Xiao's Human Factors Research Sharing

Xiao Ge, 02/2025, liz.gexiao@gmail.com

My journey of human factors research

Before 2016

Qualitative study of human factors to inform early-stage product innovation

LOCKHEED MARTIN SIEMENS

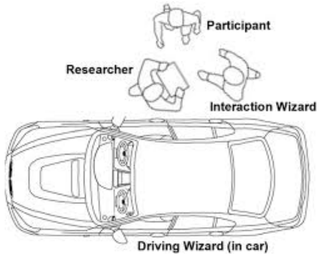
Role:

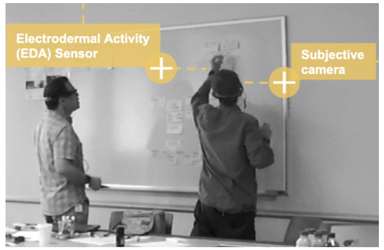
- Need finder
- Design thinker
- Trainer and coach

Research focus:

PhD (2016 - 22)

Mixed-methods research on interactions mediated by technology





Stanford ENGINEERING | Center for Design Research

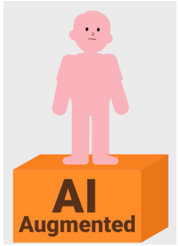
Role:

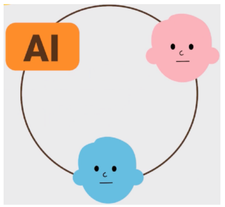
- PhD student
- Research assistant

Research focus:

After 2022

Quantitative research on human-machine interaction





HAI Stanford University Human-Centered Artificial Intelligence

Stanford | Department of Psychology SCHOOL OF HUMANITIES AND SCIENCES

Role:

- Postdoc fellow
- Lead researcher
- Lecturer

Research focus:

[Pre PhD]

Qualitative User Research for Early-Stage Product Design and Innovation

Need finder

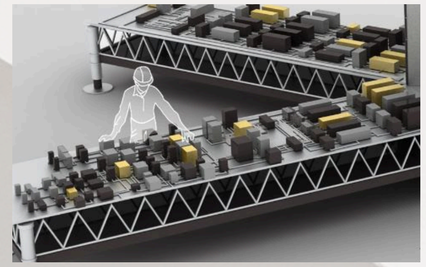
Design thinker

Trainer and coach

Graduate student

2010-2012

LOCKHEED MARTIN

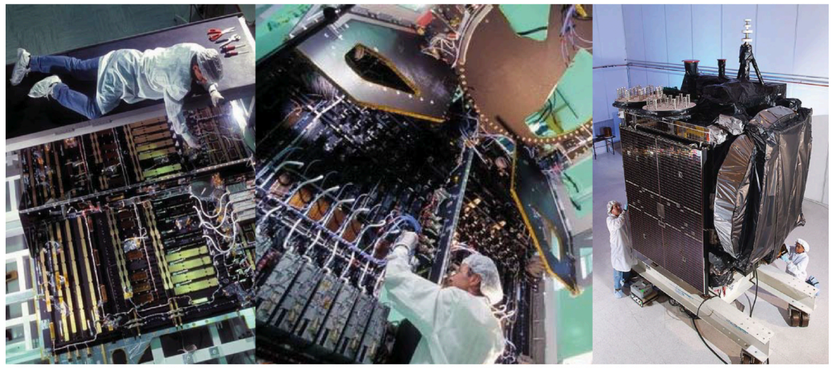


Transformed satellite assembly ergonomics

Impact on innovation strategy, product design direction / product launch, more research & development funding,

Request: Make satellites more affordable, producible, testable, scalable and modular

Research methods:



(Pictures are used for illustration. No pictures were allowed in the Lockheed Martin facility)

Specification	Metric	Rationale
Improves box access	Up until the point when assembly is "locked" and full system tests begin, any box can be accessed without cutting a hole in the structure or requiring users to assume ergonomically undesirable positions.	Currently 75% of satellites suffer from lack of access late in the assembly, which can cost up to 4 months & millions of dollars. Boxes are rarely replaced after full system tests begin.

Outcome and impact:

- My 2010-11 project became a classic case study for the class
- Project outcome was adopted by Lockheed, saving approximately $150 million per year and $20 million per satellite according to Lockheed Martin liaison Eric Byler (posted in Forbes)

[Pre PhD]

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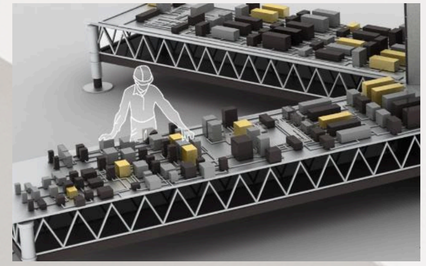


Transformed satellite assembly ergonomics

d. HASSO PLATTNER Institute of Design at Stanford

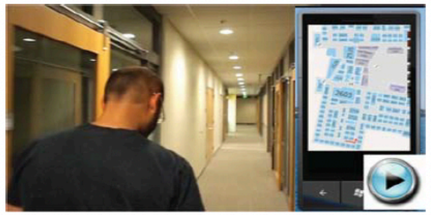
Convenient healthy eating for new moms

Design Thinking trainer, coach and lead

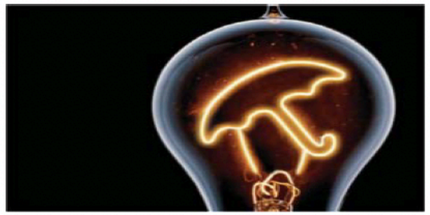
2012-2014

SIEMENS

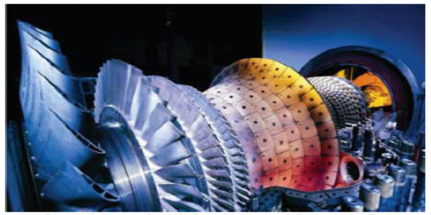
Enhanced mine security with wireless lifesaver



Interactive building responding to user needs - indoor navigation



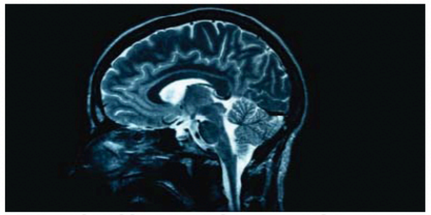
Boost of innovation with Intellectual Property counseling services



Market research of the future of gas turbine in China

Design of natural while appetizing lighting in fashion shops

Simple and safe gasification system



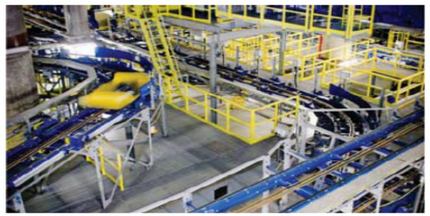
Personalized brain stroke care with augmented decision-making system

Distributed smart motor system for small and median enterprises

Interactive building responding to user needs - building control

Intelligent traffic management with human as smart sensors

Accurate and affordable urine analysis for small hospitals

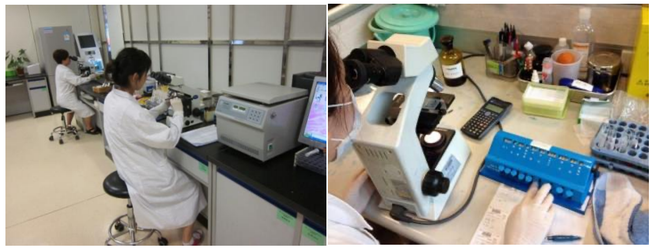


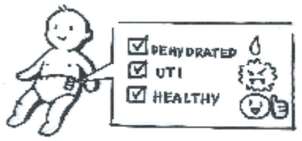
Effective operation and maintenance of airport baggage handling by social networking

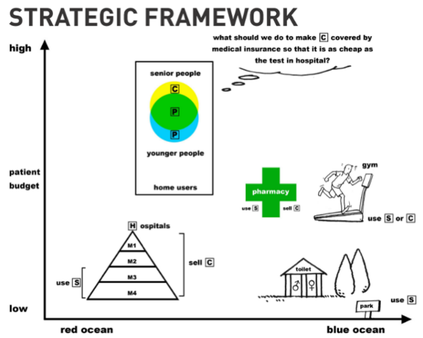
Request: Develop €50 urine strip reader for Chinese Market

SIEMENS

Research methods:







Outcome and impact:

- Deeper and broader view of unmet needs in China + strategic opportunity areas of product innovation
- Strong support from key stakeholders (e.g., the Head of digital experience, point-of-care at BU) + Secured more research funding

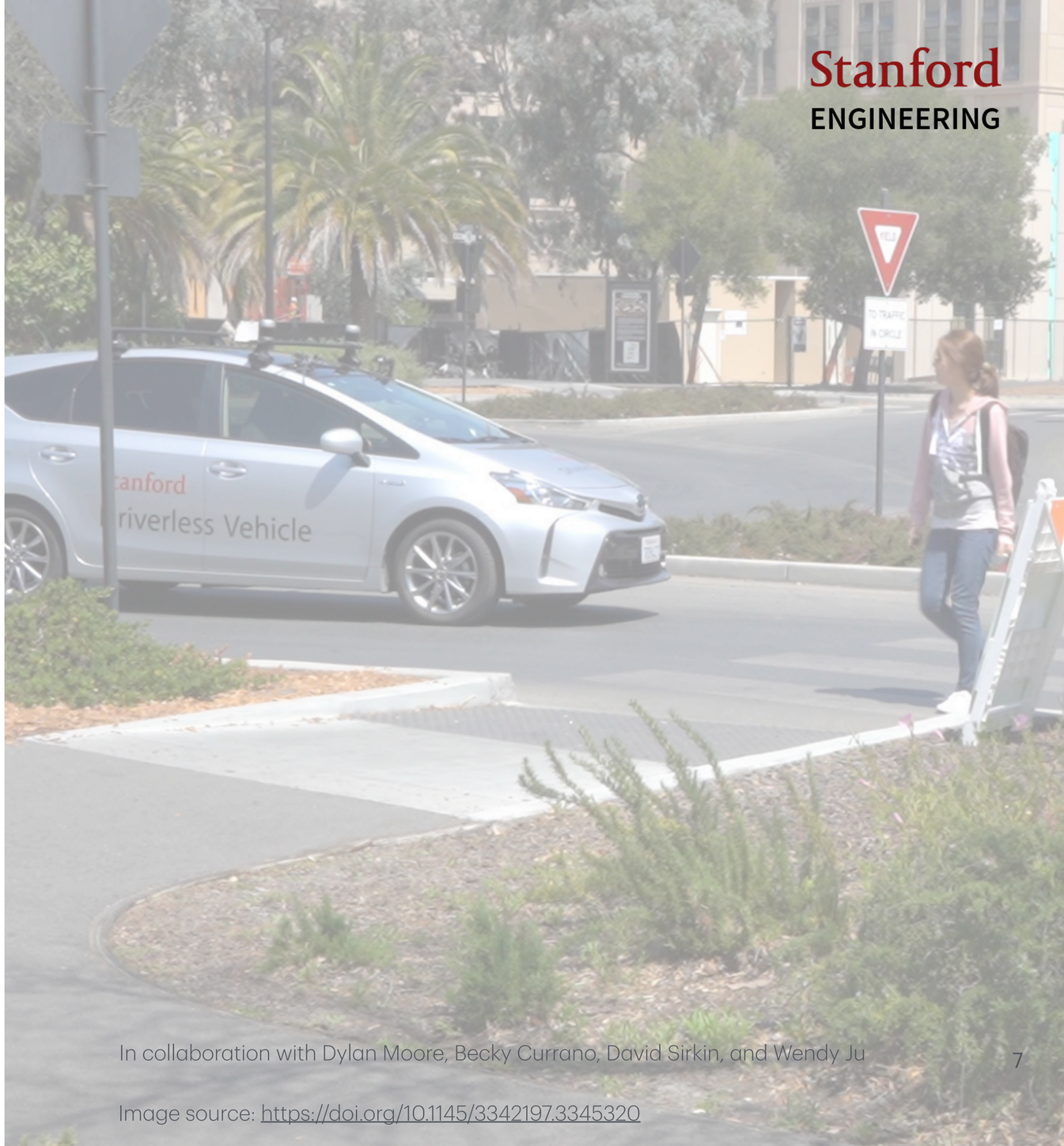
[During PhD]

“Ghost driver”: Implicit interaction at the crossroads

Research assistant

- Conducted interviews, surveys with pedestrians (users) that interacted with the “driverless” cars;
- Performed open-ended coding of video data
- Came up with car behavior scheme

Potential impact on autonomous car behavior design



Stanford ENGINEERING

In collaboration with Dylan Moore, Becky Currano, David Sirkin, and Wendy Ju

Image source: https://doi.org/10.1145/3342197.3345320

[Post PhD]

How Culture Shapes What People Want from AI

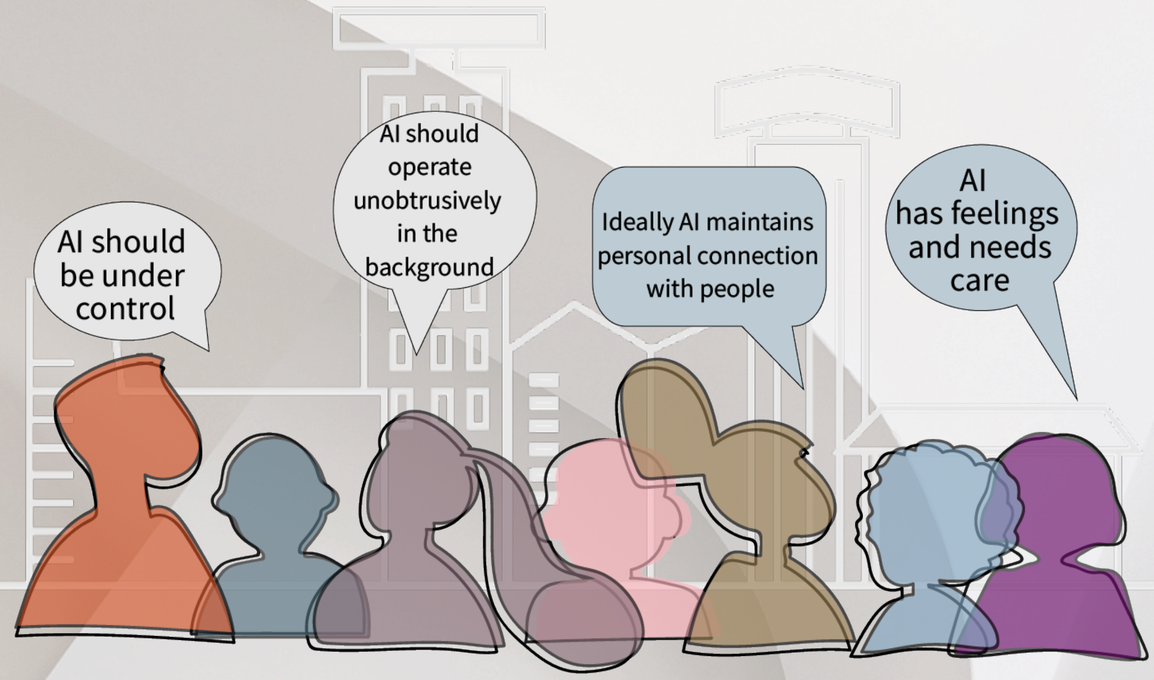
Lead researcher

Potential impact on various AI-based products

Stanford | School of Humanities and Sciences

HAI Stanford University Human-Centered Artificial Intelligence

CHI 2024 Surfing the World 11-16 May 2024



In collaboration with Chunchen Xu, Hazel Rose Markus, Jeanne L. Tsai, Daigo Misaki and Stanford Cultural Collab.

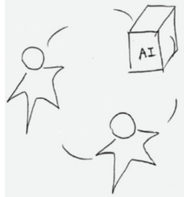
https://doi.org/10.1145/3613904.364266

Motivation: What conceptions of human do we have when we talk about human-centered AI?

Theory: Cultural models in self-construal (Markus & Kitayama, 1991)

Hypotheses:

- Seek control over AI (H1)
- Less likely to view AI as having capacities to influence (H2)



- Seek connection with AI (H1)
- More likely to view AI as having capacities to influence (H2)

Survey study:

CONFIRM theoretical assumptions → **TEST** hypotheses

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Potential impact on various AI-based products

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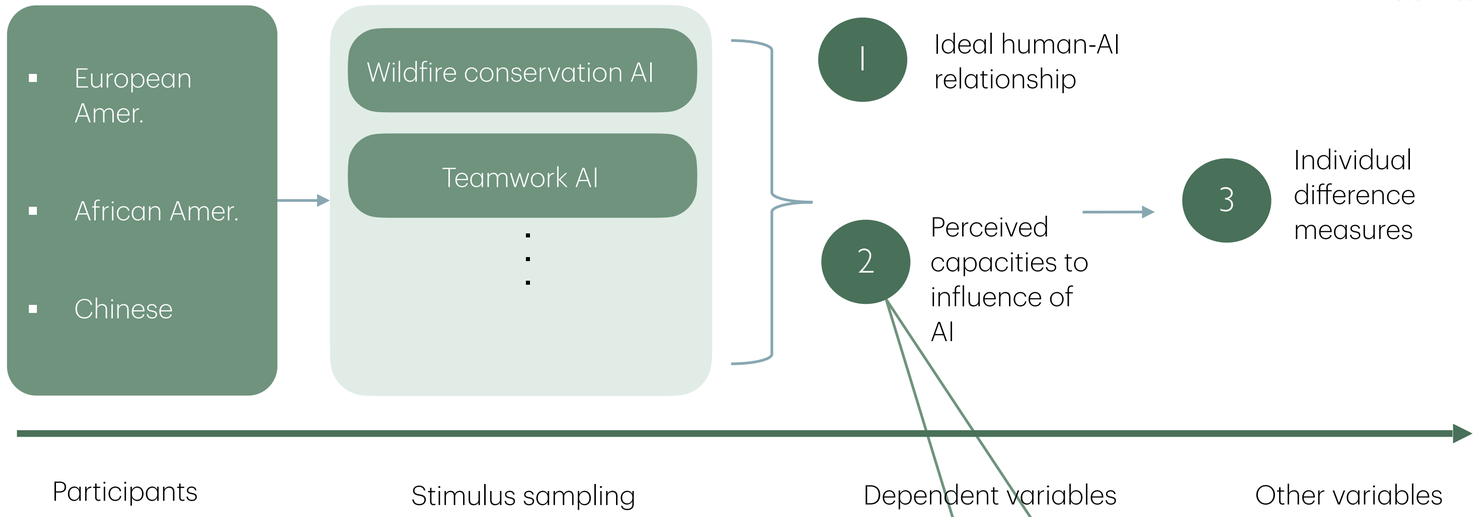
Main Study design:



Two-option nine-item measure about ideal AI's capacities to influence (α = .86)

Low capacities to influence (=1)	High capacities to influence (=2)
AI provides care to but does not need care from people.	AI provides care to but also needs care from people.
AI does not have feelings and emotions.	AI has feelings and emotions.
AI remains an impersonal algorithm to perform tasks.	AI maintains a personal connection with people.
AI operates unobtrusively in the background.	AI participates in social situations.
AI remains as an abstract algorithm whenever possible.	AI has a tangible representation of its existence (e.g., a physical body) whenever possible.
AI has little autonomy.	AI has autonomy.
AI mainly preforms tasks that are pre-planned by humans and has little spontaneity.	AI has spontaneity when performing tasks.
AI behaves consistently across different situations.	AI behaves differently across different situations.
AI interacts with people on terms made by people.	AI interacts with people on terms made by AI.

Findings: H1 and H2 receive support

Findings: H1 and H2 receive support

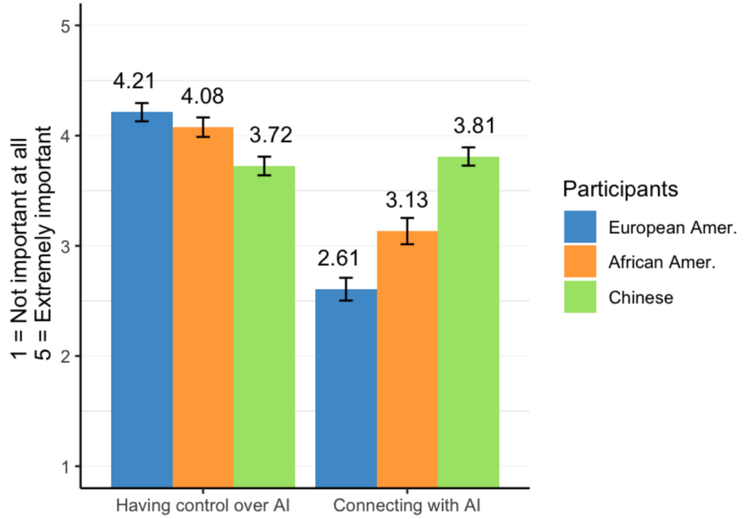


Figure 5: Importance of having control over AI and connecting with AI in Main Study, based on a 5-pt. scale. Error bars represent standard errors.

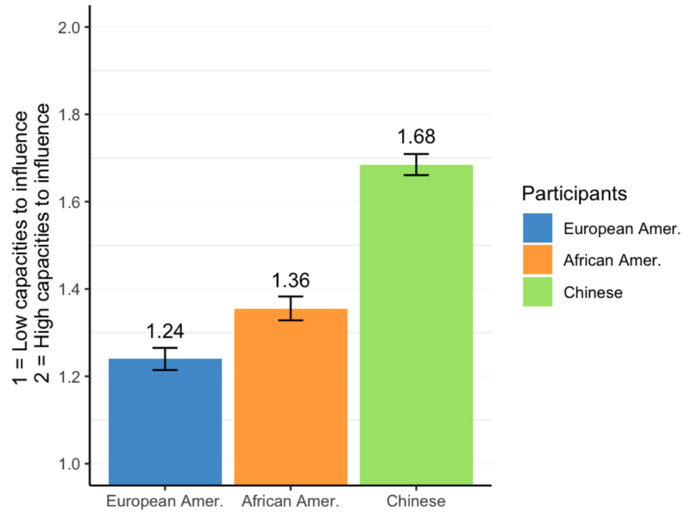


Figure 6: Preferred capacities to influence in ideal AI in Main Study, based on a 2-pt. scale. Error bars represent standard errors.

Impact:

For product design and engineering:

- Rethinking control-based relationships in designing human-AI interaction.
- Broadening the space of the imaginary for conceptualizing AI's characteristics.

For research:

- Empirical approaches to examine people's culturally-shaped preferences regarding AI
- Illuminating the implicit and latent cultural assumptions about humans that are built into current models of human-computer interaction, and through this,
- Expanding current models of human-computer interaction to increase the potential of future technologies.

[Post PhD]

Diagnosis of team performance in immersive VR

Lead data analyst

Potential impact on VR/XR/AR product design directions

In collaboration with Ade Mabogunje, Neeraj Sonalkar, Mark Miller and Jeremy Bailenson

Image source: https://www.viar360.com/how-virtual-reality-is-revolutionizing-remote-teamwork/

Motivation:

VR scenario VS

Task content VS

Hypotheses:

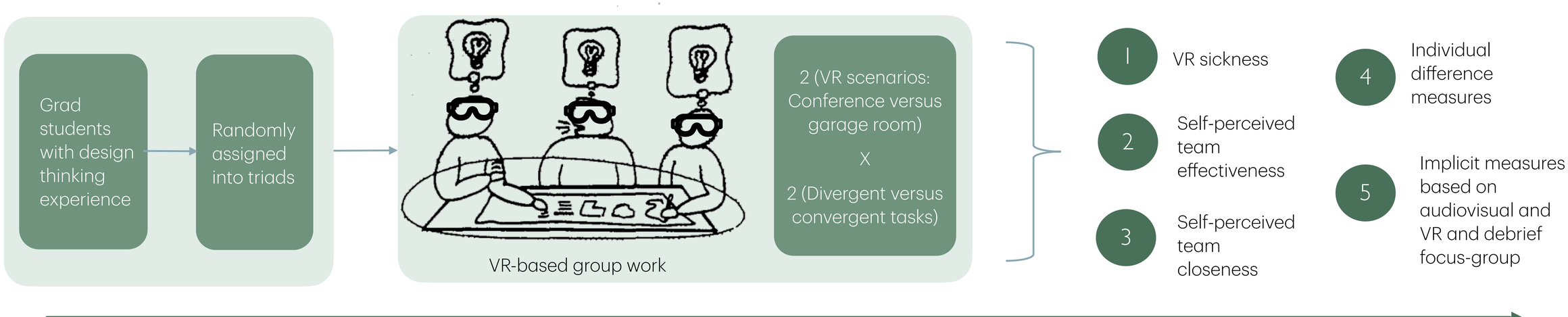
H1: Users will report different levels of VR sickness working in different VR scenarios.

H2: More VR sickness will be perceived in tasks incongruent with the VR work environment.

H3: Self-reported team effectiveness will suffer with VR sickness.

(Other RQs)

Study design:



Visual built upon Tang (1989)

Findings:

H1 receives no support.

VR scenario

VS

H2 receives partial support.

H3 receives support— effect of VR sickness level on self-perceived team effectiveness persists even after controlling for team closeness (adj. R-squared = 0.30, F (2, 96) =21.72, p<001, where VR sickness: B = -0.1, t(96)= -2.74, p<.001)

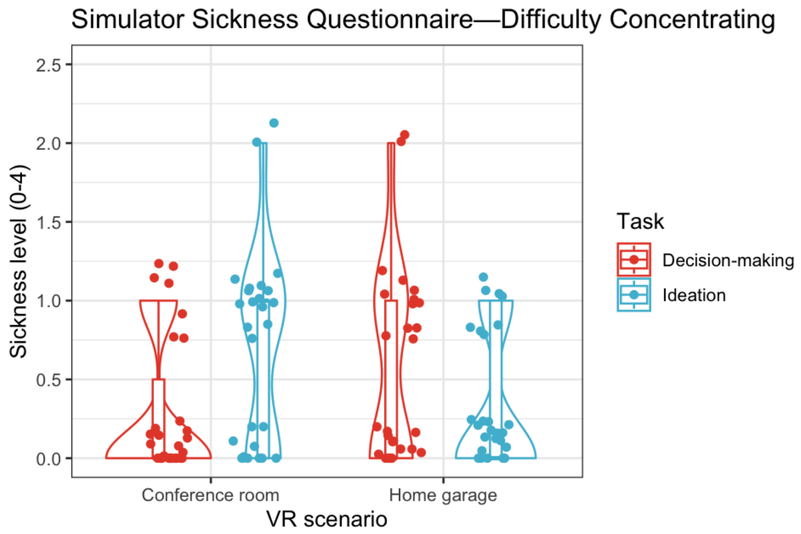


Figure 1. Distribution of SSQ—"difficulty concentrating" by VR scenario and task content, displaying median and interquartile ranges. Data here includes 10 triads of 30 participants in the 4 randomly-ordered session study. Significant interaction effect is found based on negative binomial test and Wilcoxon signed rank test.

Participant's 1st person perspective: "Unenthusiastic brainstorm" in the conference room

Figure 2. Example here shows near the end of an ideation session in the conference room. The office building-based conference room environment was reported as "distractive", "unenthusiastic ", etc for brainstorming

Impact:

- User work performance could suffer with even just slight VR sickness from 10-min VR-based work
- Offering insights how to design digital experiences that are conducive to users' work
  - VR/AR/XR as more than "escape or a place for work"

Note: Unweighted approach, survey scale based on the simulator sickness questionnaire (Kennedy et al., 1993)

Research skills and experiences from other projects during and after PhD

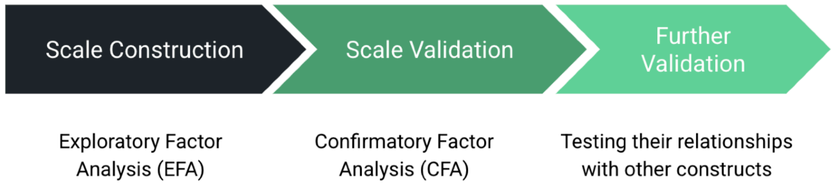
Time-series / longitudinal observational (video) data analysis

Lead researcher
(Ge, Leifer & Shui, 2021)
https://doi.org/10.1016/j.destud.2021.101020

(G. Muybridge, The Horse in Motion, 1878)

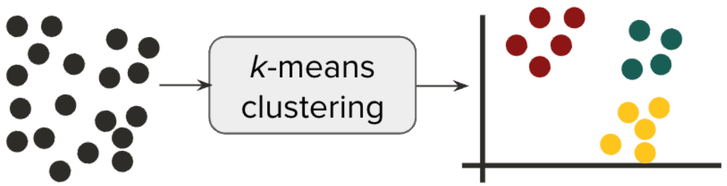
Survey scale / construct development

Lead researcher, unpublished work



Cluster analysis for user categorization

Lead researcher
(Ge, Schar, Chen, Toye, & Sheppard, 2024)
https://peer.asee.org/47404



Stanford
ENGINEERING

[During PhD]

Multivariate modeling of intra-individual variability based on time-series observational data

Lead researcher

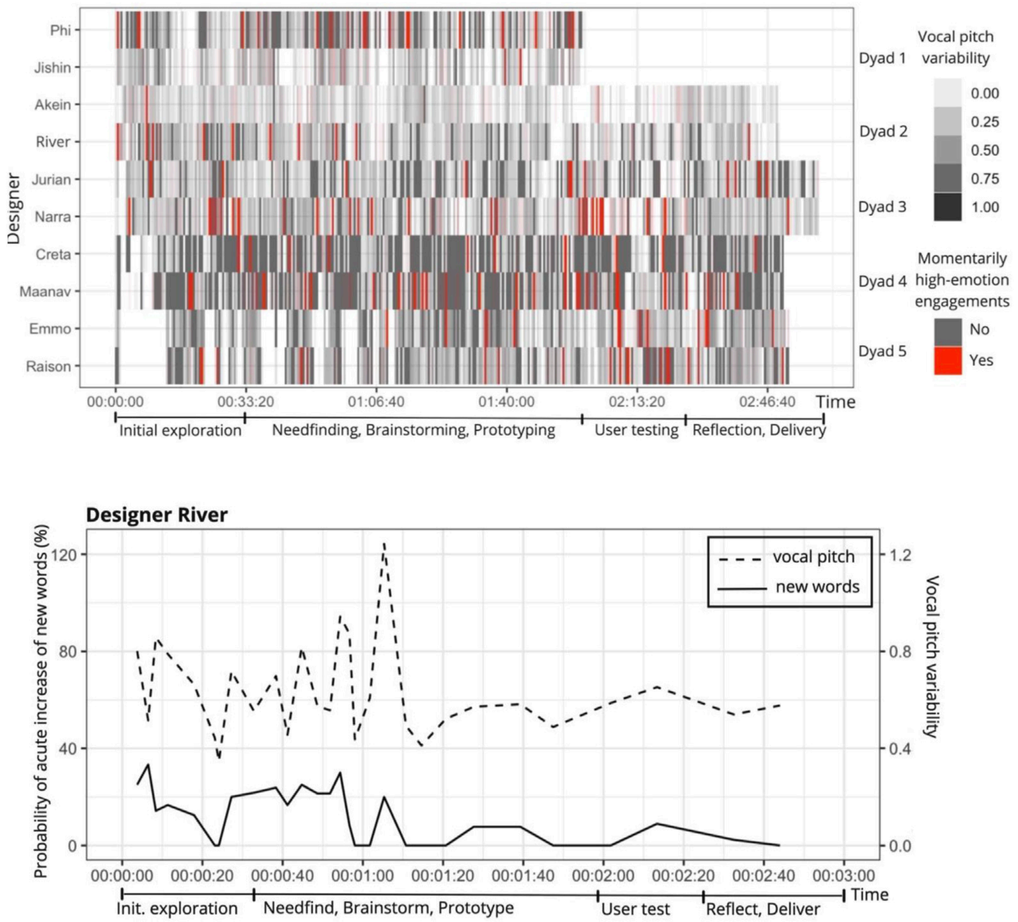


Figure 1. Examples of types of time-series analysis and data visualization I can perform

Ge, Leifer & Shui, 2021)
https://doi.org/10.1016/j.destud.2021.101020

Thank you!

Before 2016

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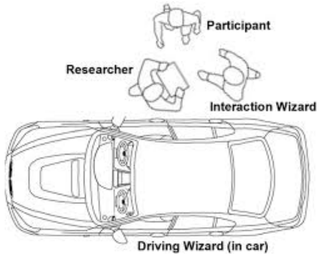

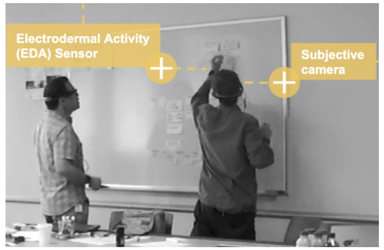

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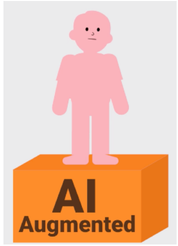

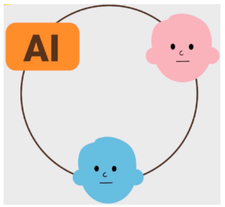

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