Ann Huang

Portfolio

(Portfolio design inspired by Dr. Jae Engle)

Mixed-methods researcher with 4,5+ years experience designing and executing collaborative, human-centered projects.

I am completing my **Ph.D. degree** (thesis submitted) at the Univeristy of Osnabrück **Institute of Cognitive Science** where I investigate how **interactions** with people and systems improve design.

My expertise lies in uncovering factors that influence people's **perception** and **decision-making**. I love to collaborate with interdicplinary teams to improve user experiences **with data-driven** insights.

Hi.
I'm Ann.

Methods that I use

My toolbox consists of a wide-ranging UX research methods. I select the methods based on the research question(s), stakeholder input, and project timeline.

Foundational Research

1:1 Interviews

Surveys

Data Analysis

Journey Maps

Eye Tracking

Biometric Tests

Co-Design Worksop

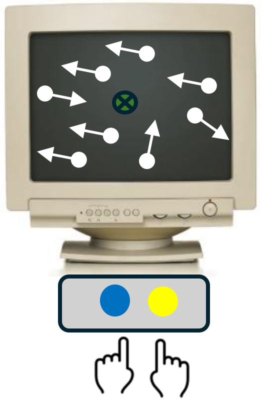
Iterative Testing

Exoploratory Data Analysis & Visualization

Some of my work

Here are some projects I’m most proud of that demonstrate my key skills in research & translating findings into design insights.

Case Study 1: **Design a joint perceptual task to investigate choice history biases in dyadic decision-making**



Methods: Background research, Experimental design, Hypothesis testing, Statistical data analysis

Case Study 2: **Measure users proxemics behaviors to design a comfortable human-agent interaction in augmented reality (AR)**

Methods: Literature research, Prototype development, Semi-structured interviews, Survey, Statistical data analysis

Case Study 3: **Investigate the perception of warning signals to enhance driver-vehicle interaction during highly critical situations in virtual reality (VR)**

Methods: Literature research, Eye-tracking, Data analysis, Statistical data analysis

Case Study 1

Investigation of the impact of social interaction in influencing choice behavior using a dyadic perceptual task & quantitative methods

I re-designed the classical perceptual task which enabled a stable 75% target performance accuracy in the observers.

Project Overview

This project was part of my main PhD research. I designed an adaptive joint perceptual decision-making task that allowed an overall target accuracy at ~75%, which minimized deviations of ±20% in the observer's performances

Team

- Lead researcher (me)
- Three junior researchers
- Lab director

Scope

- Investigate the impact of previous choice biases decision in a social context
- Test the new dyadic approach to address the gap the decision-making research and draw actionable insights for future designs

Deliverables

- Final prototype and design of the experiment task
- Academic publication in a high-impact journal

I led a 14-month* project from research conception to publication, developing and testing the dyadic task design to undersand how social interaction influences biases in choice behavior.

*Note the timeline does not account for the full publication process (peer-review & manuscript revision), which added at least 6 more months

Month 1

Background research

Conduct in-depth review of academic literature on the choice history effect in perceptual decision-making to gain subject expertise + identify knowledge gap and ways to address the gap through improving the task design

Month 3

Identify research question & formulate hypotheses

Pinpoint the exact research problem and formulate hypotheses using both natural language texts and quantitative parameters

Month 4

Co-design workshop

Brainstorm analytical solutions with team members, and prioritize solutions based on our discussions

Simulate synthetic data to understand the analysis logic

Month 5

Prototype, Test, & Iterate

Review and refine existing code (Python) scripts to design a task that is shared between two people, yet adapts to the perceptual sensitivity of each person, and allows for ~75% performance accuracy

Conduct pilot usability testing with at least 10 users grouped in pairs

Iterate prototypes based on feedback or until no issues in code

Month 9

Data Collection & Analysis

Create flyers to recruit participants, prepare consent forms, writ task instructions and procedure

We tested 78 individuals, grouped in 39 dyads

Analyze qualitative and quantitative data

Interpret the findings using various visualizations

Month 14

Present

Present findings to stakeholders

Write manuscript, begin the peer-reviewed and revision process

Published findings in high-impact journal

Examining real-life impact of social interaction in perceptual decision-making in the lab comes with constrains, including limited attention and physical space.

3hr long task

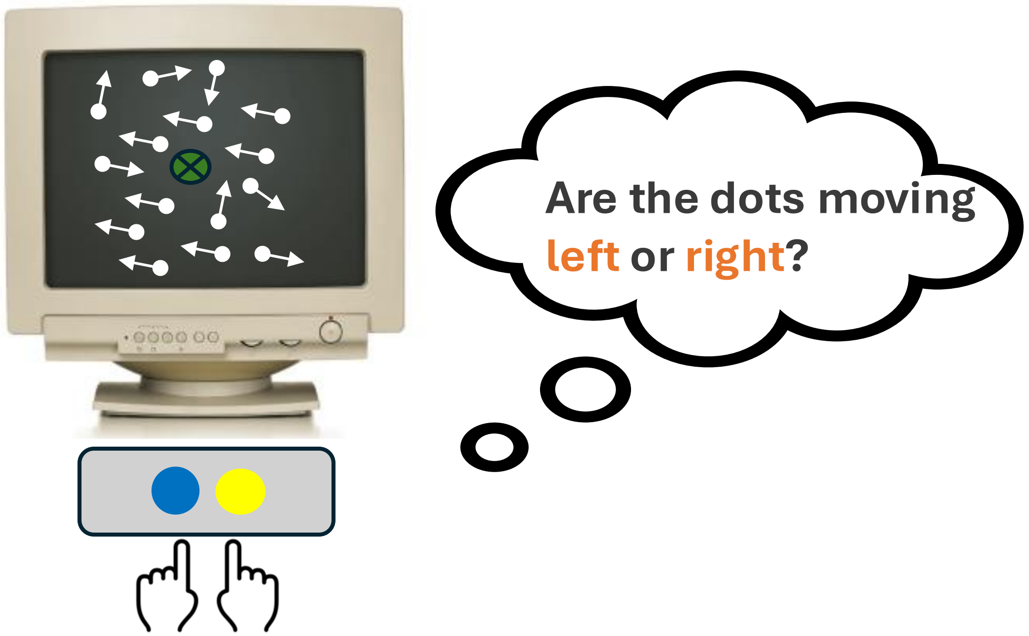
- The perceptual task consists of 1,000 experimental trials and the entire study lasts about 3,5hr, which can cause fatigue

Separate rooms

- The two dyadic participants sat in different rooms, which can reduce a sense of social presence or together-ness

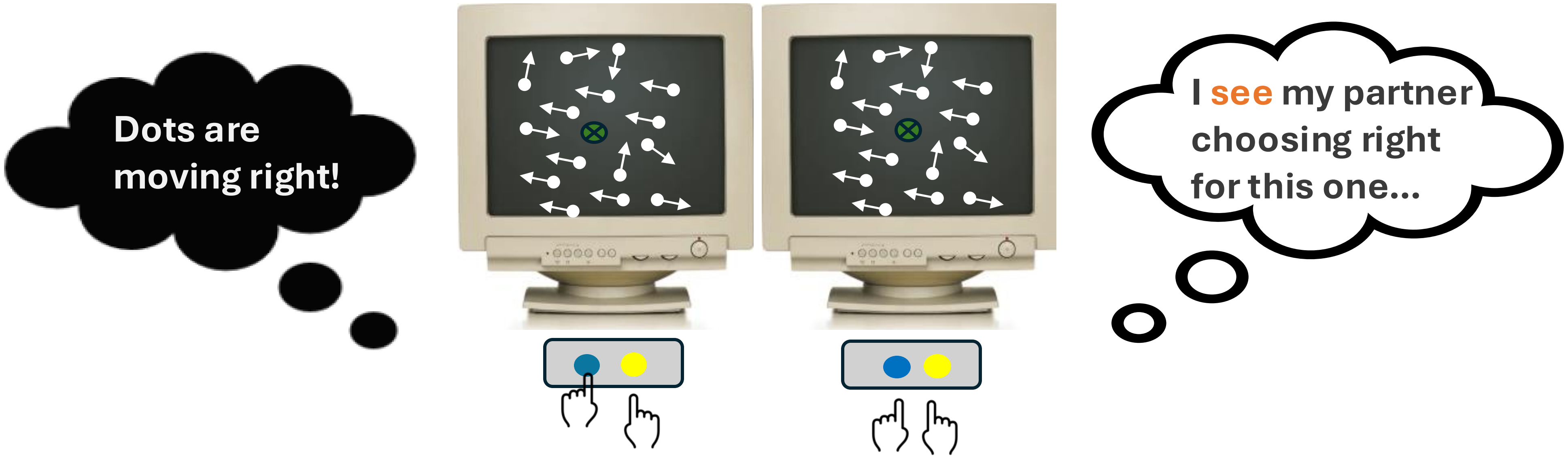
A deep-dive in the literature on perceptual decision-making revealed that previous choices *bias* the subsequent decision. For example, if people chose *right* (versus left), they are more likely to choose *'right'* again even when the successive stimuli are uncorrelated.

This is referred to as the *choice history bias effect* [1] which has been extensively studied in cognitive neuroscience



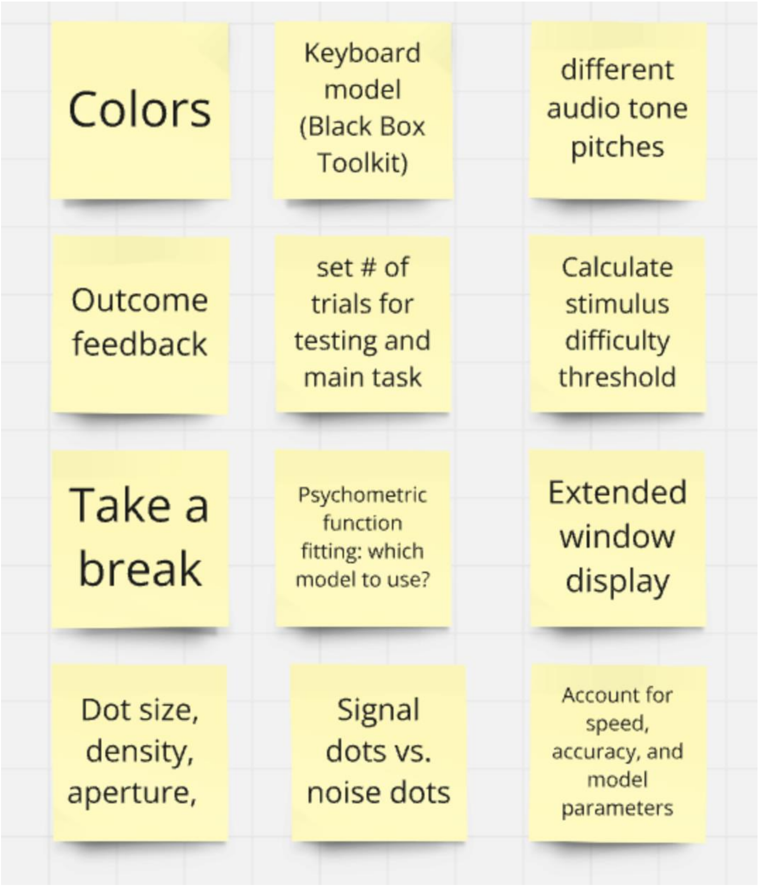
Research in social cognition highlight how shared attention influences perceptual judgments[2,3]. In real life, humans are not isolated decision-makers but often *interact* with others and integrate existing information available to us.

Creating a ***joint*** perceptual task that includes ***two*** people performing should influence the choice history bias effect on choice behavior

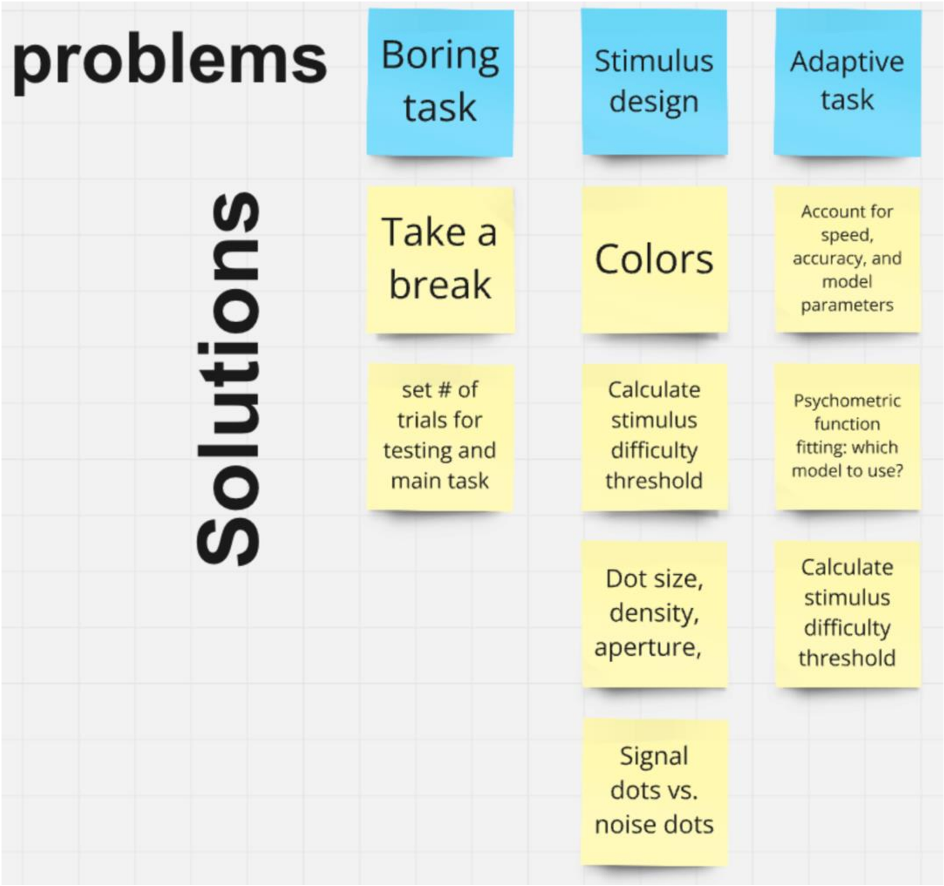


My team and I discussed the limitations of the current task design and brainstormed analytical solutions to create a dyadic task that allows to investigate social influences in decision-making.

Brainstormed



Prioritized



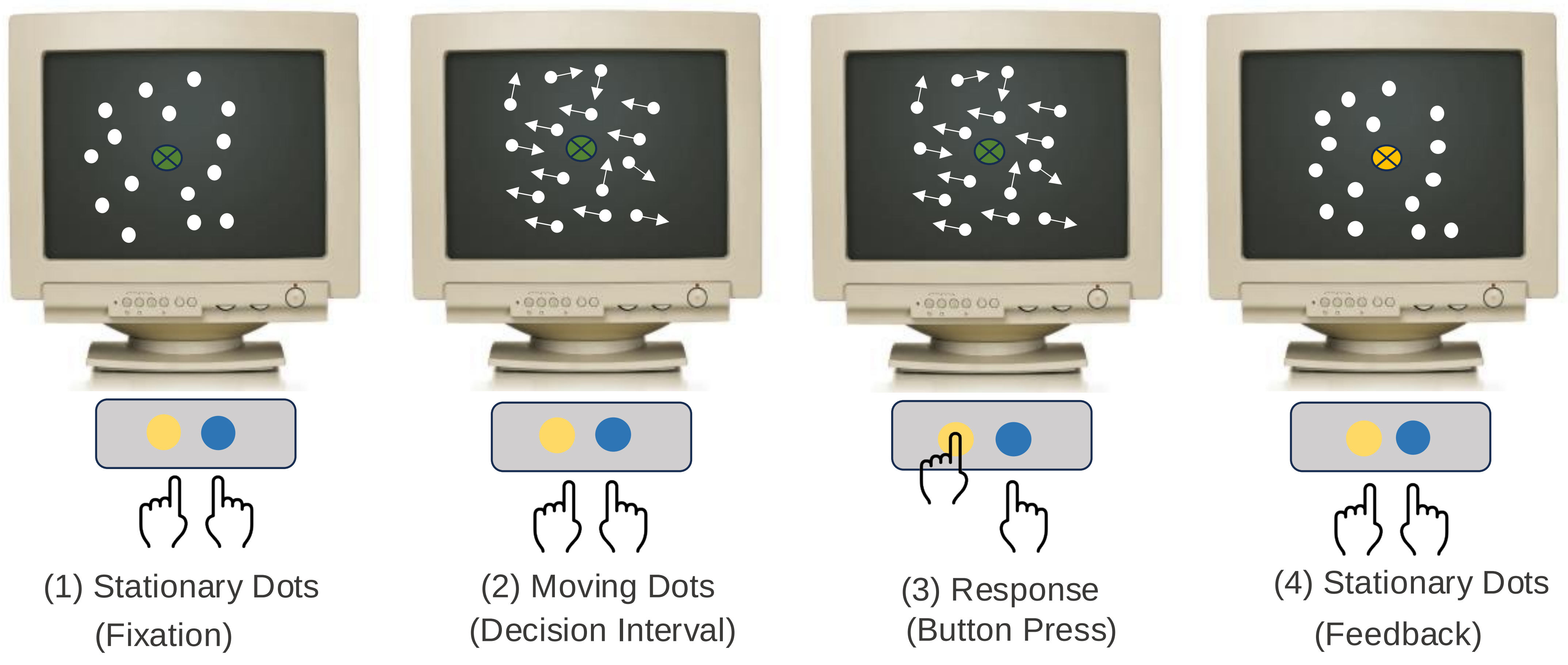
Planned to implement

1. Change the fixation colors to and visual stimulus parameters
2. Fit a drift-diffusion model to the mean reaction time and accuracy data from the testing block of the experiment
3. Add break after every two blocks

PROTOTYPE

To develop the dyadic task, we built on the established perceptual task involving discrimination of random dot motion.

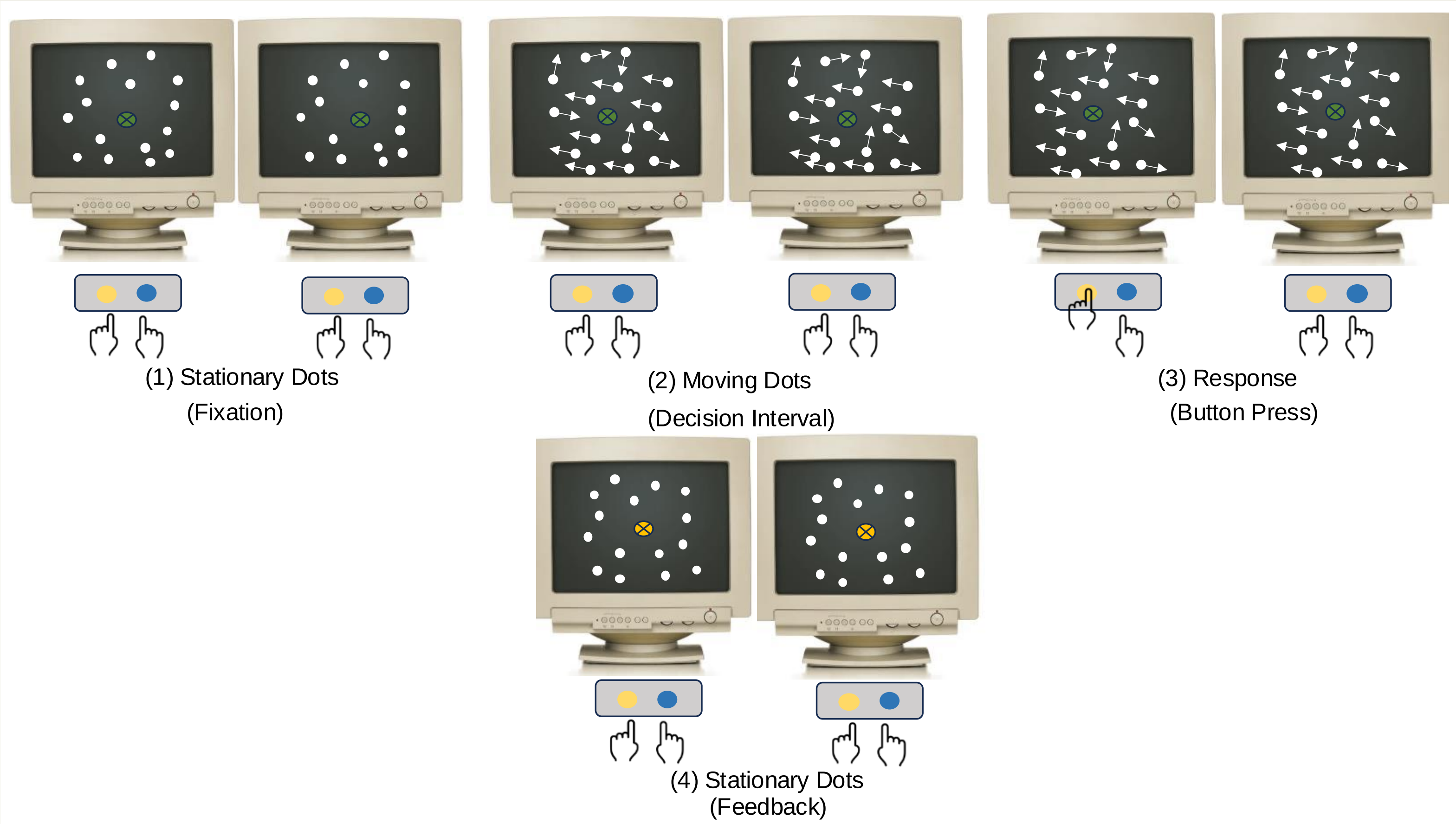
Single Participant



PROTOTYPE

We introduced a two monitors set-up, set feedback colors to indicate decision, and implemented a mathematical model that makes the task adaptive based on the actor’s past behavioral data (e.g. accuracy, speed).

Dual Participant



While two participants of one dyad were simultaneously presented with stimuli moving in identical directions, the stimuli difficulty level was tailored to each participant based on their behavioral data

After the final iteration, I collected data from 78 individuals grouped in 39 dyads and analyzed their choice responses using a stepwise logistic regression procedure.

Actor	Response at 1 trial back	Model's prediction to repeat	Response at 2 trials back	Model prediction to repeat
Own	Right	77%	Right	81%
Partner	Right	73%	Right	77%
Own	Left	73%	Left	72%
Partner	Left	77%	Left	76%

Finding: A dyadic dependency in which the participant did not ignore their partner's decisions; yet, they treated their partner's decisions differently from their own.

The **identical values** indicated the participant is not ignoring the partner's previous response but not adhering to it either.

A choice repetition bias primarily driven by the participant's **own decision at 2-back**, even though knowing their action is being observed by the other.

We designed a new joint decision-making task and collected behavioral data of 39 dyads. The results suggested an effect of social interaction on choice behavior.

Key Results

- We created a joint perceptual task and collected behavioral data which indicated that people do not ignore other's choices when they make decisions

Impact

- The joint design allows for a systematic comparison with the findings on choice history bias from those of the single participant designs
- Method is generalizable across various contexts and populations e.g, Human-AI interaction
- First to document the impact of social interaction in influencing the choice history bias effect
- Publication in *Nature Scientific Reports*

Takeaways

- Multiple iterations is always needed until the task is fully functional and replicable– being able to handle deep frustrations is part of the process!
- The practice of synthetic data simulation is *always*, not only a great sanity check on data integrity, but also a excellent tool to build a solid understanding of the analysis process

Case Study 2

Measuring user's interpersonal distances and physiological parameters for designing a comfortable human-agent interaction in augmented reality (AR)

*We developed an **AR application** in which users interact with six virtual agents in an art gallery context. I collected data of 54 users, conducted statistical analyses on the recorded distances and physiolgoical data.*

Project Overview

This project was part of my intership at the Human-Cetnered Ubiquitous Computing Lab at LMU Munich

Team

- Lead researcher (me)
- One junior researcher
- Three senior researchers

Scope

- Investigate whether a virual human-like agent occupies a personal space and how does it impact user behavior in an AR enviorment

Deliverables

- Academic publication at high-impact journal

I led a 12-month* project starting from background research to publication, prototyping and testing an AR application to study user interaction with virtual human agents. The findings informed design guidelines for a more comfortable social AR experience.

*Note the timeline does not account for the full publication process (peer-review & manuscript revision), which added at least 6 more months

Month 1

Background research

Conduct in-depth review of academic literature on proxemics and social interaction in digital spaces to understand the most recent development in the field

Developed research questions and formulate hypotheses

Month 2

Co-design workshop

Discuss the design choices of the avatars (sex, ethnicity, height, text-to-speech, etc.)

Discuss experiment and survey design to address our research questions

Month 4

Prototype, Test, & Iterate (Experimental Design)

Prototype an AR application with integration of wearable physiological sensors to gain early understanding of user behavior with human-like agents

Tested 10 users and identify any software issues

Iterated based on usability test feedback

Month 7

Data Collection & Analysis

Create flyers to recruit participants, prepare consent forms, write task instructions and procedure

We tested 54 participants

Analyze qualitative and quantitative data

Interpret the findings using various visualizations

Month 12

Present

Present findings to stakeholders

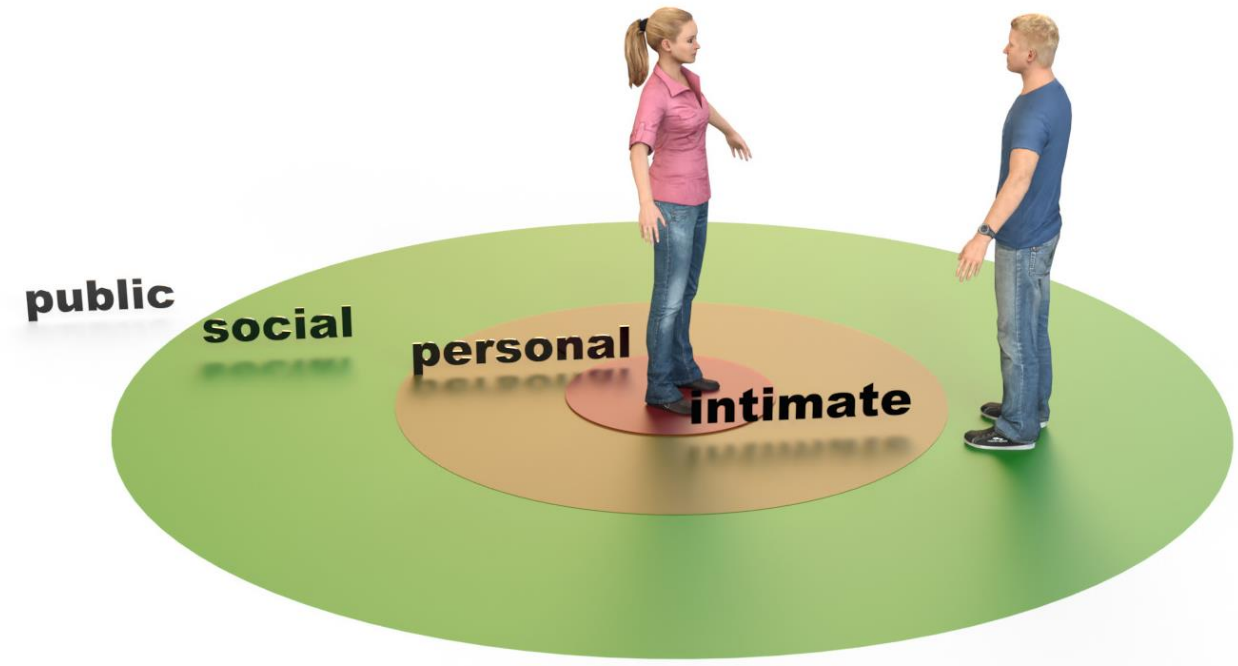
Write manuscript, begin the peer-reviewed and revision process

Published findings in high-impact journal

A deep dive into the literature on proxemics and social interaction [4,5] in digital spaces revealed that users keep distance from the human-like avatars, much like they do with strangers in real life. However, this is unknown in AR.

In terms of interaction designs, a set of explicit behavioral rules are often assumed for creating a reasonable communication scenario e.g., an avatar sees you and waves at you. However, there will always be cases where applying a certain rule is wrong for that specific instance.

For example, imagine an avatar that is not *“aware”* of the user’s need for privacy. This can create an unpleasant experience for the user. Accounting for *proxemics* can address this pain point and enhance user engagement.



We formulated key questions to examine how virtual agents impact user interaction in AR.

Does a virtual human-like agent occupy a personal space (PS) in AR?

Questions

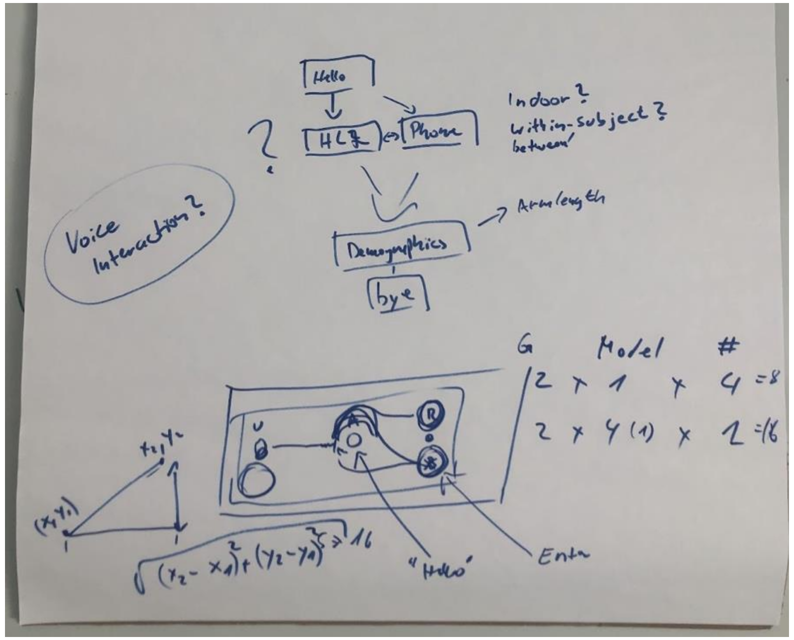
Q1: Do people respect a virtual human agent's PS in AR as if they would keep a distance with strangers in real life (distance >1 m)?

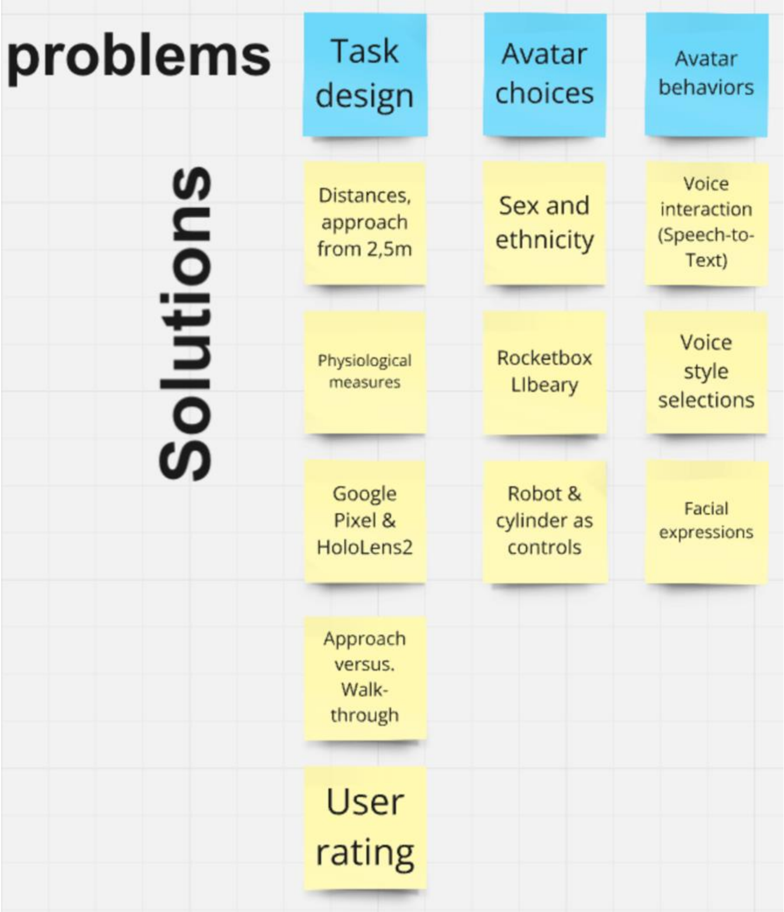
Q2: Does violation of a **human** agent's PS increase participant's level of physiological arousal as compared to that of the **non-human** agents?

Significance

- Collision in personal space means **conflict** in the avatar's socio-spatial affordances
- Violation of space is unpleasant and a **pain point** in the user's interaction experience

For the AR application, we designed a stop-distance task embedded in an art gallery scenario.



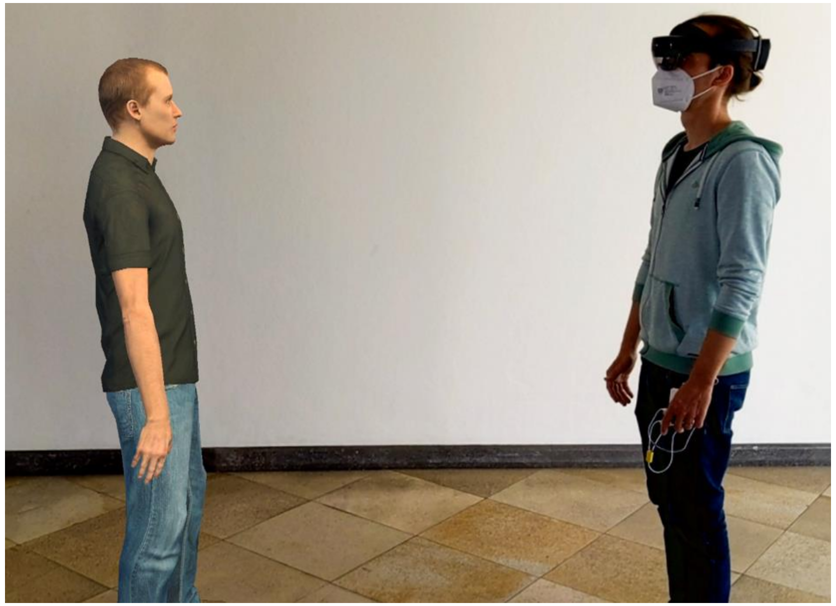


Planned to implement

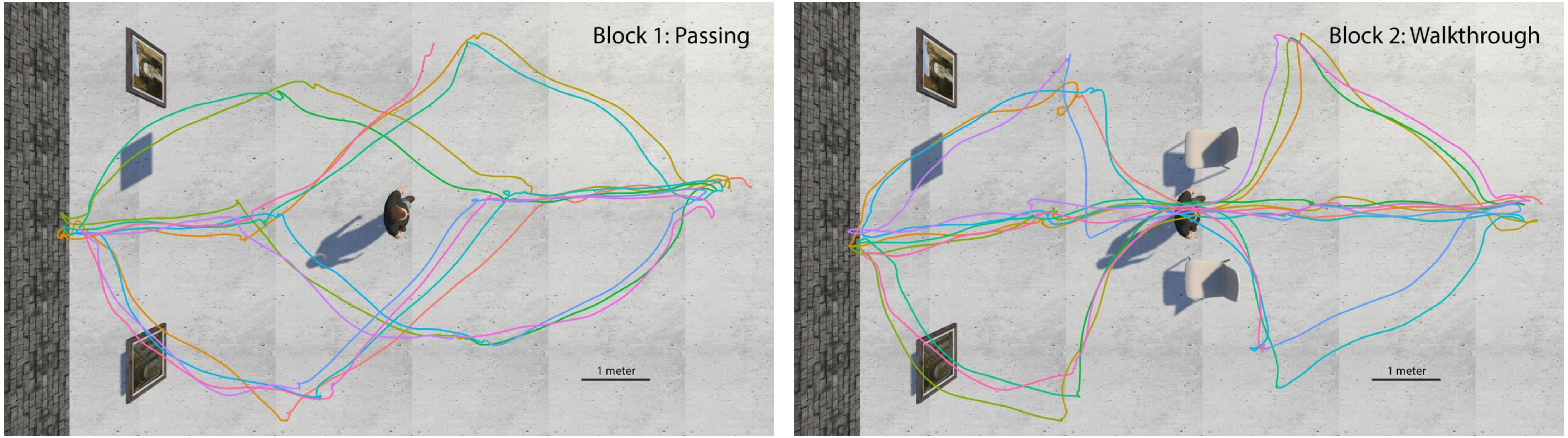
1. Present 6 avatars (2 males; 2 females; 1 robot; 1 cylinder) deployed using two types of AR systems
2. Approach versus walk-through the avatars (6 objects x 2 displays x 2 repetitions = 24 trials)
3. Voice interaction between the user and the avatar
4. Interviews & questionnaire on the perceived quality of interaction

I first developed a prototype and tested the stop-distance task on a smartphone (Google Pixel), then iterated on the design based on feedback from usability testing. Finally, we deployed the task using an AR headset (Microsoft HoloLens2).

- ✓ Users respected the personal space of the avatars (distance >1m)
- ✓ The human-like avatars were perceived as realistic
- ✓ Explore other nonverbal behaviors for avatar designs
- ✓ Troubleshoot: smartphone frequently crash
- ✓ Implement physiological measures for richer analyses



The experiment consisted 2 blocks: approach the virtual agents in the first block & walk through them in the second.

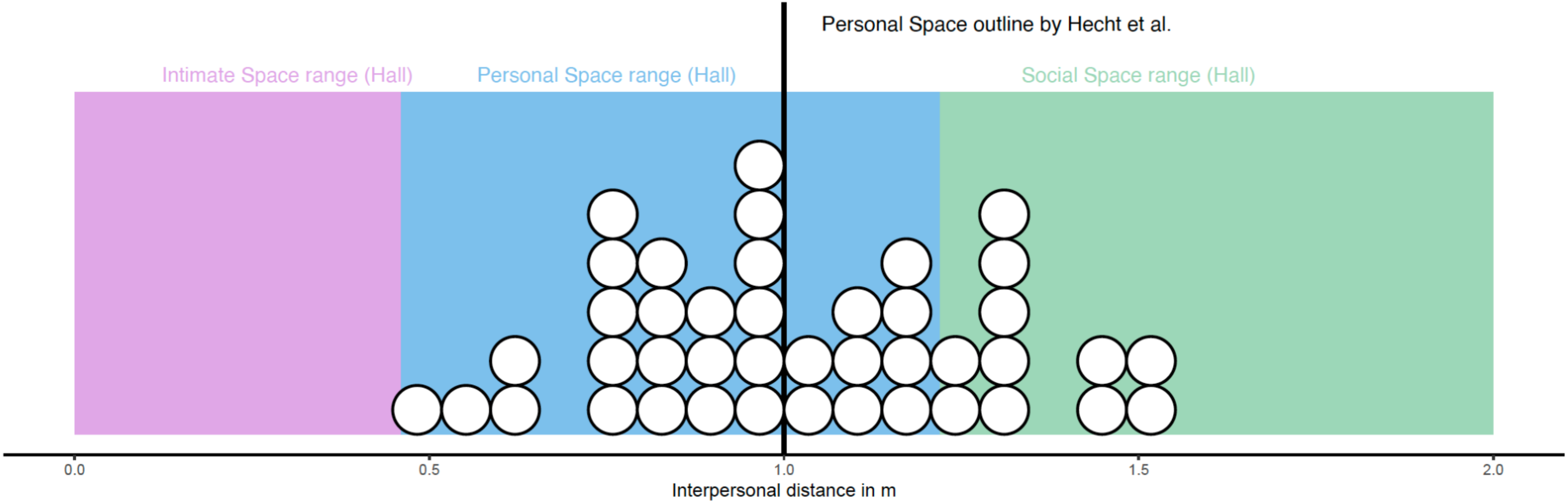


[Click here to view a video demonstration of the task]

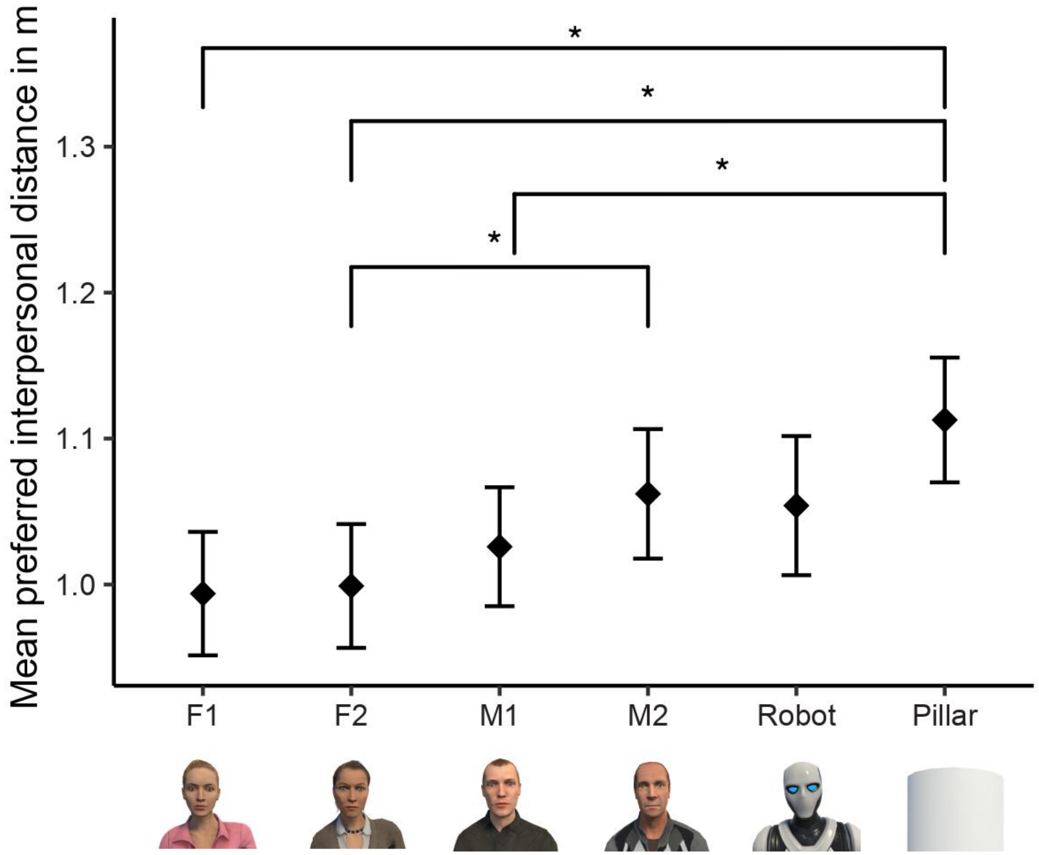
We **measured:**

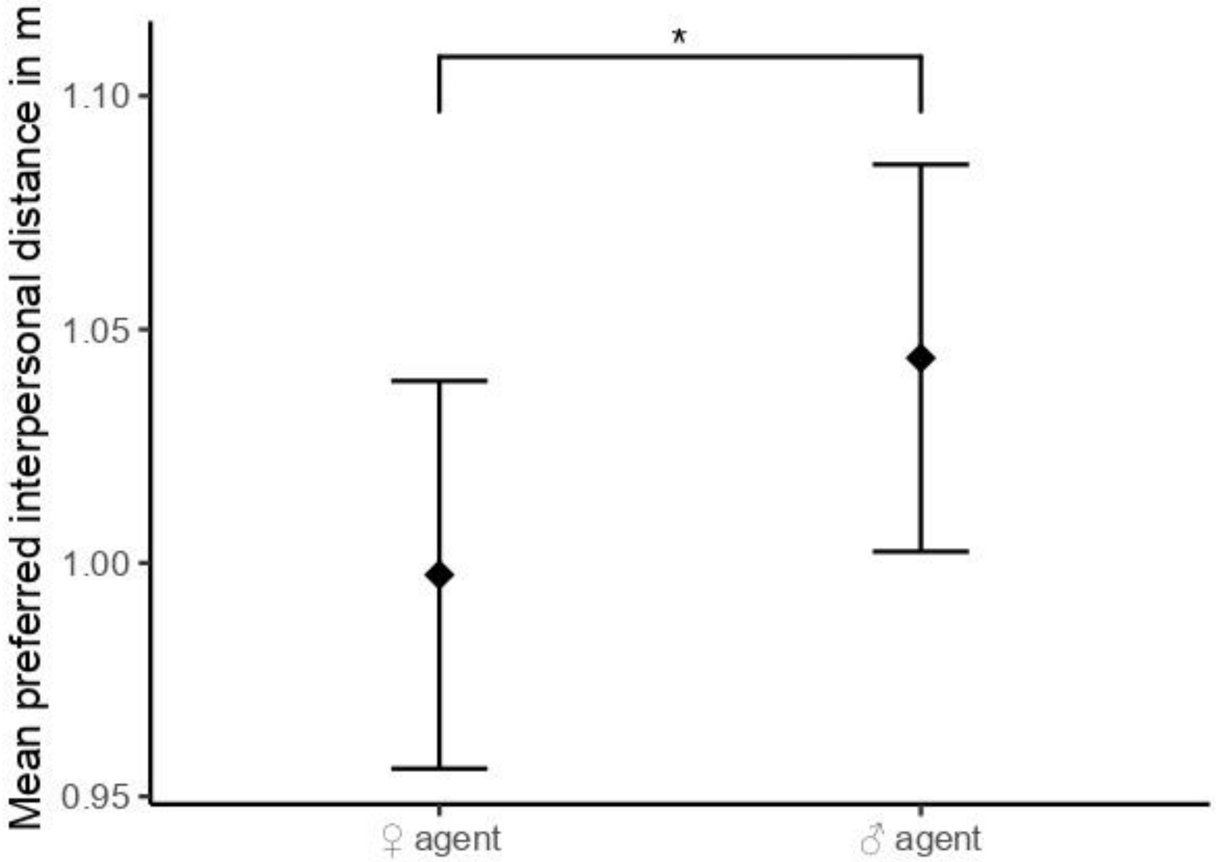
- The distances when the user approaches and greets standing in front of the virtual agent (or **preferred IPD**)
- The **spatial distance** when the user walks past the agent to view the art exhibit
- User's **physiological responses** when walking through the virtual agent

Most (N=31) interacted within a personal space (0.46-1.22m), and 11 people kept a social distance (1.22-2.4m) with the virtual agents. None entered an intimate space (<0.46m) or kept a public distance (>2.4m) with the virtual agents.

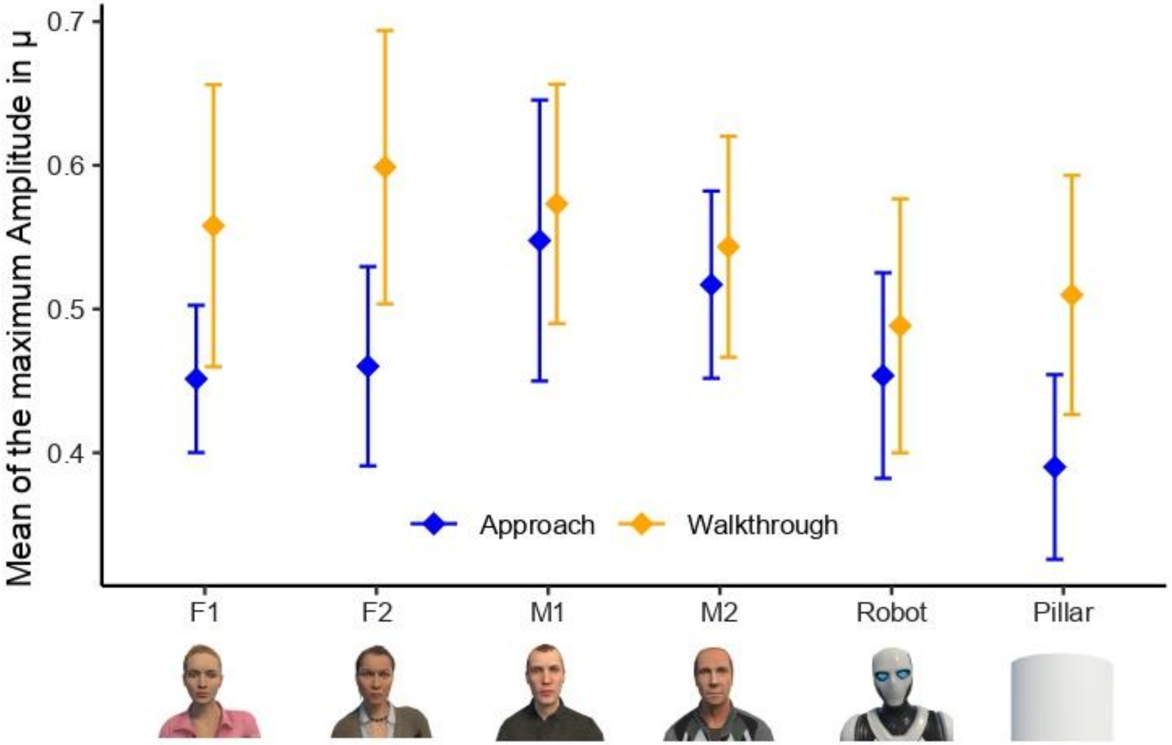


Human-like agents → smaller interpersonal distance (*p* < *.001)*
Female agents → smaller interpersonal distance

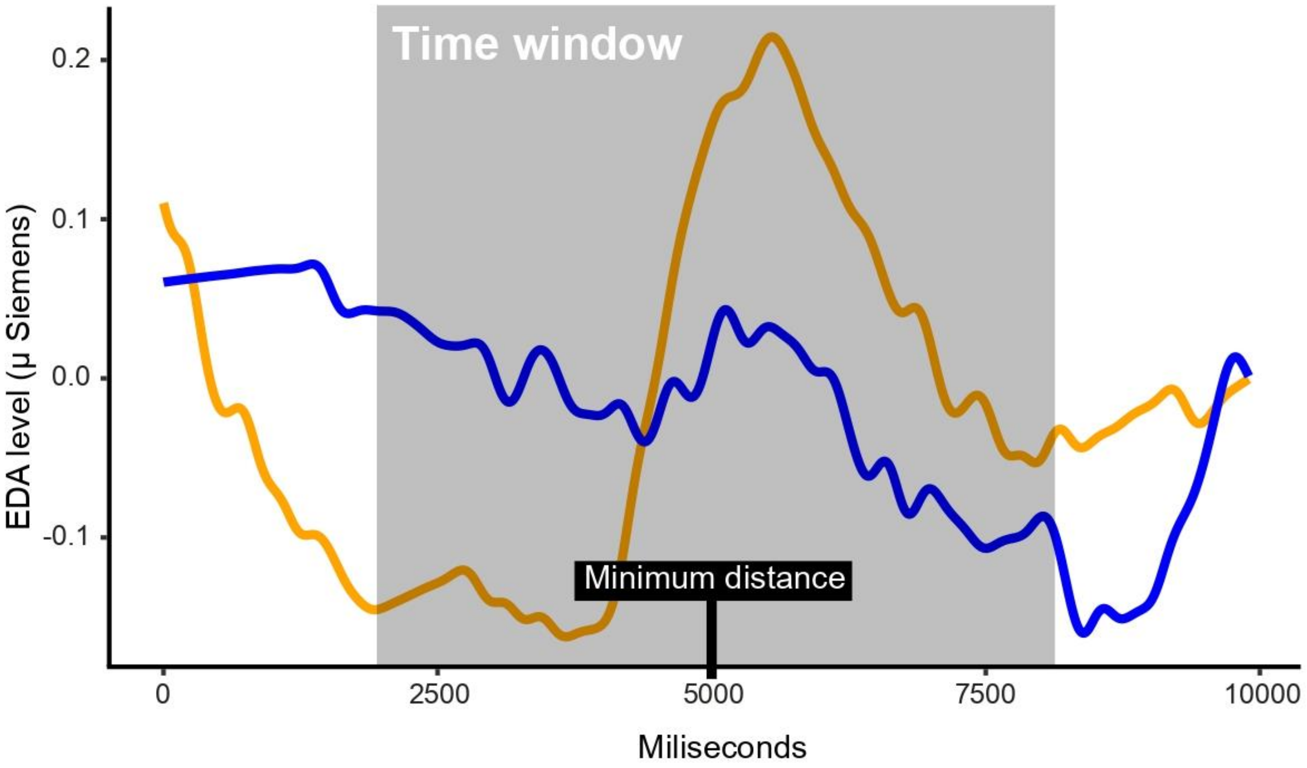




An elevated skin conductance responses for some of the agents



The maximum amplitude for all virtual agents



Example of one participant (orange: walk-through; blue: passing around)

We developed an AR application that tested the user's interaction behavior with virtual agents. Our results showed that virtual agent occupies a personal space, indicating that proxemics is key in designing for social AR experience.

Key Results

- We developed an AR application and collected the distances and physiological data of 54 users when interacting with 6 virtual agents.
- We found that human-like agents invited a closer interpersonal distances.
- The users also exhibited an elevated physiological arousal when personal spaces collided

Impact

- Design guidelines for social AR experience based on the behavioral results
- A prototype showing a combination of proxemics-aware & physiological computing systems to encourage positive human-agent interaction
- Publication in *CHI Conference on Human Factors in Computing Systems*

Takeaways

- Interviews and user feedback including current and past work are key in prototype iterations

Case Study 3

Investigate the effectiveness of warning signal modalities to enhance driver-vehicle interaction during highly critical situations in virtual reality (VR)

I analyzed data collected at the levels of eye, hand and feet from 255 users operating a simulated semi-automated vehicle. Our study found that audio-visual signal increases the likelihood of successful maneuver of critical traffic events by 18% compared to no signals.

Project Overview

This project was part of my PhD research. I collaborated with two junior researchers to analyze data collected in VR, which inform vehicle interface designs that optimize for trust and safety

Team

- Three lead researchers (me included)
- Two senior researchers
- Two lab directors

Scope

- Investigate how drivers perceive audio, visual and audio-visual signals for take-over requests during highly critical situations in a semi-automated vehicle in VR

Deliverables

- A replicable and ecological protocol to evaluate continuous driving performance across various populations
- Academic publication

I led a 14-month* project from conception of research questions to publication, processing and analyzing qualitative and quantitative data to understand user interaction with vehicle interfaces

*Note the timeline does not account for the full publication process (peer-review & manuscript revision), which added at least 2 more months

Month 1

Background research

A deep-dive review of academic literature on the modalities of warning signals for driver's take-over in semi-automated vehicles, identifying the gap between the embodied cognition theory and design practice

Month 2

Identify research question & formulate hypotheses

Formulate the research questions to address how the warning modalities differ in their effects on driver's reaction time, successful manuever, and gaze dwell time on the hazardous objects

Month 3

Data cleaning & processing

Cleaning and preprocssing 255 users' data, creating visualizations to understand the data, dealing with incomplete and missing data

Define the dependent variables and how to correctly calculate them

Month 8

Data Analysis

Visualize the data, conduct descriptive statistics and statistical tests to address our questions

Month 14

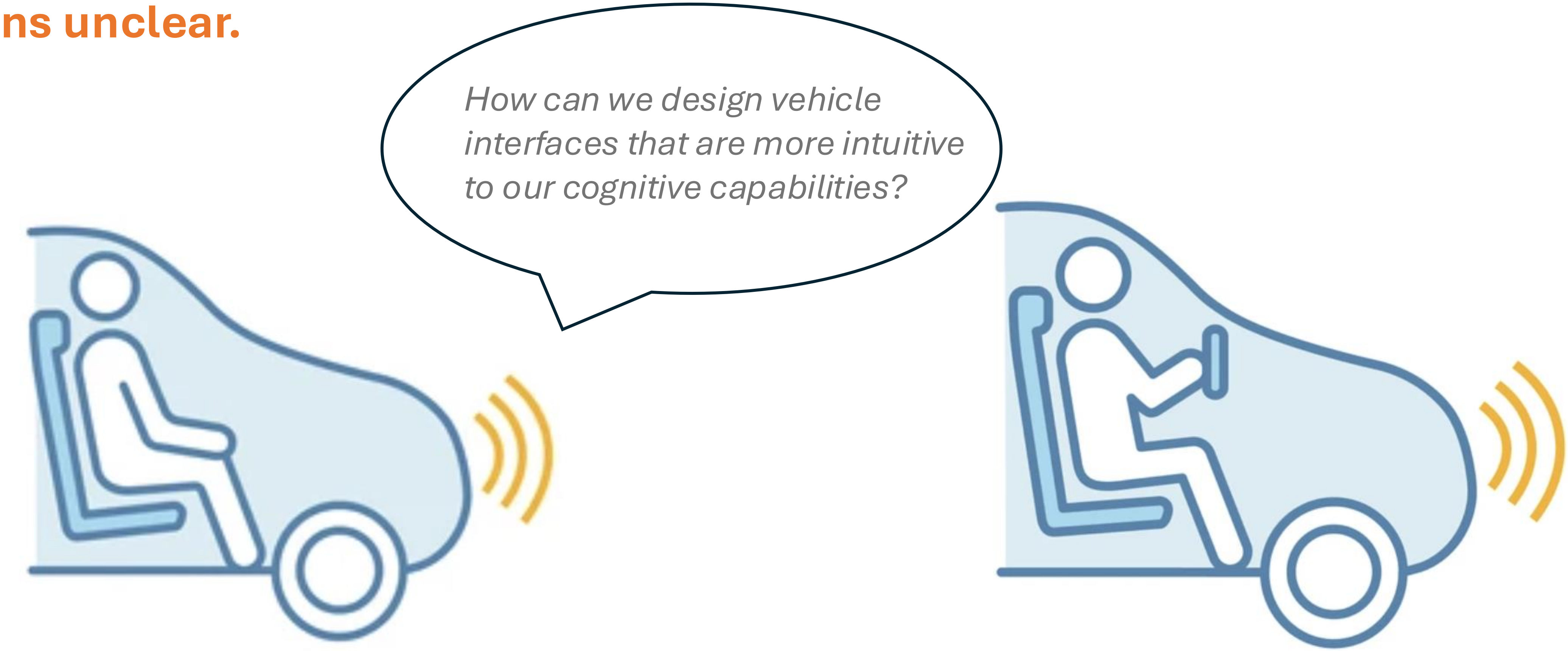
Present

Present findings to stakeholders

Write manuscript, begin the peer-reviewed and revision process

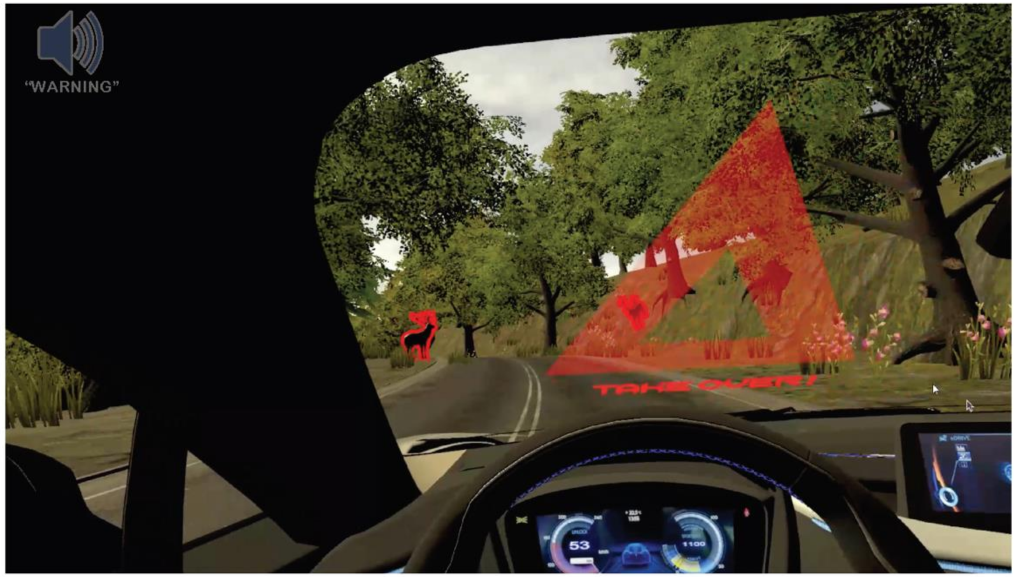
Published findings

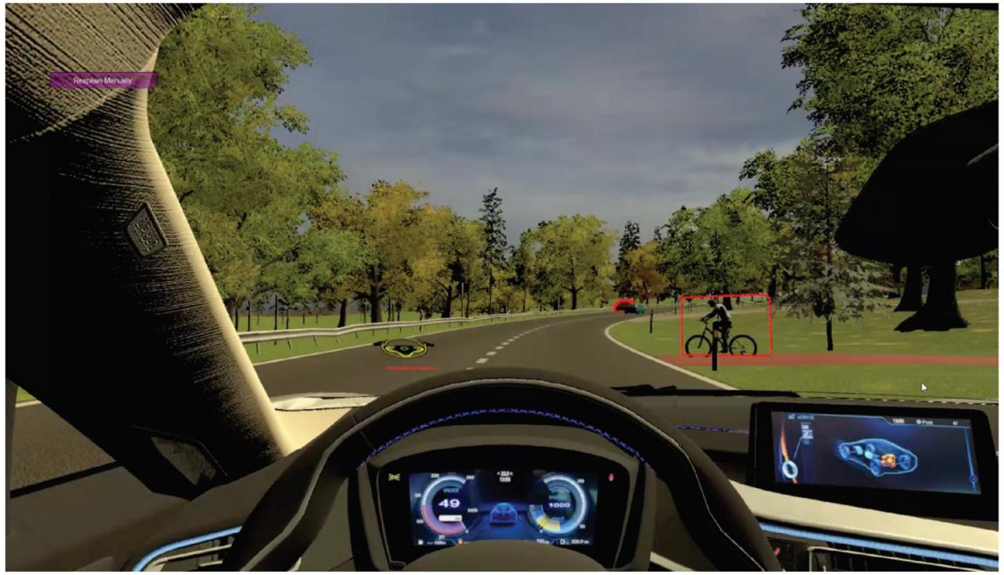
A deep dive into the literature on semi-automated vehicles suggest that warning signals facilitate drivers in the take-over process [6,7]. Yet, the effectiveness of the auditory, visual, or combined modalities in improving driver's situational awareness, reaction time, and vehicle maneuver remains unclear.



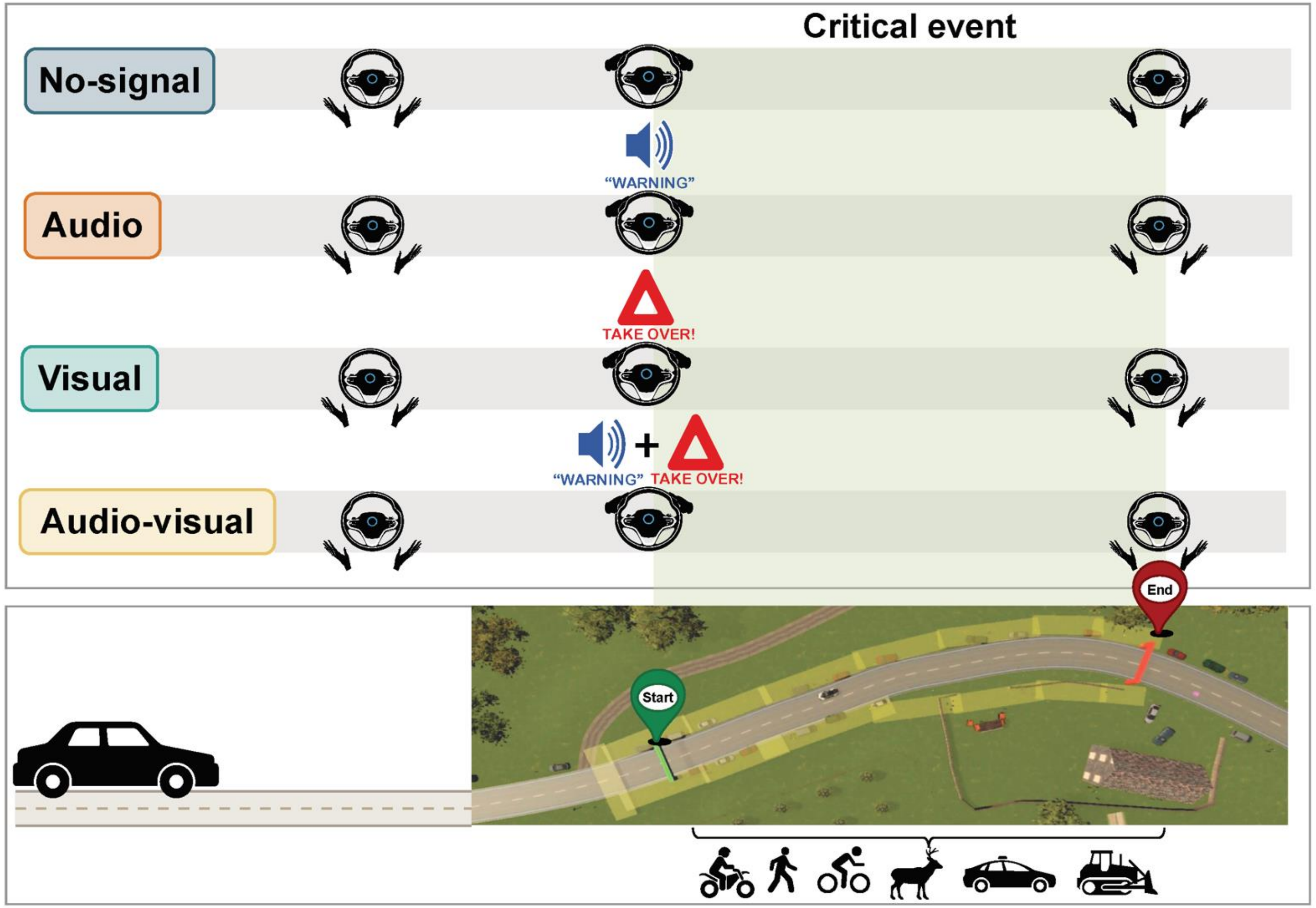
For practioners to design a semi-automated vehicle interface that aims to align more naturally with the driver’s cognitive state, a systematic and holistic experimental protocol is needed.

We use an immersive VR approach that reflects the real-life take-over process and subsequent maneuver through critical traffic scenarios. This allows a close investigation on how different signal modalities influence the driver’s attention and situational awareness.





The users are randomly assigned in four experimental conditions to drive through 11km long of various terrains (~10 min total) and navigate 12 critical traffic events. This setup enables a continuous collection of the performance metrics.

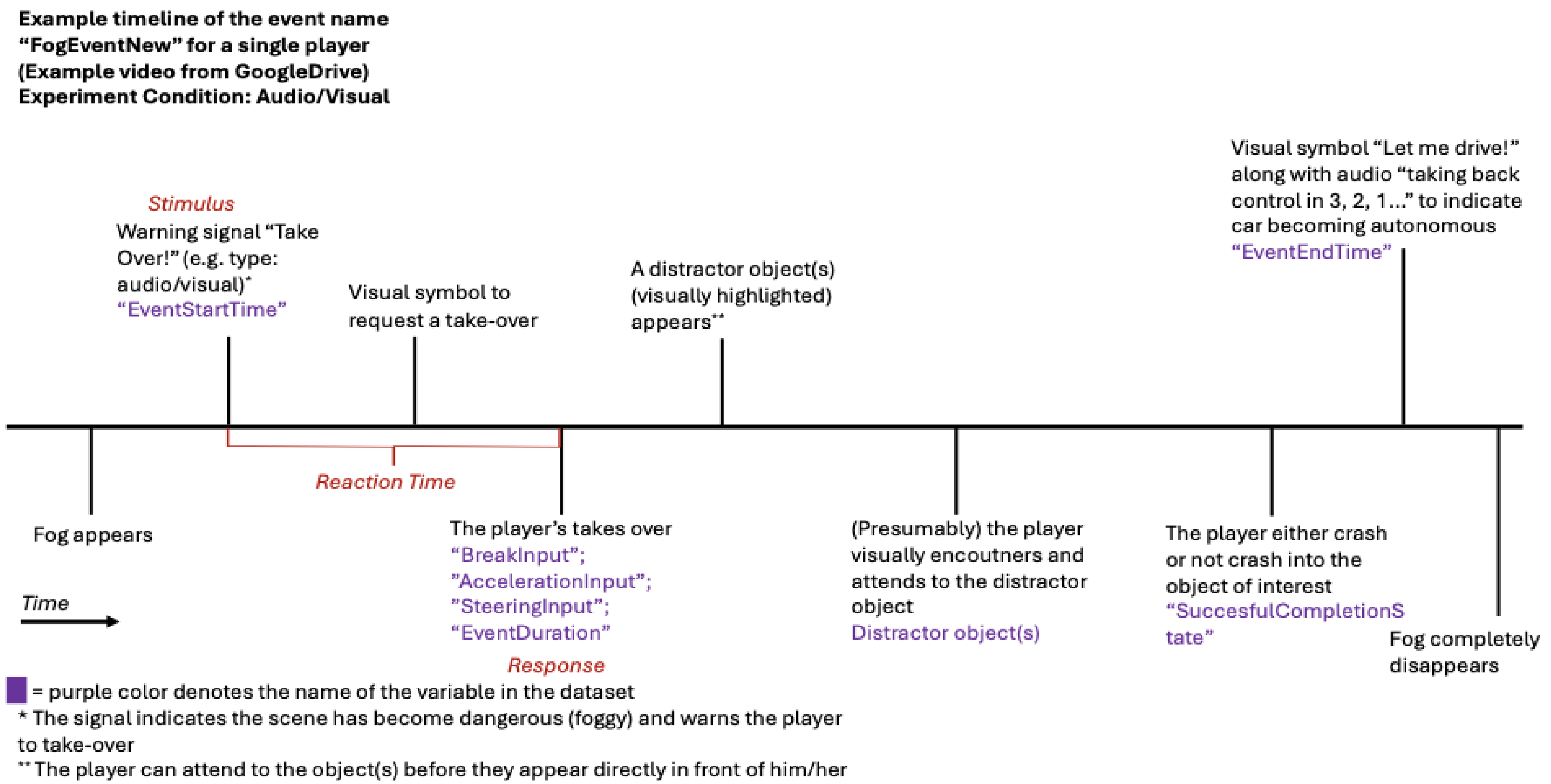


We analyzed the following metrics to evaluate the take-over performance:

- Reaction times
- Situational awareness
- Successful maneuvering

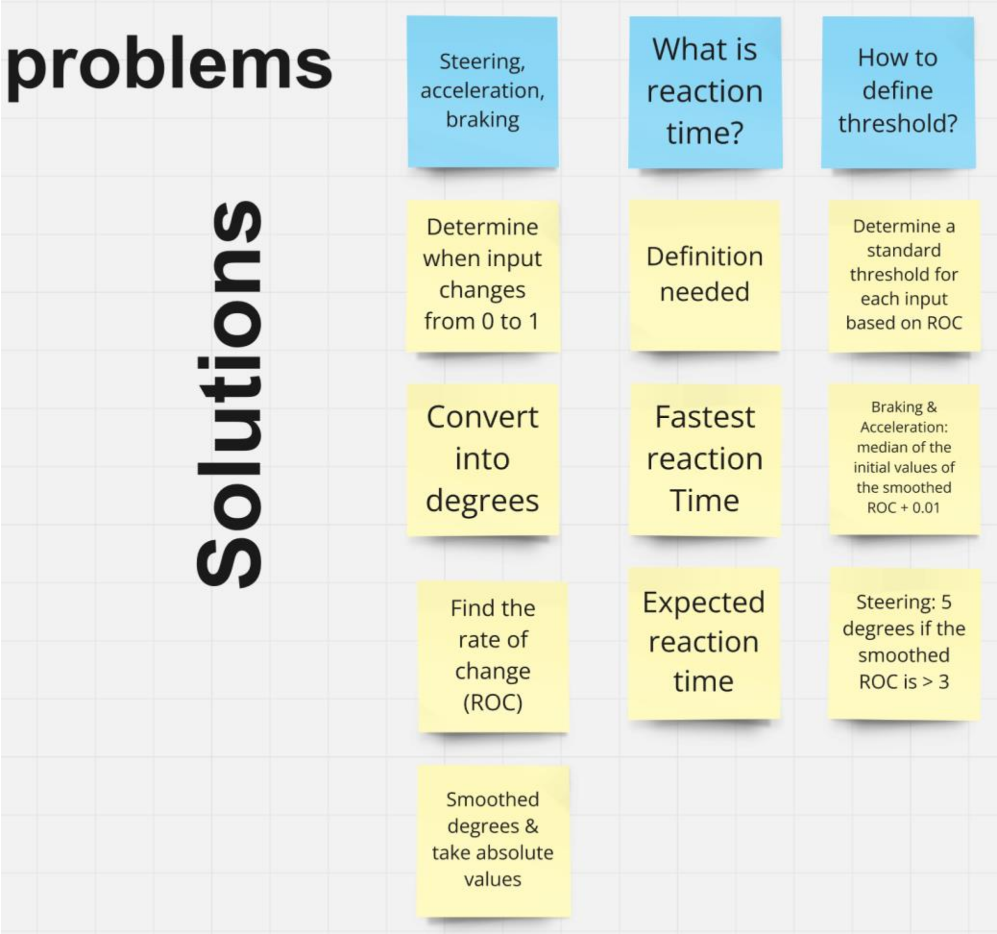
To analyze the time it took the driver to react, I first needed to define what reaction time is and correctly map the variables in the dataset for an accurate calculation

I analyzed the experiment recordings, developed an event timeline, mapped the variables in the dataset, and appropriately defined reaction time as the interval between the onset of signal to the driver's initial response (i.e., braking, accelerating or steering).



I researched and discussed with the team about methods of calculations, visualizing the data and implementing analytical solutions that would address our questions

Discussed solutions



Planned to implement

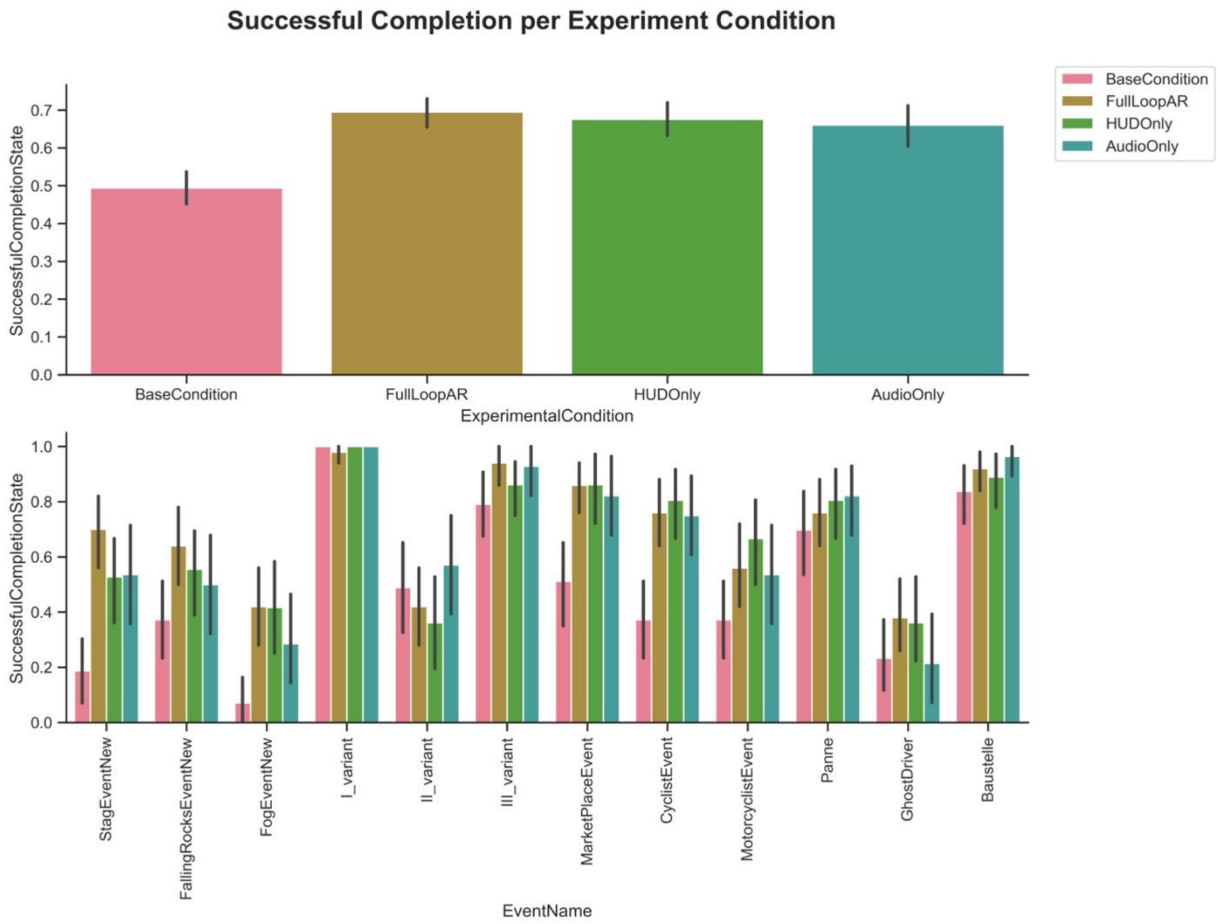
1. For each input, find the rate of change (ROC) and smooth the data
2. Determine the threshold for each input type based on the observed data & literature
3. Identify when the peak velocity (local maxima) > threshold
4. Calculate both the *expected* and *fastest* reaction time. This will tell us what the event *expected* the driver do vs. what the driver *actually* did. Maybe this could reveal & inform important design insights!

To evaluate the driver's situational awareness, I analyzed the eye tracking data. Specifically, I wrote code that analyzes the data samples to determine: 1) whether the driver saw the object of interest, for 2) how many times and 3) how long

- For this, I assessed the literature on what is considered *"seeing"*? (i.e., duration > 200ms)
- We also discussed whether it is important to differentiate the observed *"types of attentions"*? (i.e., is it critical to distinguish looking at one object multiple times for a short duration vs. looking at an object once, but for a long time?)

I also calculated and visualized the success rate for each event per each signal condition before performing any formal statistical tests as this right away gives us a sense of the effectiveness of the signals

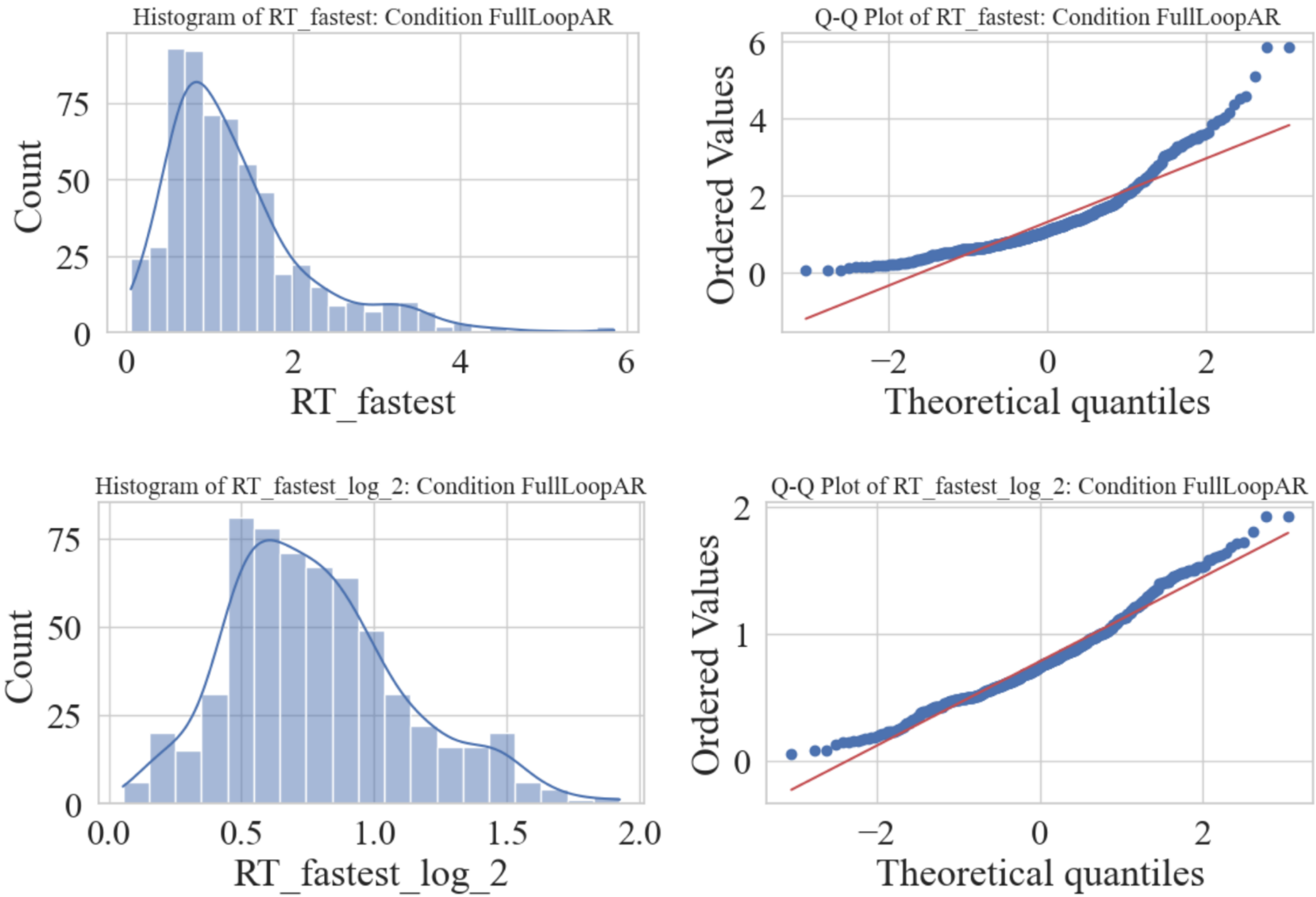
The visualization shows the warning signals lead to increased safety (success rate > 60%)



Looking at the data, I discussed with the team the best practices to deal with missing values and outliers, as well as methods of analyses

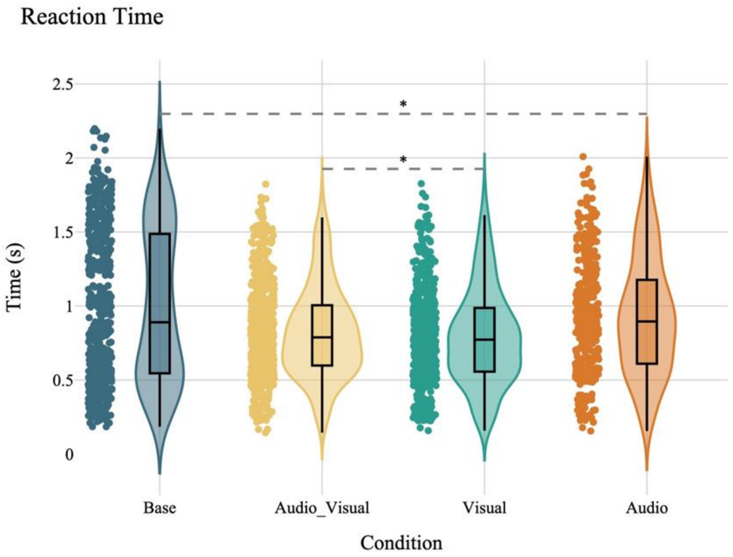
Log transform or Box-Cox?

Friedman test or Mixed-effects model?

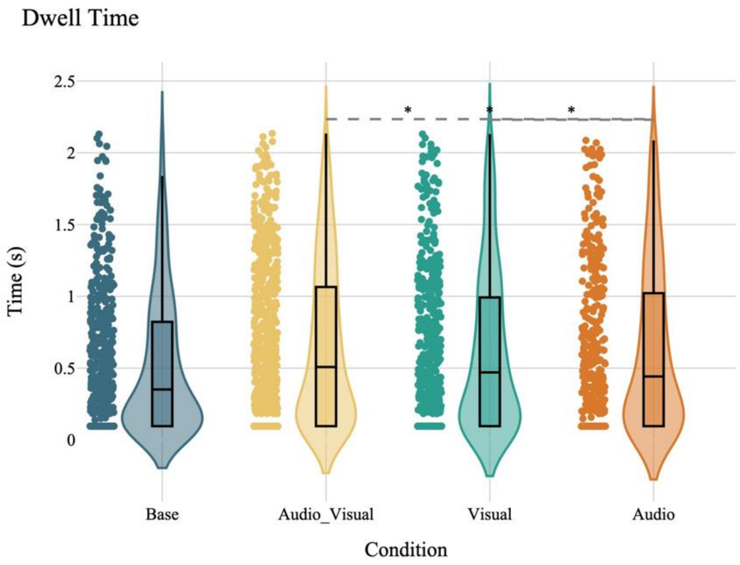


Our findings highlighted the effects of warning signals: reduced reaction time, increased situational awareness, and decreased perceived anxiety and increased trust

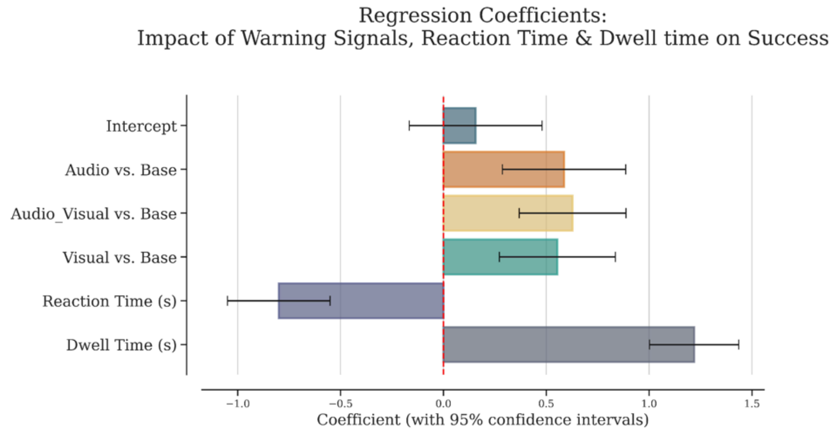
1. Reaction Time (audio-visual prompted the fastest reactions compared to audio-only)



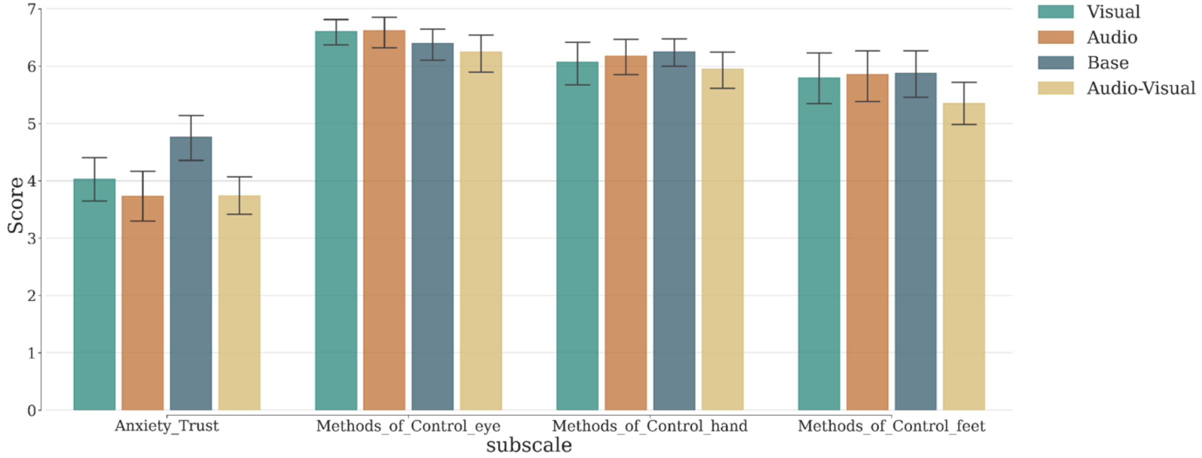
2. Dwell Time (signals increased attention to hazard)



3. Success Factors (signals increases likelihood of successful maneuver)

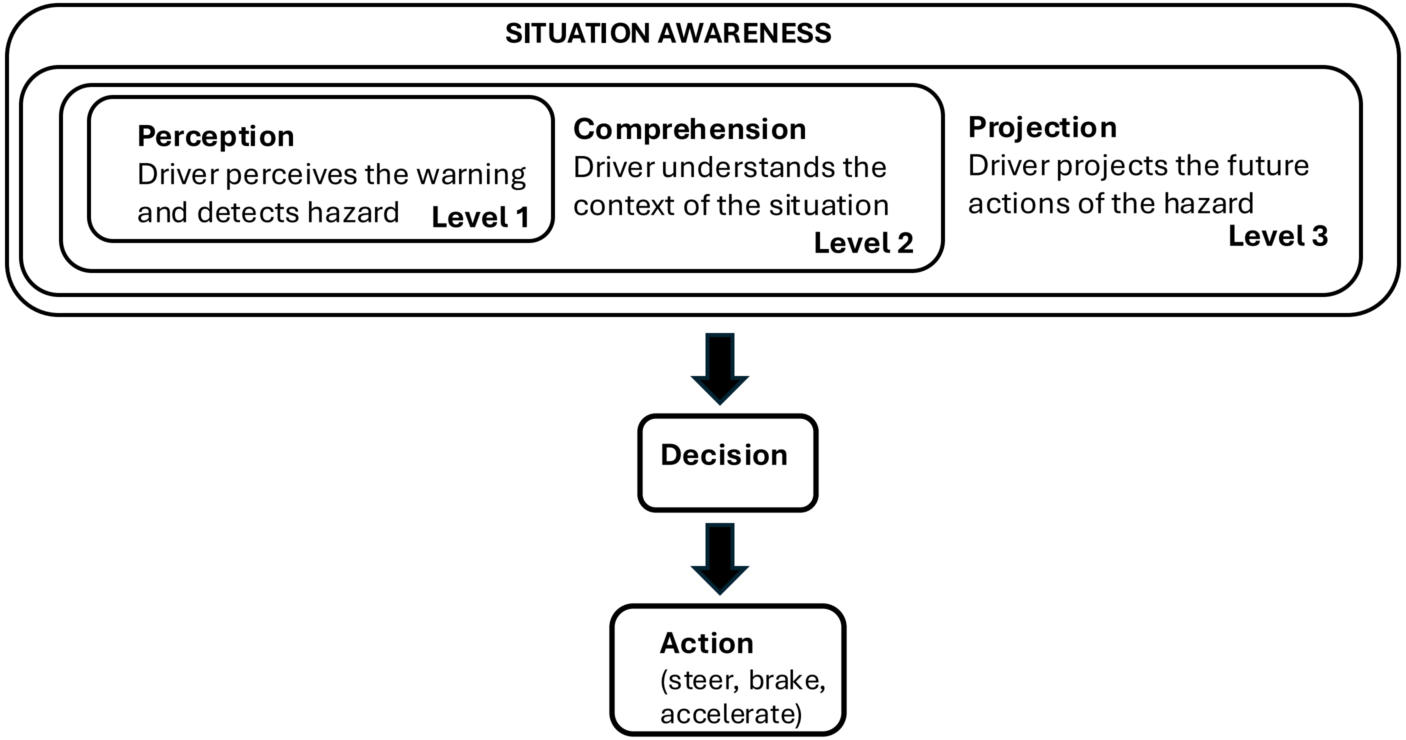


4. Questionnaire (signals reduced perceived anxiety and increased trust)



Our study revealed how different signal modalities influence the semi-automated vehicle handling, from perceiving the signal to take-over and the subsequent driving. This aligns with the Endsley's model [8] of situational awareness.

As such, the results present implications for future interface designs. For example, integrating context-aware adaptive warning systems that align with the driver's cognitive state, improving safety.



We conducted comprehensive quantitative & qualitative analyses to evaluate the impact of warning signals on driver's perception and behavior. Our results indicated distinct effectiveness of the signal modalities.

Key Results

- The quantitative analyses showed the visual signal decreases driver's reaction times, whereas the auditory signals did not.
- Any warning signal, together with seeing the driving hazards increased successful maneuvering
- The audio and visual signals improved situational awareness
- The warning signals reduced anxiety and increased trust.

Impact

- A replicable, scalable, and an ecological protocol that offers a comprehensive measurement of the user's perception to motor engagements
- Inform interaction interfaces design that could suit the user's different stages of information processing

Takeaways

- Cleaning and exploring the data are very critical steps before conducting any analysis steps. Visualizing the data is always a great sanity check

Interested in hearing more about my experience or what I am seeking next?

Let's Connect:

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References

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