Vehicle's Driving Mode and External Appearance:

Effects on Pedestrians' Road-Crossing Behavior

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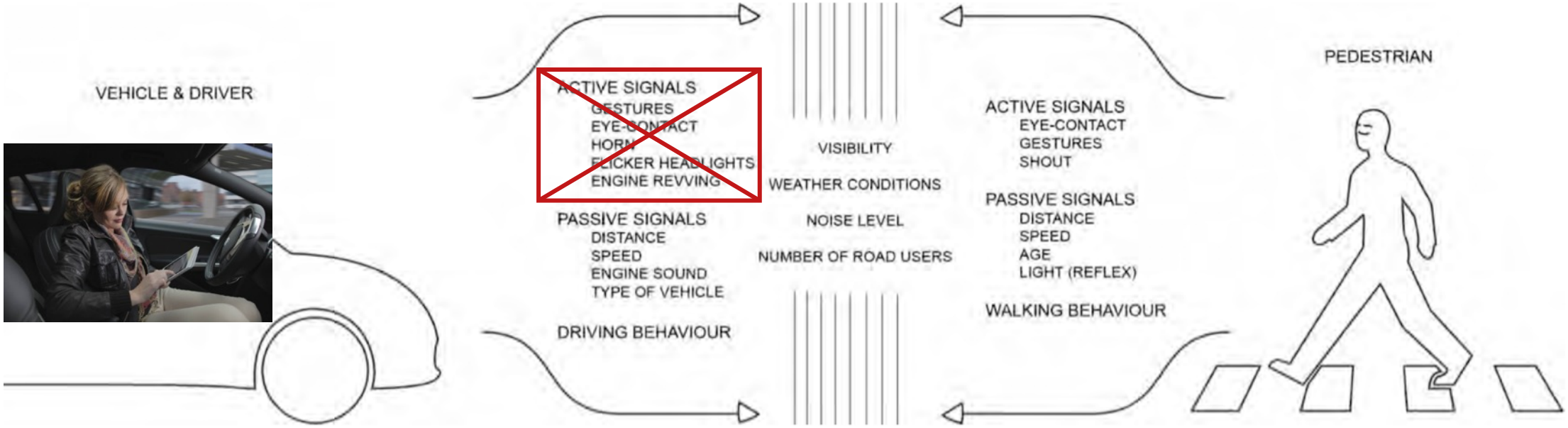
Public perception of Automated Driving

Missing Driver-centric communication



Source: Lundgren, V. M. et al. (2015). AVIP : An Interface for Communicating Intent of Automated Vehicles to Pedestrians.

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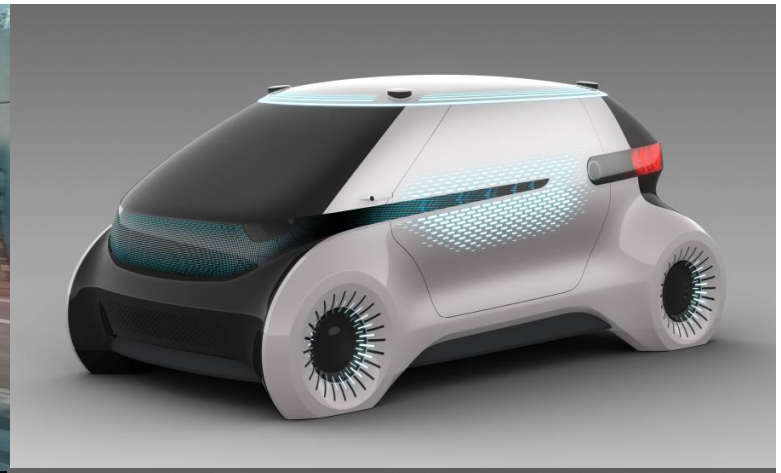
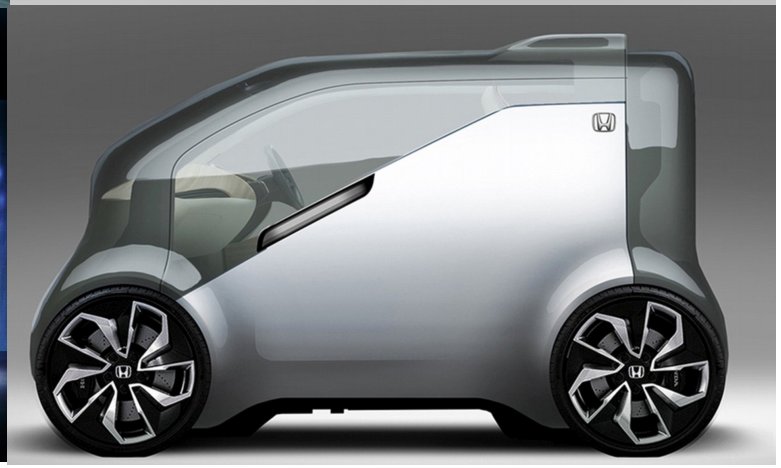
Vehicle appearance

AV appearance





Research Questions

Effects of:

- Perceived driving mode (normal vs. automated vehicle)
- External appearance
  - Friendly vs. aggressive
  - Ordinary vs. futuristic

Experiment Setup

Renault Twizy

Friendly
Small
Low-power
Novel
Futuristic

BMW 3 series sedan

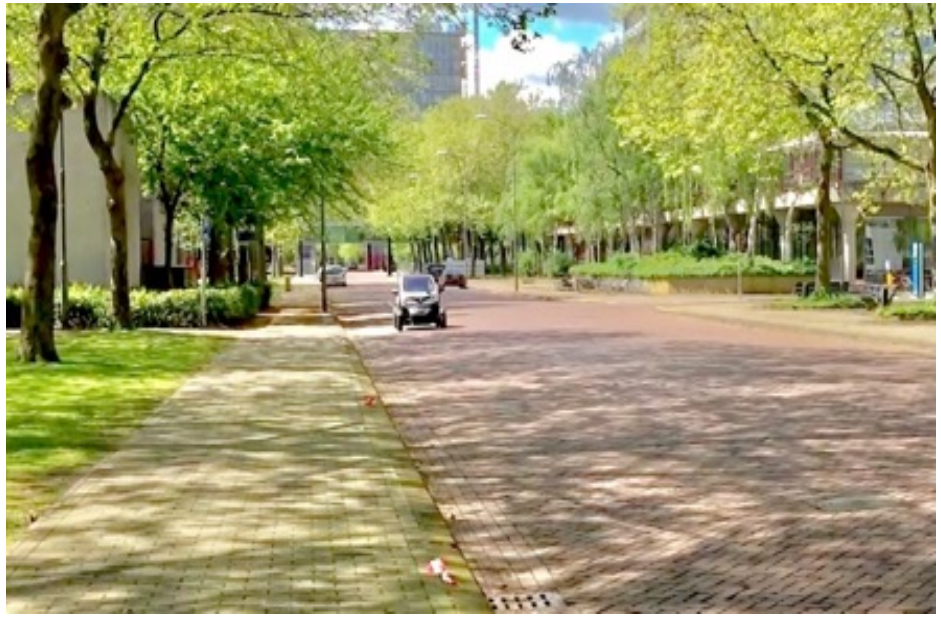
Aggressive
Large
High-power
Ordinary
Commonplace

Experiment Setup






Experiment Setup



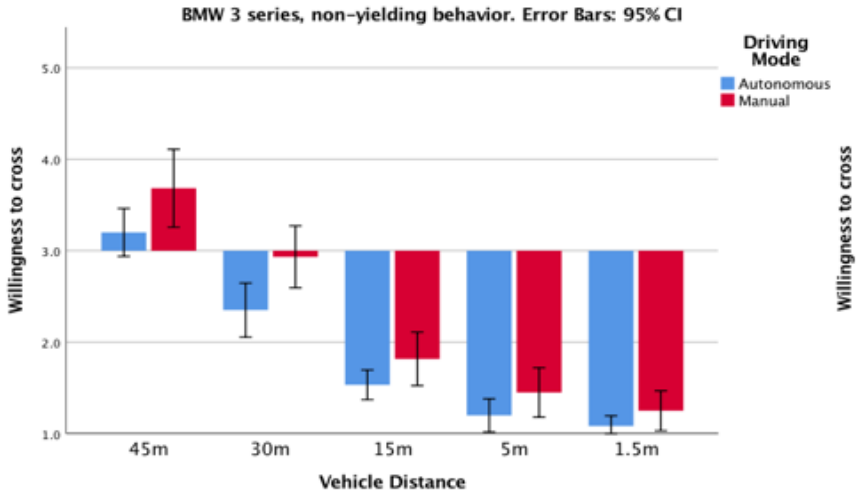
Independent variables:

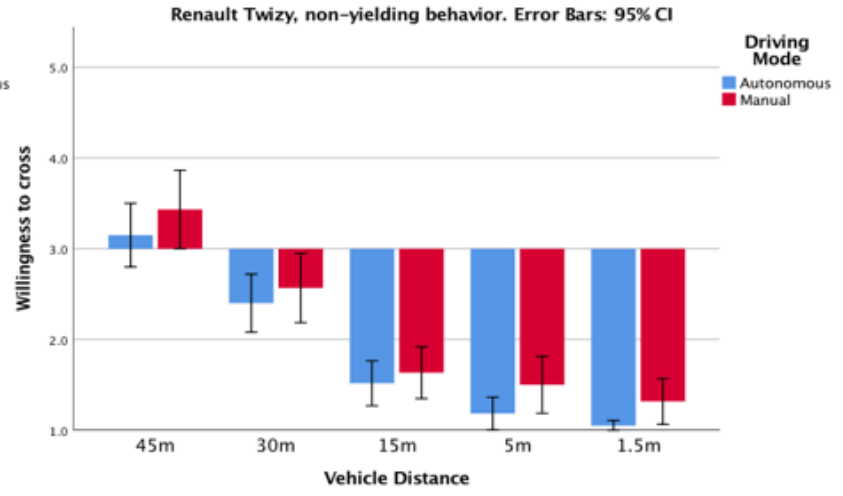
Vehicle type (appearance)
Vehicle behavior (Yielding/ non-yielding)
Vehicle driving mode (automated/ non-automated)
– Between subjects

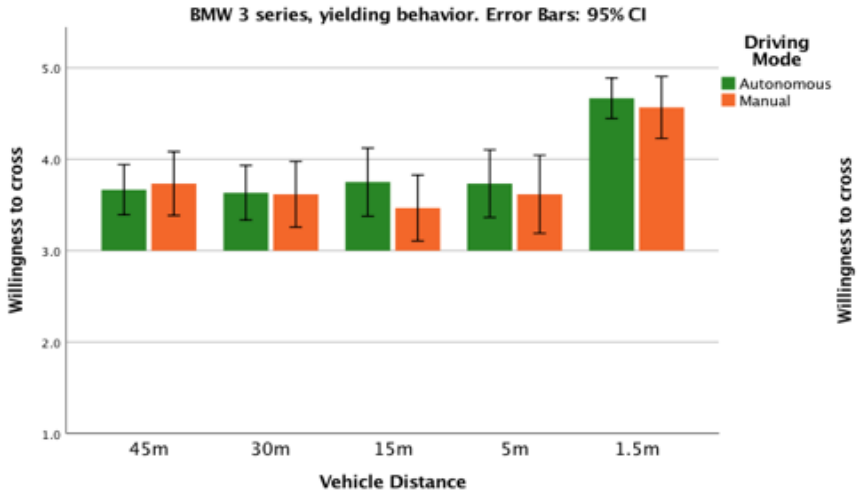
Measurement points:

45m, 30m, 15m, 5m, 1.5m
Car started to brake gently at 54m away (1.8m/s^2)

How does Willingness to Cross change?







Takeaways

Driving behavior is the most important determinant of crossing decision (implicit communication of intent)

Driving mode (automated/ manual) had no statistically significant impact on crossing behavior

External appearance had a significant impact in the “ambiguous zone” (neither to far away, nor too near)

- Pedestrians were less willing to cross in front of the Twizy
- Futuristic and novel appearance caused hesitance. <*Experimental vehicle?*>

Follow-up: Appearing like an AV

- How effective is a sensor system make a vehicle look more “self-driving”?
- Will a “self-driving capable” appearance have a positive effect on willingness to cross?
- How does an external HMI (eHMI) as an explicit intention indicator affect willingness to cross?

Experiment setup

Baseline

eHMI

Appearance

eHMI+Appearance

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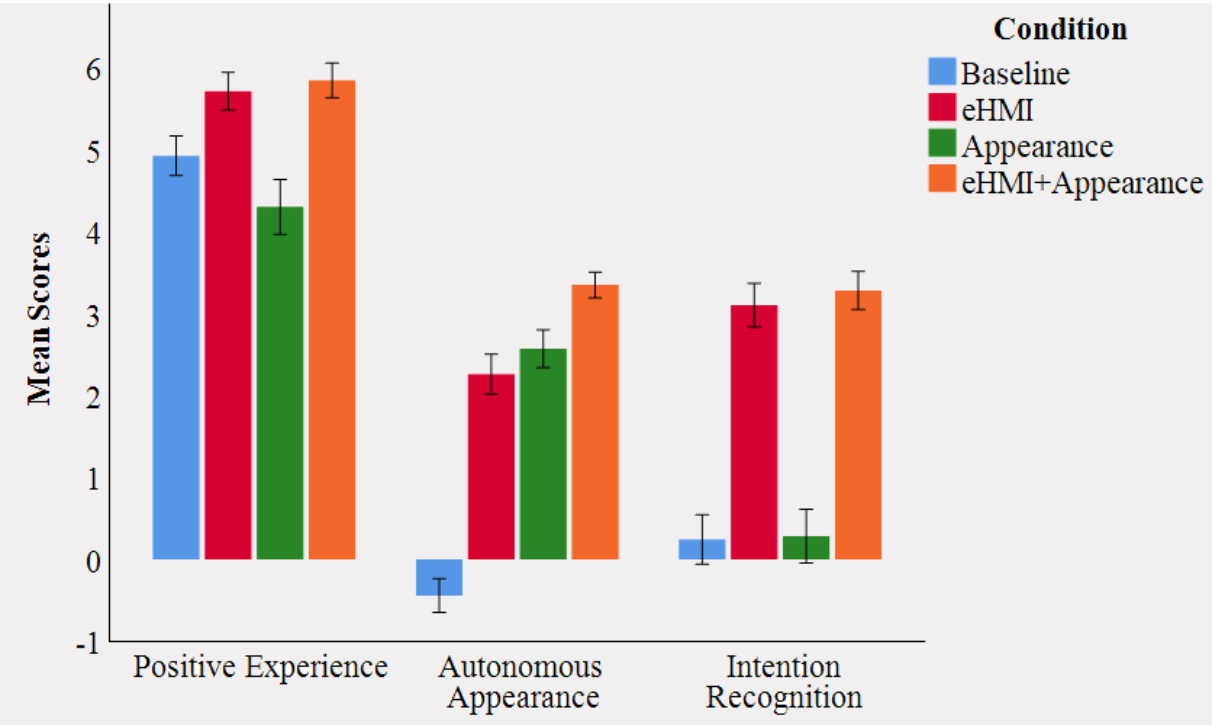
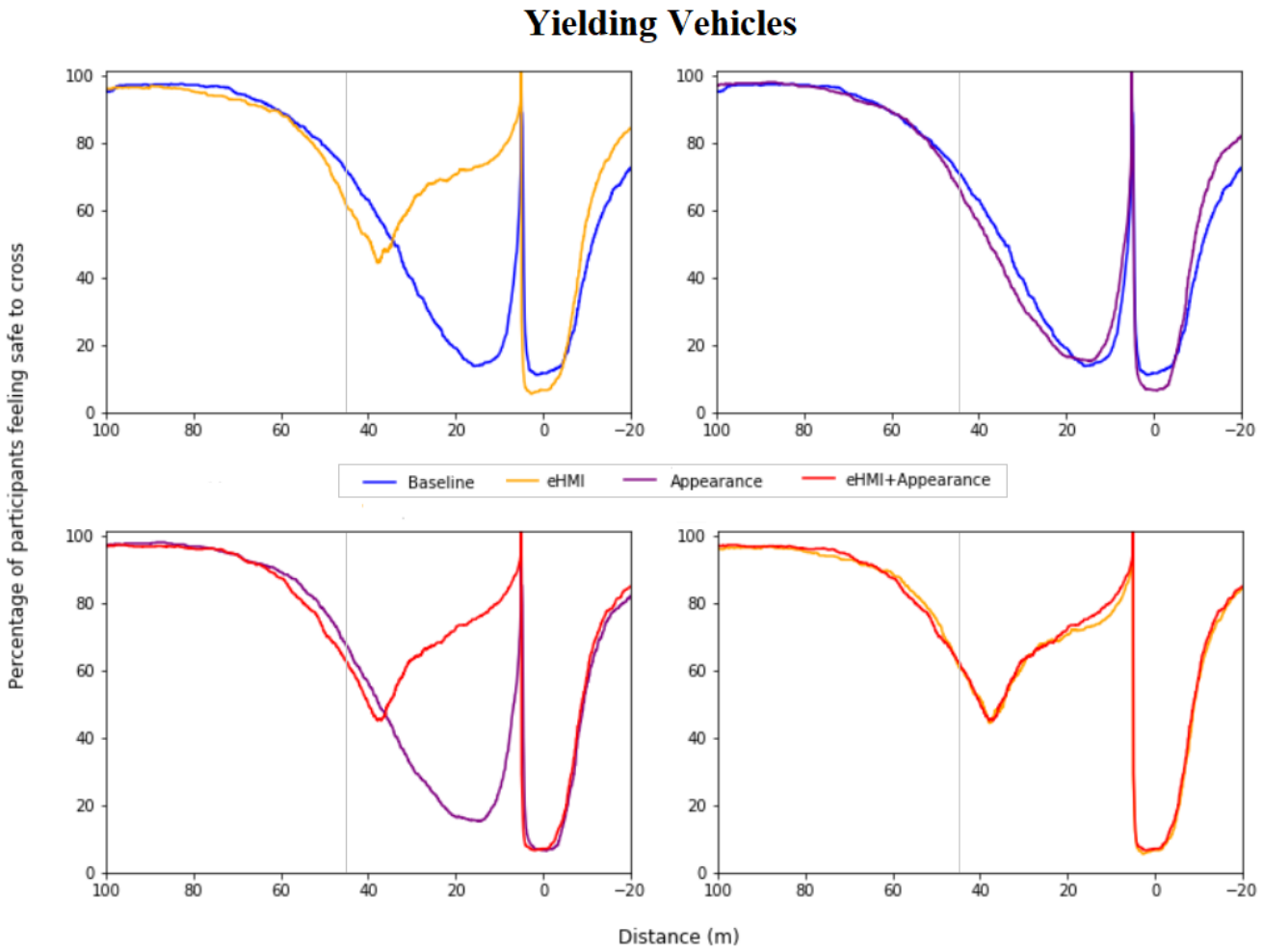
Findings

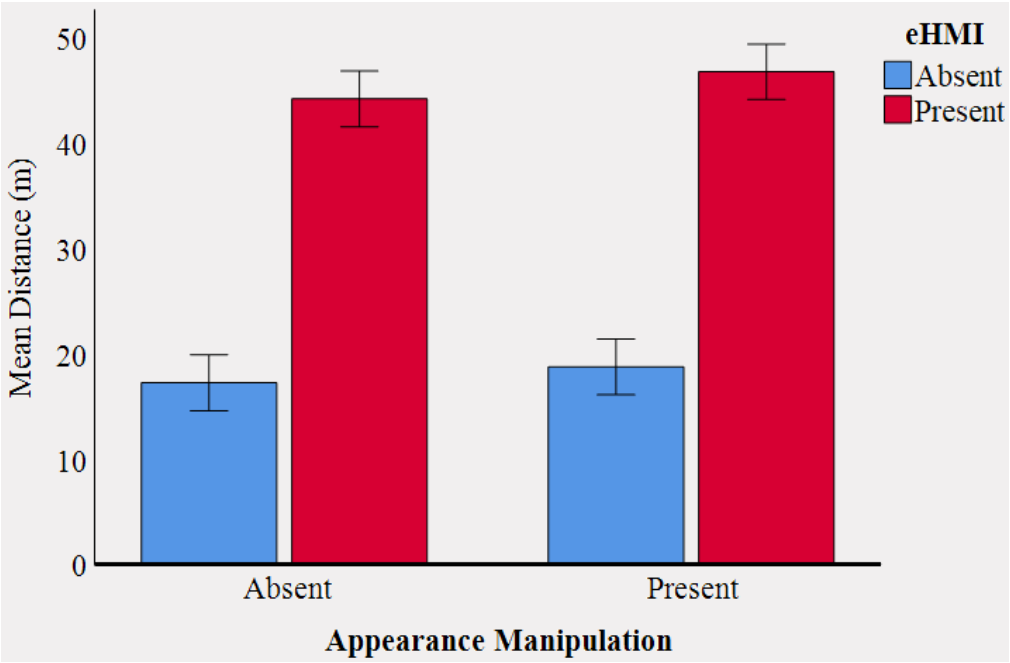


Both sensors and eHMI made the car look more like a “self-driving car”

Even when such cars are not popularly seen in The Netherlands

Findings





- Sensors had no detrimental effect on pedestrian behavior.
- eHMI had a positive effect

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Takeaways

- Sensors seem to make people think that a car is “self-driving”
- Despite that, people are not necessarily ‘afraid’ to cross the road
- eHMI appears to aid crossing decisions

When AVs behave in an expected manner, people seem to behave around them just as around ordinary cars

Putting the previous findings together: a highly futuristic design can cause hesitation by breaking mental models. But sensor systems do not.

For future AV introduction: design choices are important. It may be beneficial to not make AVs stand out as too futuristic to ease social acceptance in the early stages

Let's talk!

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