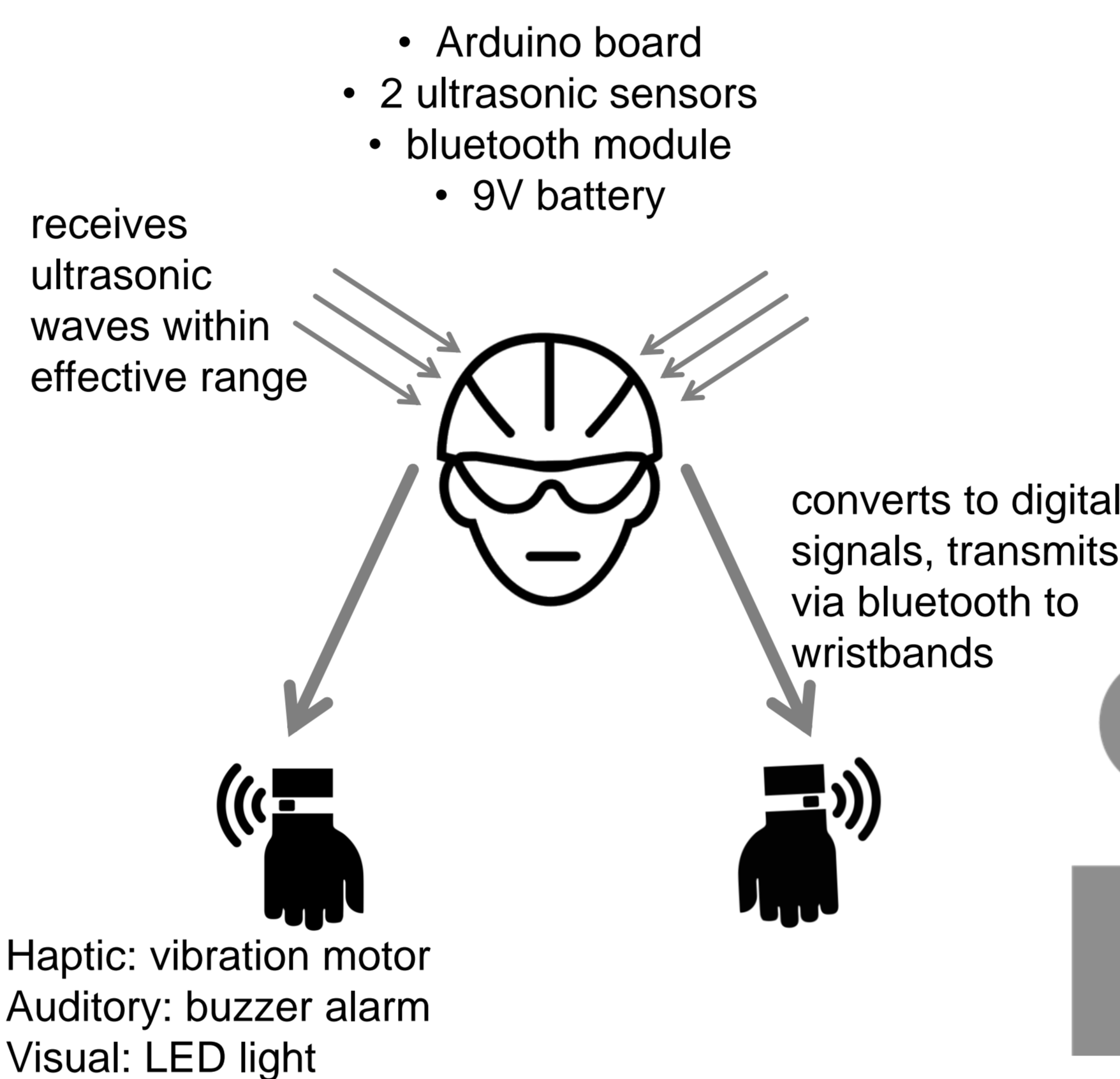
Research Questions

Which notification method is:

RQ1. the most effective in alerting the user of the **direction** from which the vehicle is approaching? (*awareness-of-direction*)

RQ2. the most effective in alerting the user of which direction to **turn** in? (*turning-decision*)

RQ3. the most preferred?



Methodology

Within-subjects; session: ~30 to 60 min

1. Pretest

2. *Awareness-of-direction* x 3

Participants pressed the response button corresponding to the same side they received the notification, e.g. right wrist flashes, press right response button.

3. *Turning-decision* x 3

Participants pressed the response button opposite to the side they received the notification, e.g. left wrist buzzes, press right response button.

4. Post test

10 participants

21 to 44 yrs old; 7 female, 3 male



600 trials

6 conditions x 10 trials = 60 trials per participant



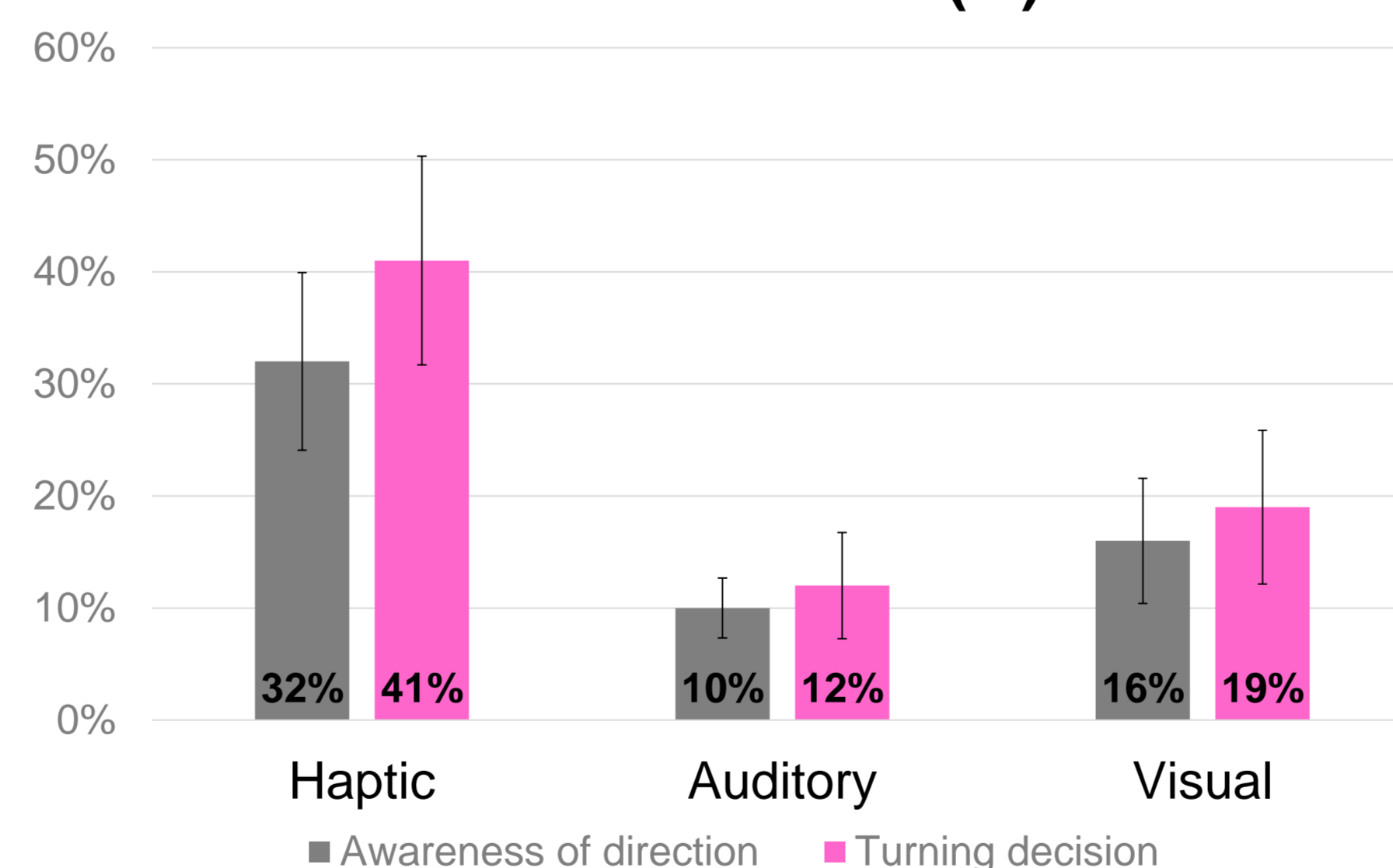
Results

RQ1. Auditory

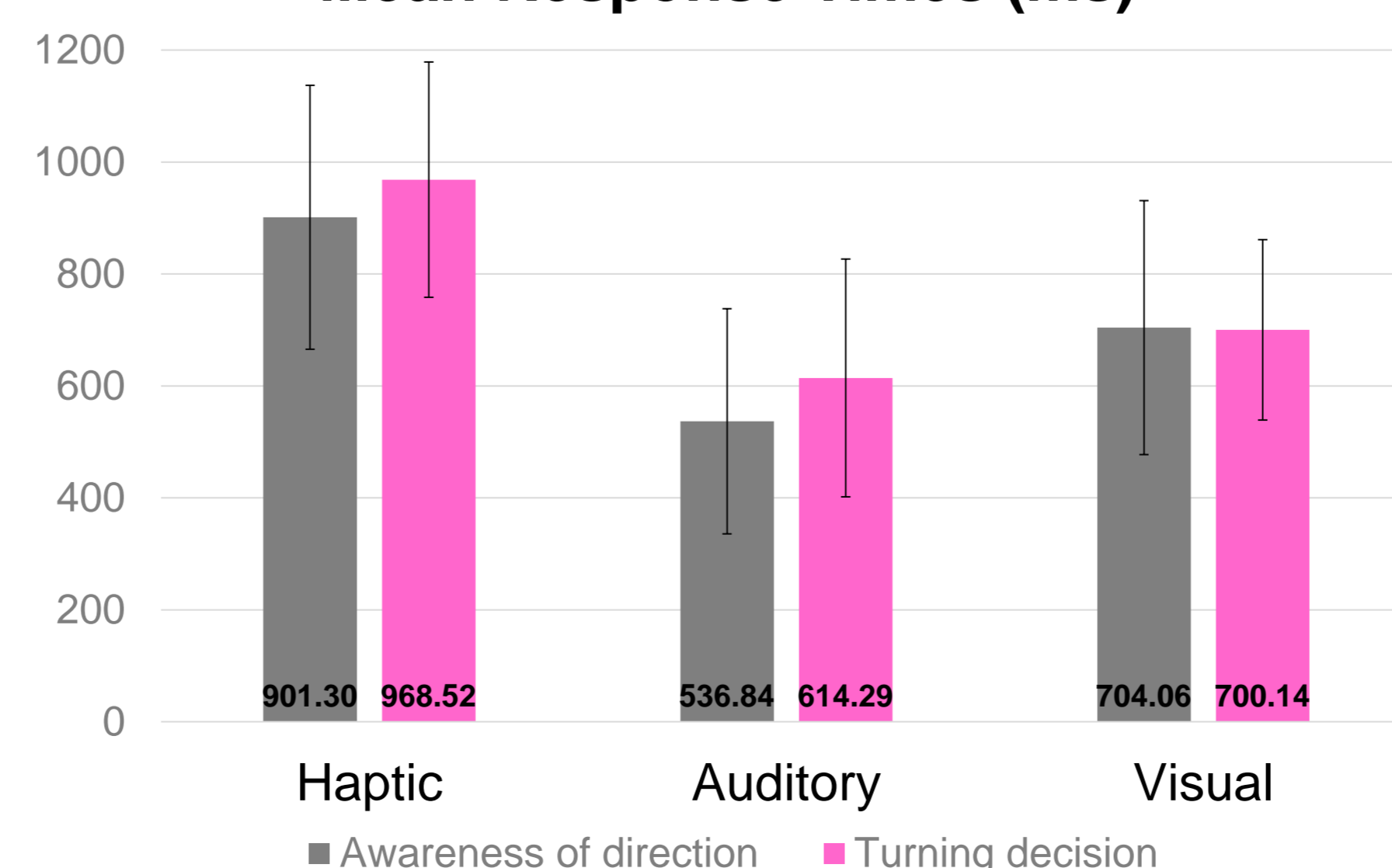
RQ2. Auditory

RQ3. Haptic

Mean Error Rates (%)



Mean Response Times (ms)



Participant Feedback

- Complementary and tiered notifications
- Different locations on body for notifications
- Warning fatigue
- Differing sensitivity across participants

"vibrations will discomfort my wrist eventually. I would hate it if it was stronger. I would take it off. [...] It would make me feel like not wanting to bike anymore."

"I love it, it's fantastic, excellent, there's a need for this. Totally warranted [because] Ottawa is a very dangerous city to bike in. Cars do not respect bike lanes."

"if it's possible you can make the vibration on the seat, and also on the pedal."

"I want to know how dangerous it is, not be notified all the time."

"Combining sound and vibration could work because if you're moving your hand you wouldn't notice the vibration but you would hear the sound [...] but both together all the time will be annoying."