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Augmented reality concepts for pedestrian-vehicle interactions: An online study

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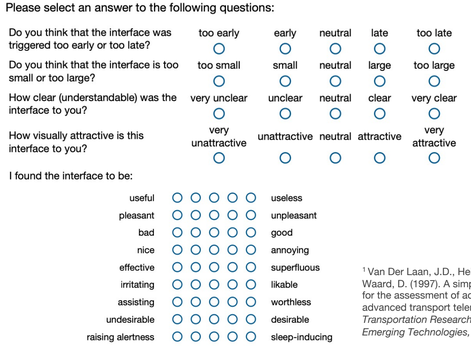
Nine AR interfaces designed using an experience-based, and theoretically informed design approach, were presented in an online questionnaire for user evaluation.

Statistical analysis of presented measures, and the computation of an overall composite score revealed a preference towards traditional and familiar traffic elements.

Method

- Online questionnaire administered to participants across **Germany**, **The Netherlands**, **Norway**, **Sweden**, and **The United Kingdom.**
- Participants were presented with **18** videos (**non-yielding**, and **yielding** per interface) in a **within-subject** experimental design, in **random order**.
- Measured **intuitiveness**, and **convincingness** of the interfaces.
- Presented **descriptor scale** and **acceptance scale** [1].
- **Free text entry** to expand on their scale ratings, for **qualitative data capture**.



Please select an answer to the following questions:

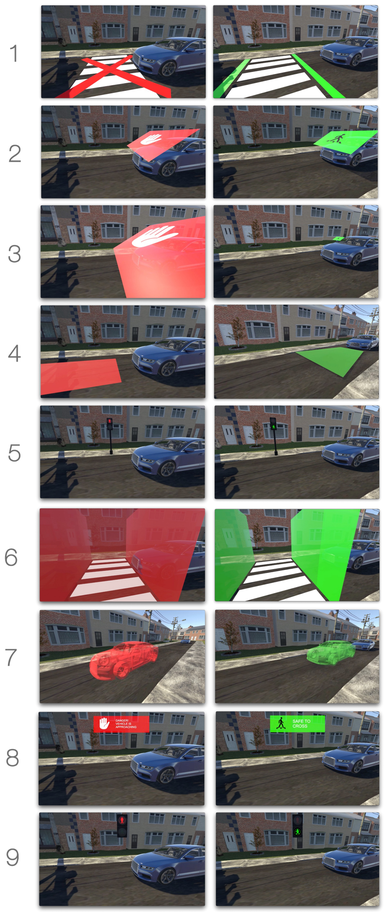
Do you think that the interface was triggered too early or too late?	too early ○	early ○	neutral ○	late ○	too late ○
Do you think that the interface is too small or too large?	too small ○	small ○	neutral ○	large ○	too large ○
How clear (understandable) was the interface to you?	very unclear ○	unclear ○	neutral ○	clear ○	very clear ○
How visually attractive is this interface to you?	very unattractive ○	unattractive ○	neutral ○	attractive ○	very attractive ○

I found the interface to be:

useful	○ ○ ○ ○ ○	useless
pleasant	○ ○ ○ ○ ○	unpleasant
bad	○ ○ ○ ○ ○	good
nice	○ ○ ○ ○ ○	annoying
effective	○ ○ ○ ○ ○	superfluous
irritating	○ ○ ○ ○ ○	likable
assisting	○ ○ ○ ○ ○	worthless
undesirable	○ ○ ○ ○ ○	desirable
raising alertness	○ ○ ○ ○ ○	sleep-inducing

[1] Van Der Laan, J.D., Heino, A., & De Waard, D. (1997). A simple procedure for the assessment of acceptance of advanced transport telematics. *Transportation Research Part C: Emerging Technologies, 5(1), 1-10.*

Interfaces



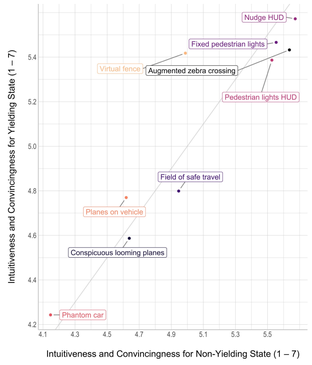
The design process behind these Interfaces has been presented in:

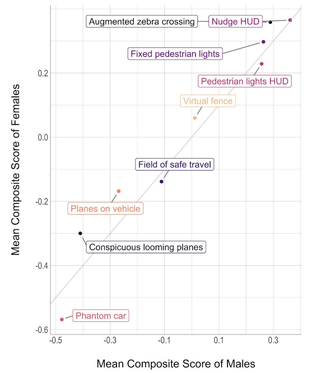
Tabone, W., Lee, Y. M., Merat, N., Happee, R., & De Winter J. C. F. (2021). Towards future pedestrian-vehicle interactions: Introducing theoretically-supported AR prototypes. *Proceedings of the 13th International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (pp. 209–218).

Results

N = 992 (492 males, 491 females, 8 non-binary, 1 n/a.)
n = 202 🇩🇪, *n* = 197 🇳🇱, *n* = 184 🇳🇴, *n* = 197 🇸🇪, *n* = 212 🇬🇧
Age: 18 – 69 (*M* = 45.10, *SD* = 14.17).

Interface	Composite Score * M (SD)
8. Nudge HUD	0.37 (0.86)
1. Augmented zebra crossing	0.32 (0.89)
5. Fixed pedestrian lights	0.28 (0.88)
9. Pedestrian lights HUD	0.25 (0.86)
6. Virtual fence	0.04 (1.00)
4. Field of safe travel	-0.12 (1.00)
2. Planes on vehicle	-0.26 (1.01)
3. Conspicuous looming planes	-0.35 (1.00)
7. Phantom car	-0.52 (1.05)





* The composite score was created by first standardising the scores of the all strongly-correlated items (the 15 variables measured in the scales), so that their overall item mean (of all 9 interfaces concatenated) was 0 and the corresponding standard deviation was 1. A higher score indicates a stronger user preference.

Key takeaways

- Preference towards **traditional** and **familiar** traffic elements.
- **Head-up displays** (ie. 8, 9) and interfaces **mapped on the road** (ie. 1, 5, 6) seem to perform better.
- **No** significant **differences** in ratings across **genders**.
- **66%** of respondents feel such **AR communication** would be **useful**.
- **Traditional** and **familiar** traffic design elements seem to work **better** than other concepts generated by **experience-based design** methodology.

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