Institute for Transport Studies
FACULTY OF ENVIRONMENT

UNIVERSITY OF LEEDS

What information do cyclists and pedestrians want when interacting with a fully Automated Road Transport Systems (ARTS)?

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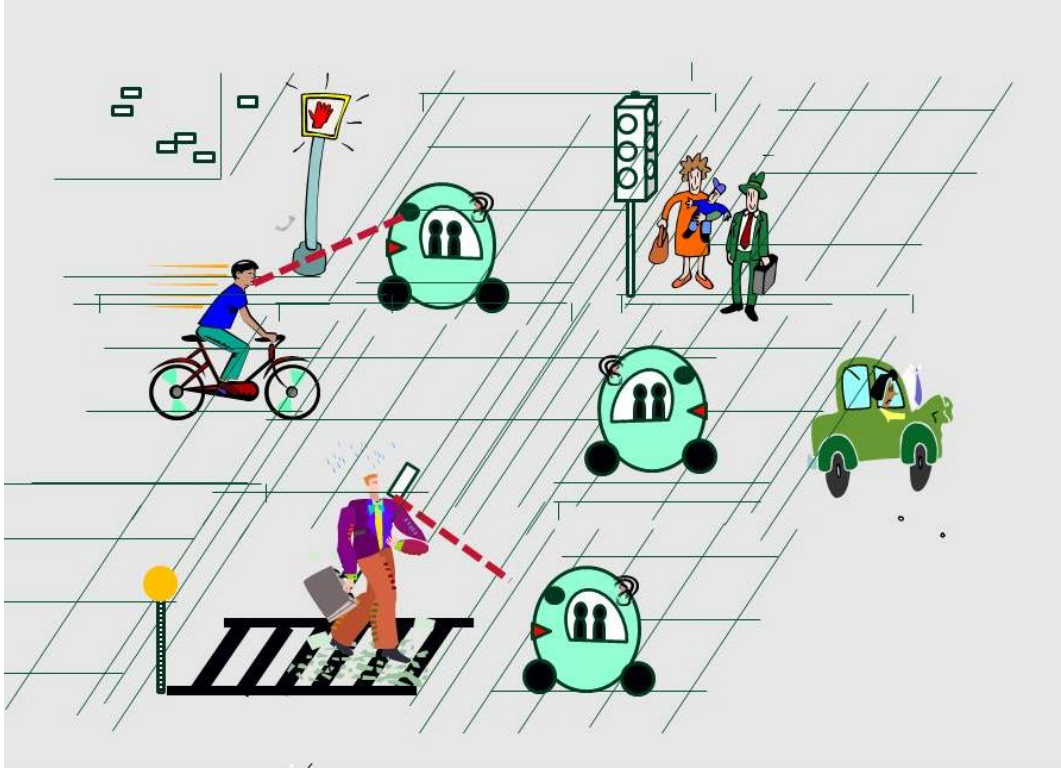
ITS

CityMobil2 Project

- Funded by European Commission (FP7)
- Large-scale demonstration of Automated Road Transport Systems (ARTS) in a number of cities across Europe
- Public transport
- No driver (operator)
- Low speed (up to 45 km/h)
- Simultaneous Localisation AND Mapping (SLAM)
- Shared space
- First mile/last mile solution to complement other public transport

No Drivers in the Vehicle



Excellent obstacle detection

No more eye contact

No more gestures

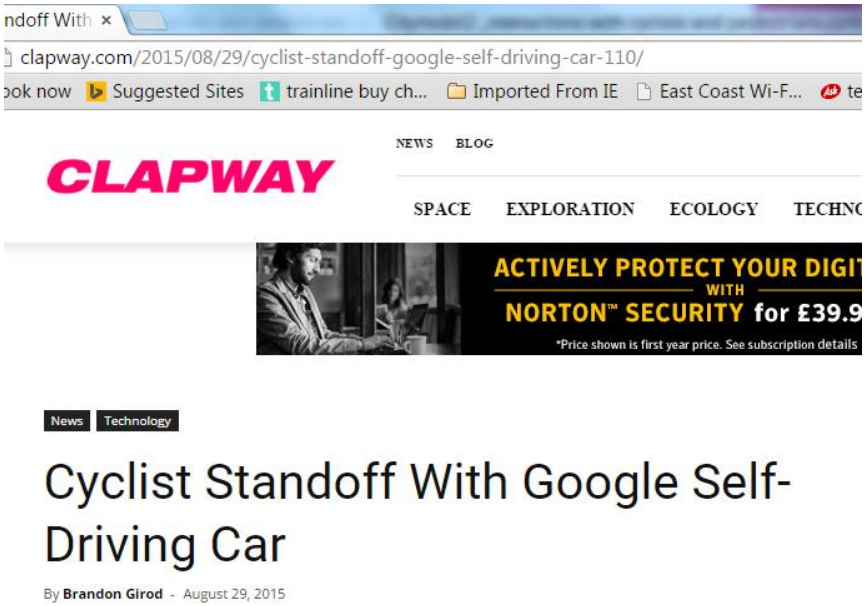
<u>NO COMMUNICATION</u>

→ New HMI?

→ New behaviour?

Anecdotal observations

- Stand off situations
- Lack of trajectory prediction
- Unintended consequences



Human Machine Interface

Nissan

Mitsubishi

Google's patents

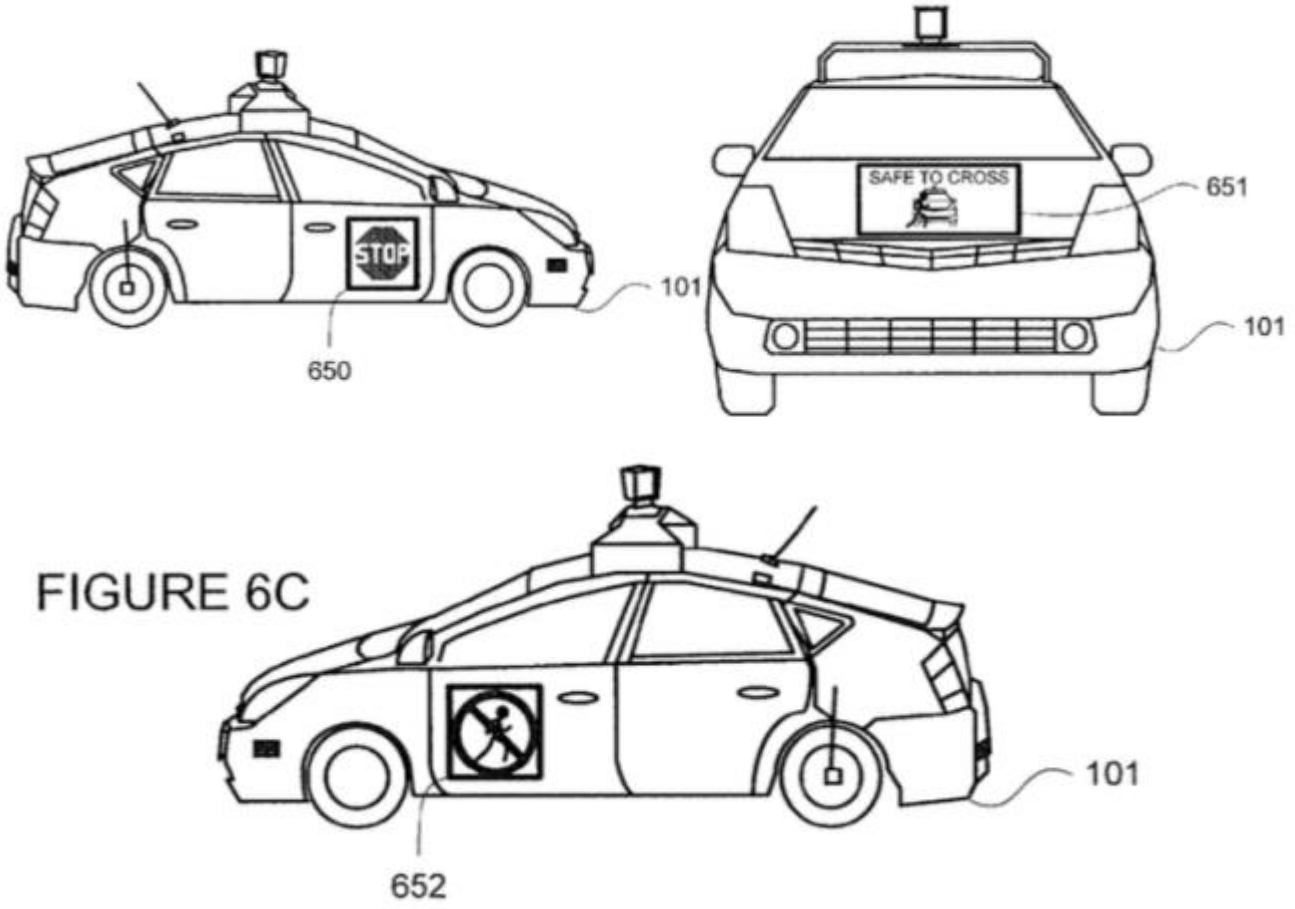


FIGURE 6C

Related research

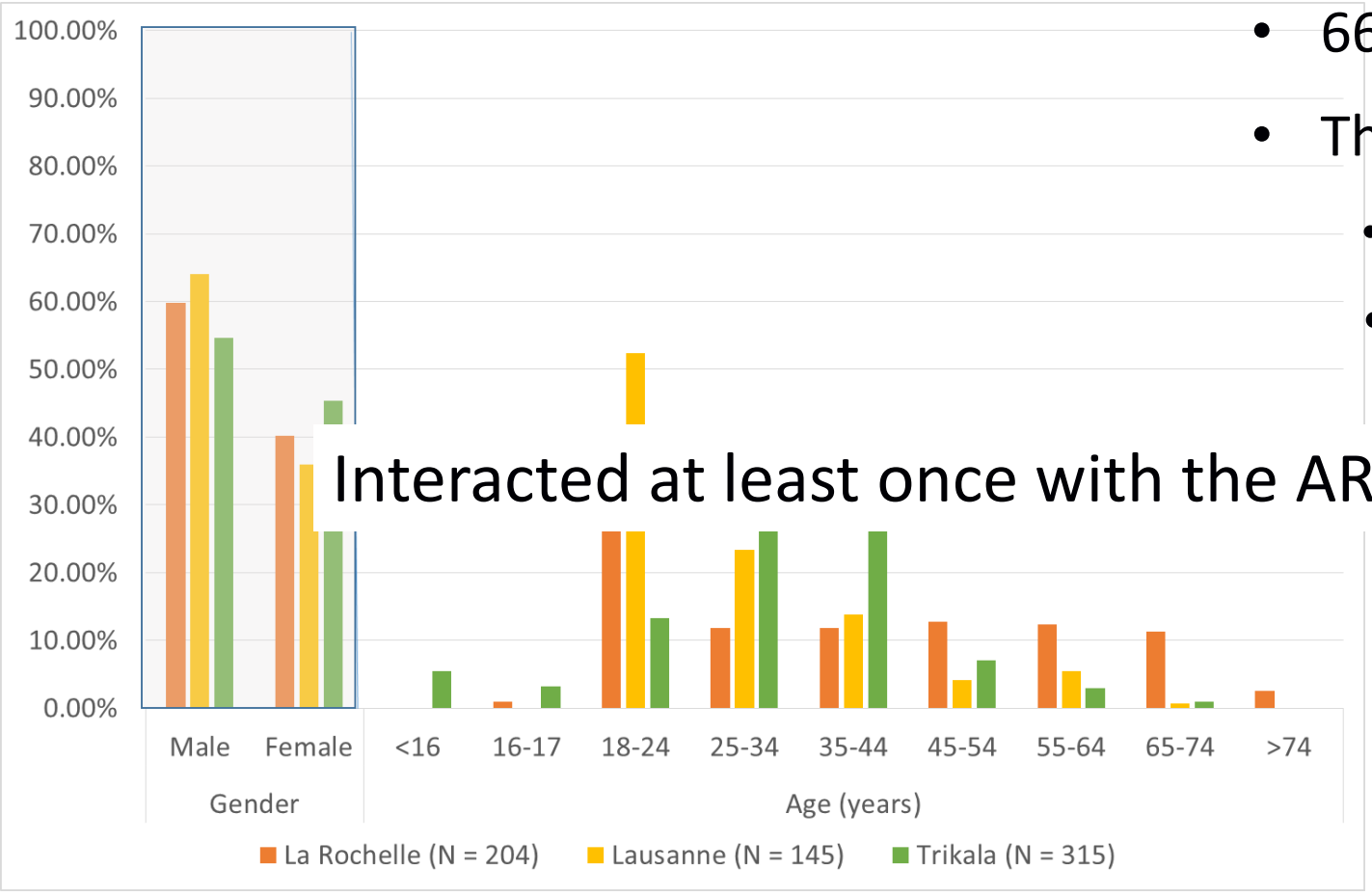
Clamann, Aubert & Cummings, 2016

Lagström & Lundgren , 2016

Current Study

- 42 questions, 8-10 minutes to complete
  - Demographics and travel patterns
  - Unified Theory of Acceptance and Use of Technology (Vankatesh et al., 2003)
  - **Interaction and Communication needs**

Participants



- 664 respondents
- Three cities:
  - La Rochelle, France;
  - Lausanne, Switzerland,

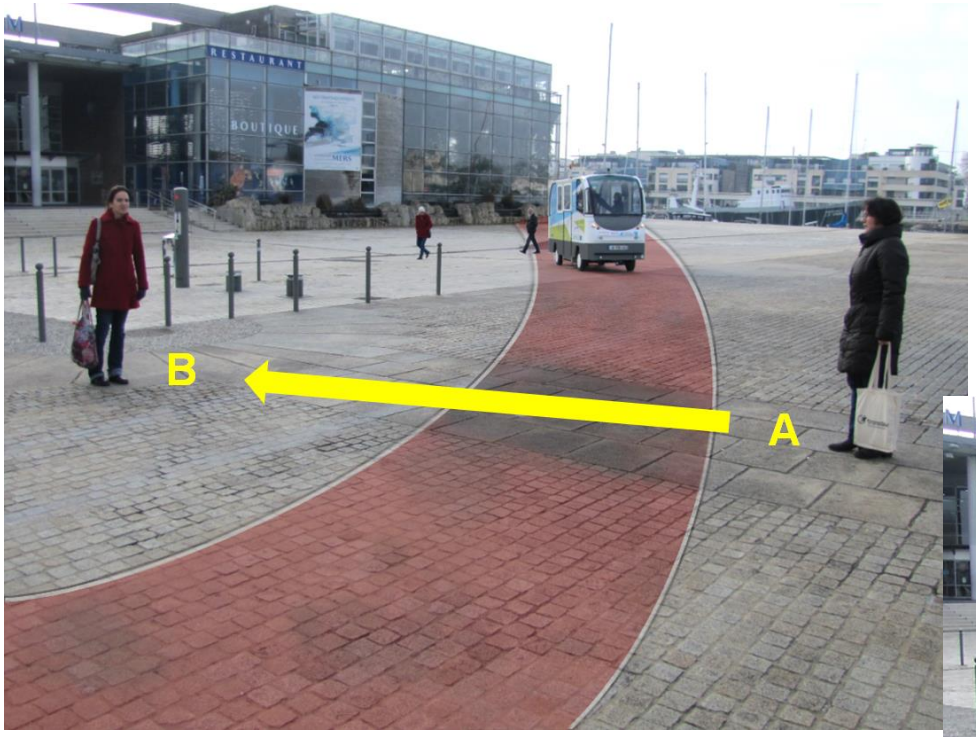
Interacted at least once with the ARTS kala, Greece

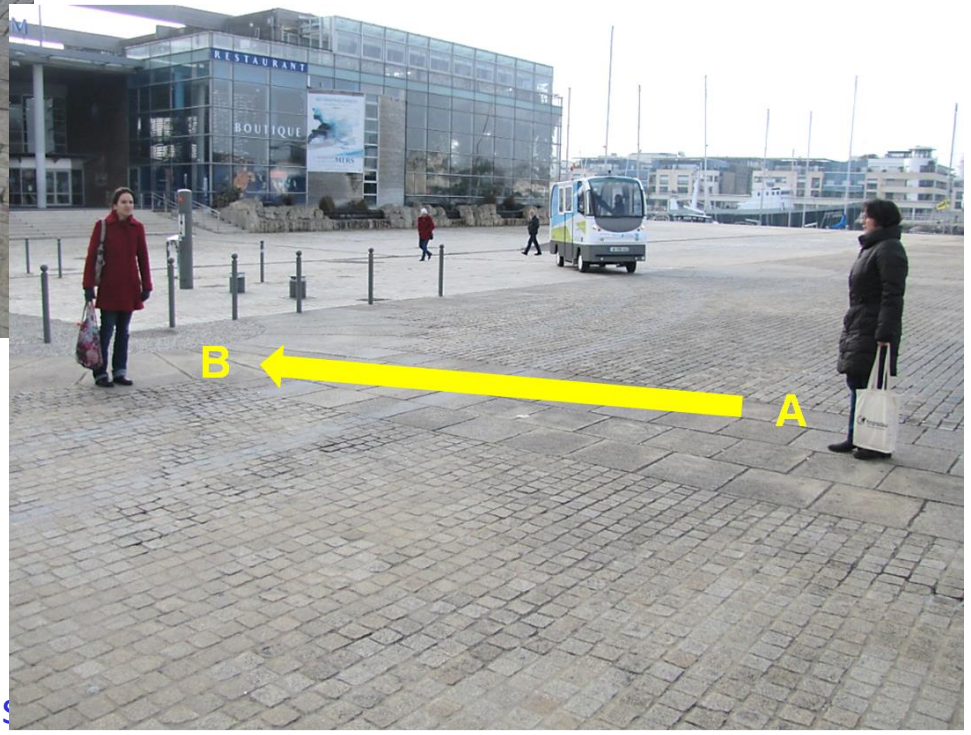
Main Questions:

How do cyclists and pedestrians feel (safety/priority) about the ARTS?

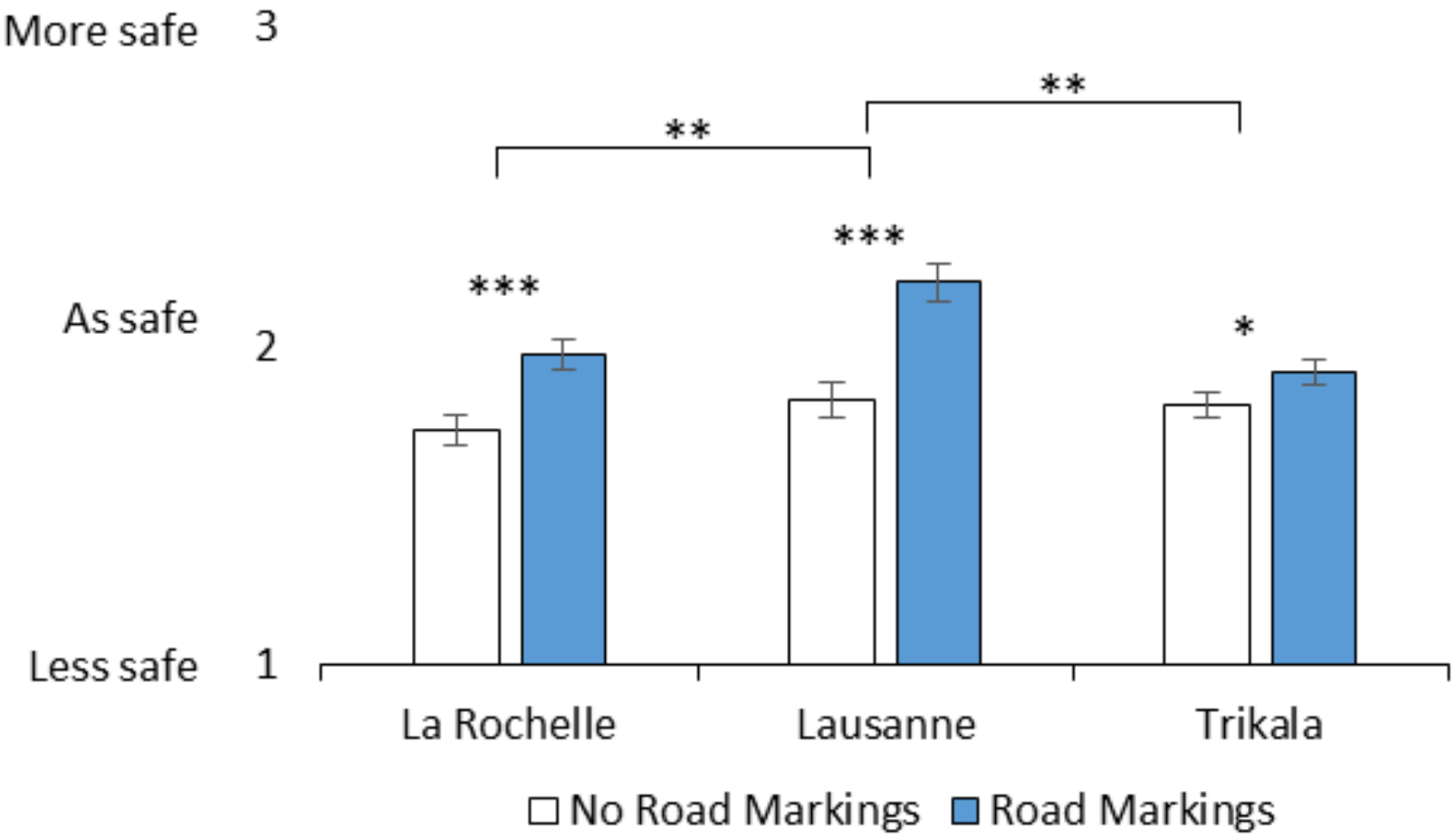
What information do cyclists and pedestrians require from the ARTS?

Safety and Priority?



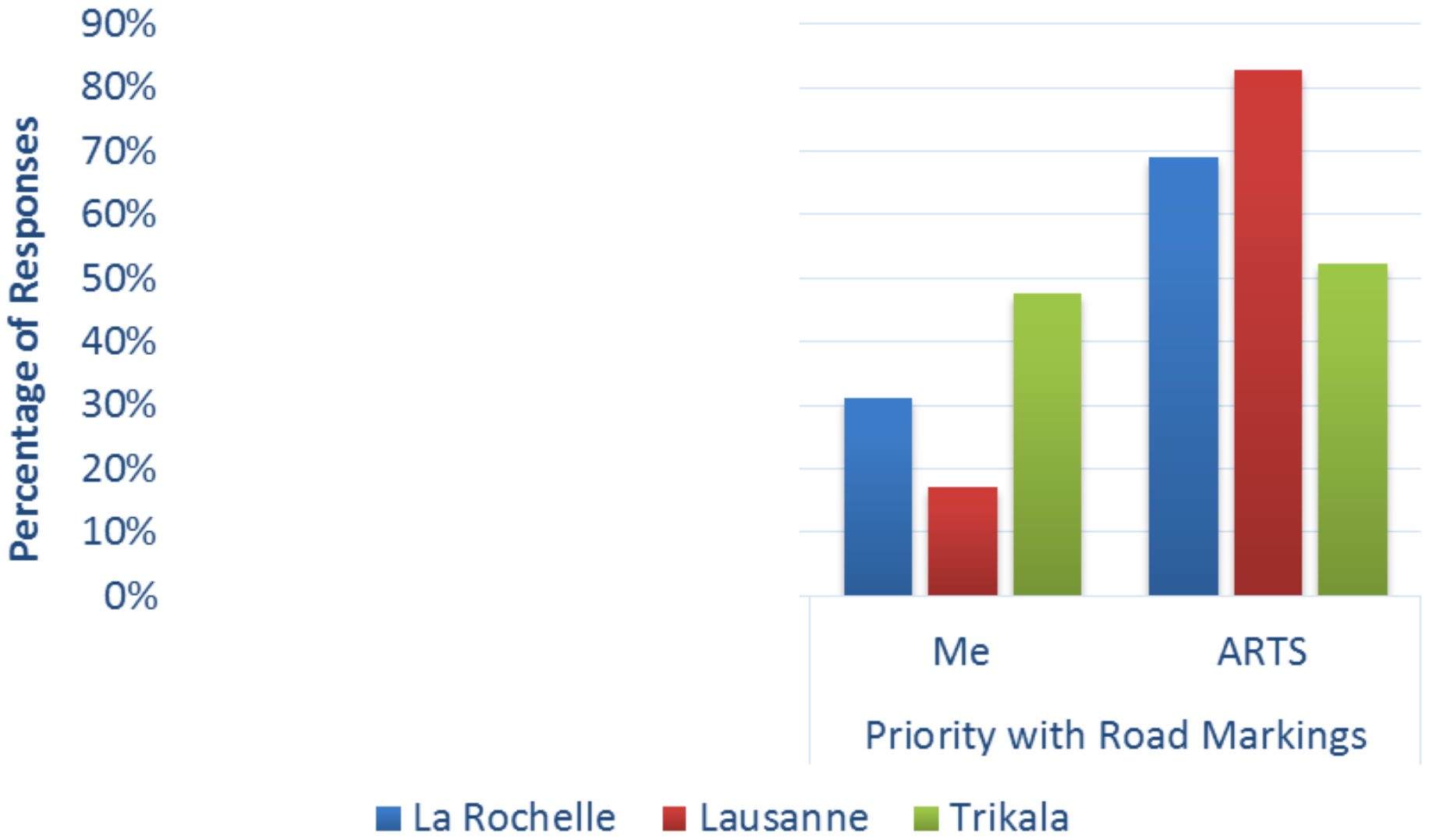


Do you feel safe?



Road Marking (F (1,659) = 5.259, p < .05, ηp2= .08, Location (F(2,659) = 2.493, p < .05, ηp2= .013)
Road Markings and Location (*F*(2,659) = 6.272, *p* < .01, *η*p2= .019)

Who has priority?



What information?

→ *whether it is stopping*

→ *whether it is turning*

→ *how fast it is going*

→ *whether it is going to start moving*

→ *whether it has detected me*

Not very important……Very important

5-point scale

Road markings Important?

No

Overall:

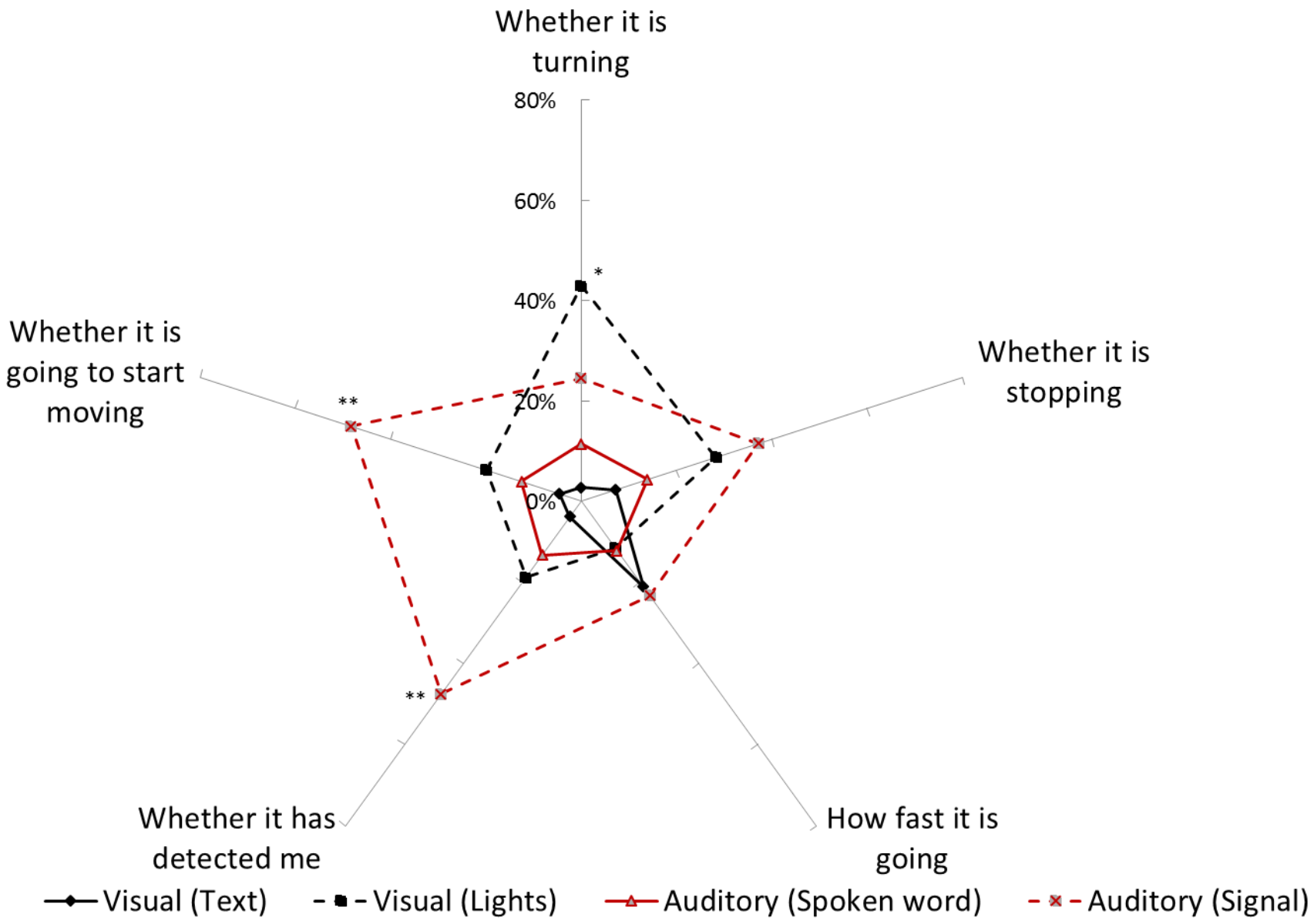
- Most important: detection
- Least important: speed of travel

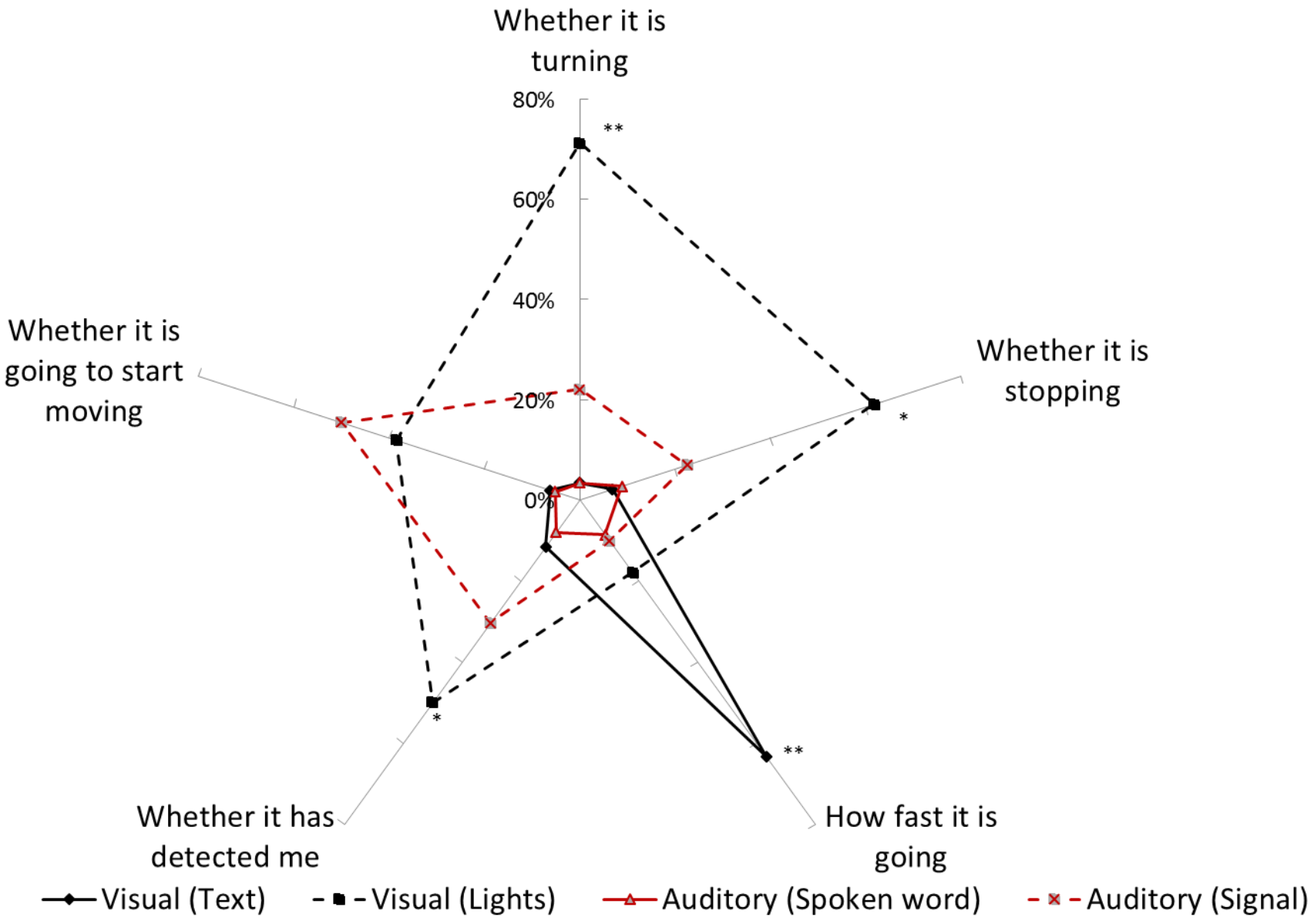
Per site:

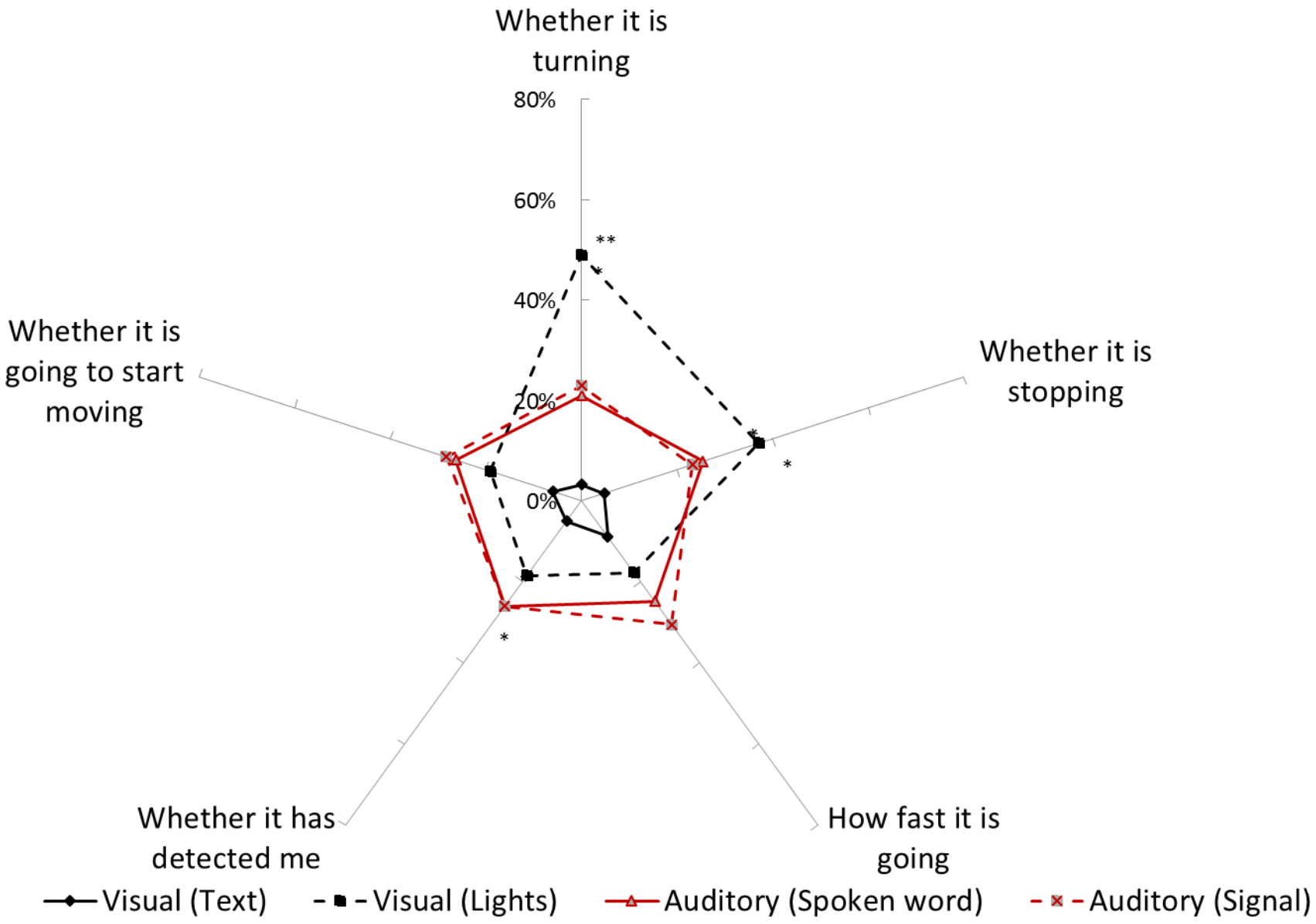
- La Rochelle, if it has detected me and turning
- Lausanne, all but speed
- Trikala none

How would you like to receive this information?

- Visual (Lights)
- Visual (words)
- Auditory (tones/signals)
- Auditory (words)


Whether it is turning
80%
60%
40%
20%
0%
*
Whether it is stopping
How fast it is going
Whether it has detected me
**
Whether it is going to start moving
**
Visual (Text)
Visual (Lights)
Auditory (Spoken word)
Auditory (Signal)


Whether it is turning
80%
60%
40%
20%
0%
**
Whether it is stopping
*
Whether it is going to start moving
Whether it has detected me
*
How fast it is going
**
Visual (Text)
Visual (Lights)
Auditory (Spoken word)
Auditory (Signal)


Whether it is turning
80%
60%
40%
20%
0%
**
*
Whether it is stopping
*
How fast it is going
Whether it has detected me
*
Whether it is going to start moving
Visual (Text)
Visual (Lights)
Auditory (Spoken word)
Auditory (Signal)

AVIP-prototype

Message	Final Concept
I'm in AD mode	As long as the vehicle is In autonomous drive mode, the middle part of the signal bar is lit.
I'm about to yield	When the vehicle has identified an approaching pedestrian, and intends to stop and yield, the light expands towards the sides until the LED strip is completely lit.
I'm resting	When the vehicle has stopped, it shows that it's waiting/resting by pulsating the signal bar calmly.
I'm about to start	When the car intends to drive, the lit LED strip shrinks down before the car drives away.

LAGSTRÖM & LUNDGREN, 2016

Focus Group: Priority

- **Direction of travel** not obvious
- Not sure who had priority
- Would prefer **demarcations**
- Not sure if the vehicle can **identify hazards**?
- Suggested use of horns and lights for **detection and communication**
- **Visibility**: Colour maybe too discrete, brighter colour to make it easy to see. In La Rochelle: Yellow would be more suitable to fit in with other public transport modes
- **Speed:** Too slow, but probably ok as shared space
- Better for **tourists** than commuters
- **Sound**: Lack of engine noise a problem for its localisation, especially for the visually impaired

Timely news release!

14 November 2016

NHTSA
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NHTSA sets 'Quiet Car' safety standard to protect pedestrians

NHTSA 27-16
Monday, November 14, 2016
Contact: Public.Affairs@dot.gov

New requirement of audible alert will help prevent 2,400 pedestrian injuries a year

WASHINGTON - The U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) today announced that it is adding a sound requirement for all newly manufactured hybrid and electric light-duty vehicles to help protect pedestrians. The new federal safety standard will help pedestrians who are blind, have low vision, and other pedestrians detect the presence, direction and location of these vehicles when they are traveling at low speeds, which will help prevent about 2,400 pedestrian injuries each year once all hybrids in the fleet are properly equipped.

"We all depend on our senses to alert us to possible danger," said U.S. Transportation Secretary Anthony Foxx. "With more, quieter hybrid and electrical cars on the road, the ability for all pedestrians to hear as well as see the cars becomes an important factor of reducing the risk of possible crashes and improving safety."

Under the new rule, all hybrid and electric light vehicles with four wheels and a gross vehicle weight rating of 10,000 pounds or less will be required to make audible noise when traveling in reverse or forward at speeds up to 30 kilometers per hour (about 19 miles per hour)

Summary and Conclusions

- As the deployment of automated vehicles becomes commonplace, the views of other road users should be sought.
- In particular, understanding how VRUs (and other vehicles) interact and communicate with a ‘driverless’ vehicle is important
- This study shows that VRUs definitely want some information, and prefer the ARTS to be in a dedicated space.
- They assume they have priority in shared space

Implications

- Do we need totally new or modification of existing
  - Signage? STANDARDS?
  - Road infrastructure?
  - Traffic rules?
  - What about cultural differences?
  - Road safety training?

Thank you for your attention!

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www.citymobil2.eu

Merat, N. *Louw, T., Madigan, R., Dziennus, M., & Scheiben, A. (under review) Communication Between VRUs and Fully Automated Road Transport Systems: What's important? (Accident Analysis and Prevention)*