

Persuasive virtual agents for peer pressure simulations in Immersive Virtual Reality

Designing for people with a mild to borderline intellectual disability and alcohol use disorder.

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Simon Langener, MSc.
Human Media Interaction
s.langener@utwente.nl



UNIVERSITY
OF TWENTE.

Human
Media
Interaction



Tactus
verslavingszorg

I work on **Behaviour Change Support Systems** for vulnerable groups, such as people with an intellectual disability.

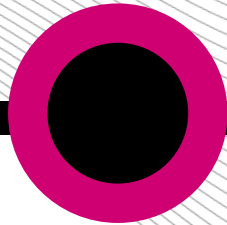
I research **embodied learning** strategies in **virtual reality** focusing on the treatment of substance abuse.

I **develop and evaluate** the **interaction design** to make XR-technology accessible.

I combine **psychology** with **technology** to design playful learning experiences.

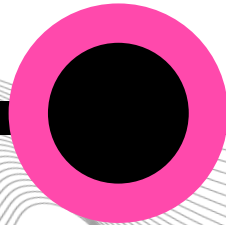
I teach about the importance of **accessible XR** for vulnerable groups and supervise bachelor & master projects.

Content



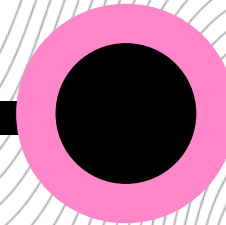
BACKGROUND

- IVR for the treatment of AUDs
- Influential ECAs
- PhD project goals



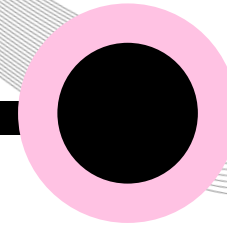
PROTOTYPE DEVELOPMENT

- Prototyping with field experts



DISCUSSION

- What did we learn?

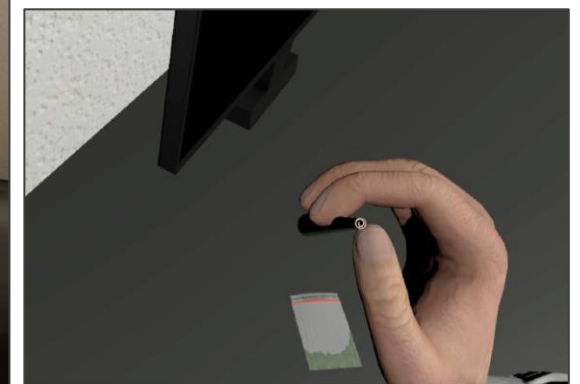


FUTURE RESEARCH

- Our plans and beyond

Background – IVR for addictive disorders (AUDs)

- IVR enables us to recreate risk situations for patients



Langener, S., Van Der Nagel, J., van Manen, J., Markus, W., Dijkstra, B., De Fuentes-Merillas, L., . . . Schellekens, A. (2021). Clinical relevance of immersive virtual reality in the assessment and treatment of addictive disorders: A systematic review and future perspective. *Journal of clinical medicine*, 10(16), 3658.

Background – IVR for addictive disorders (AUDs)

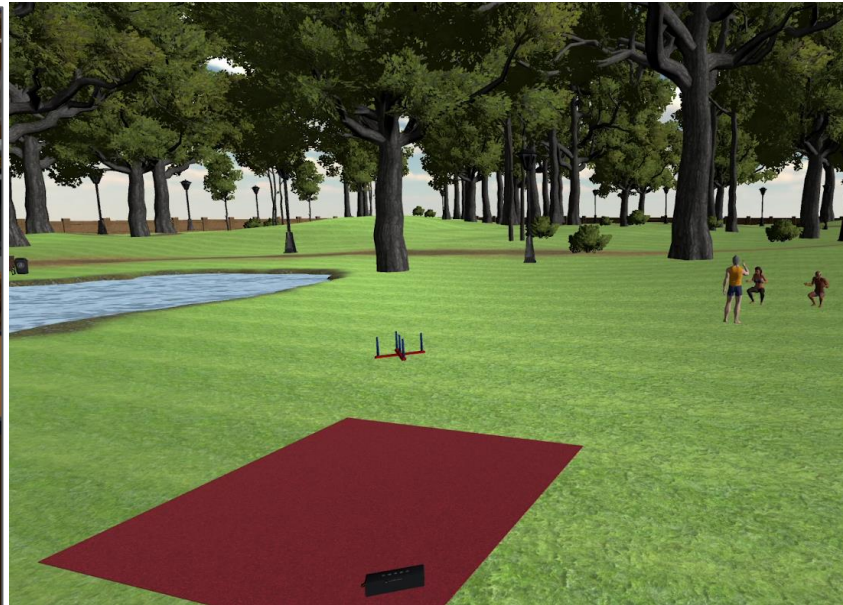
- IVR enables us to recreate risk situations for patients
- Senses are substituted: Visual, auditory, (tactile, and olfactory)



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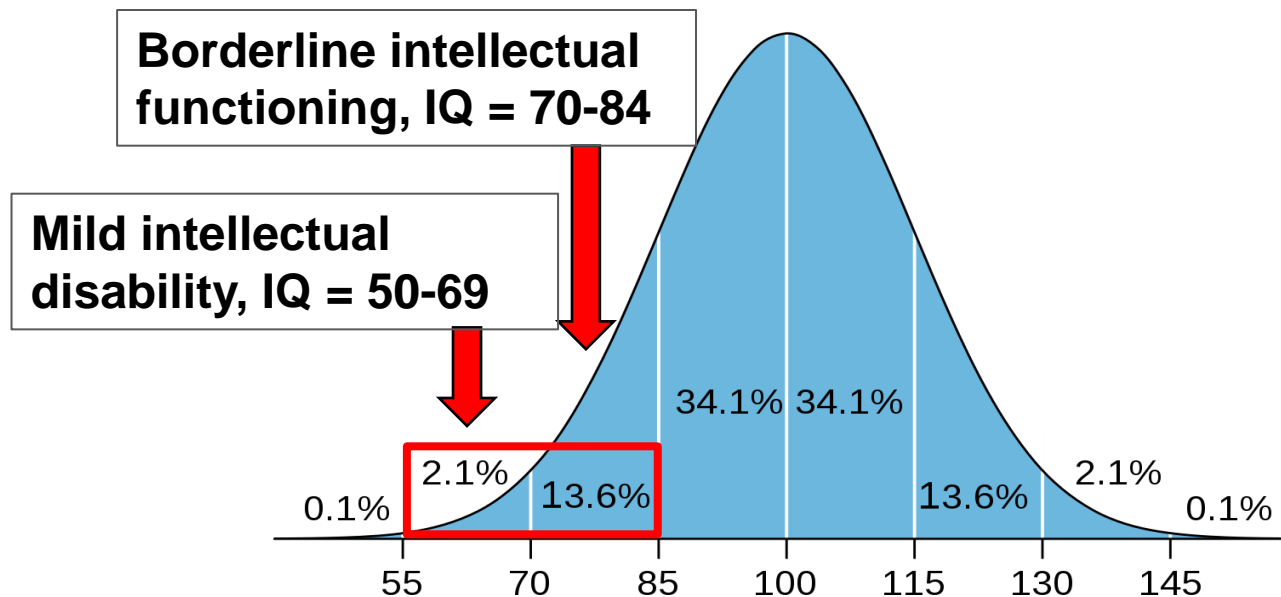
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- Cue reactivity (e.g., cravings, physiological responses)



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- Patients with lower literacy could benefit [2][3]



[2] LANGENER, S., VANDERNAGEL, J., KLAASSEN, R., VAN DER VALK, P., and HEYLEN, D., 2021. "Go up in smoke": Feasibility and initial acceptance of a virtual environment to measure tobacco craving in vulnerable individuals. In *2021 IEEE 9th International Conference on Serious Games and Applications for Health (SeGAH)* IEEE, 1-8.

[3] VAN DUIJVENBODE, N. and VANDERNAGEL, J.E., 2019. A systematic review of substance use (disorder) in individuals with mild to borderline intellectual disability. *European addiction research* 25, 6, 263-282.



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- Cue reactivity (e.g., cravings, physiological responses)
- Patients with lower literacy could benefit [2][3]

BUT: Implemented agents lack sophisticated conversational abilities to simulate complex persuasive encounters.

Background – Influential Embodied Conversational Agents

- ECAs were explored for addiction screening and counseling [4]
- Can influence humans using persuasive techniques [5-7]
- No exploration for peer pressure simulations ❌
- No application in our target group ❌

[4] RUBIN, A., LIVINGSTON, N.A., BRADY, J., HOCKING, E., BICKMORE, T., SAWDY, M., KRESSIN, N., SALTZ, R., and SIMON, S., 2022. Computerized relational agent to deliver alcohol brief intervention and referral to treatment in primary care: a randomized clinical trial. *Journal of general internal medicine* 37, 1, 70-77.

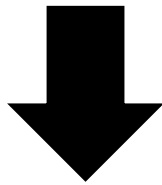
[5] LUCAS, G.M., LEHR, J., KRÄMER, N., and GRATCH, J., 2019. The effectiveness of social influence tactics when used by a virtual agent. In *Proceedings of the 19th ACM international conference on intelligent virtual agents*, 22-29.

[6] ZALAKE, M., DE SIQUEIRA, A.G., VADDIPARTI, K., and LOK, B., 2021. The effects of virtual human's verbal persuasion strategies on user intention and behavior. *International Journal of Human-Computer Studies* 156, 102708.

[7] RIVA, P., AURELI, N., and SILVESTRINI, F., 2022. Social influences in the digital era: When do people conform more to a human being or an artificial intelligence? *Acta Psychologica* 229, 103681.

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BUT:

First effects of social cues on cue reactivity (e.g., cravings) were identified [8]

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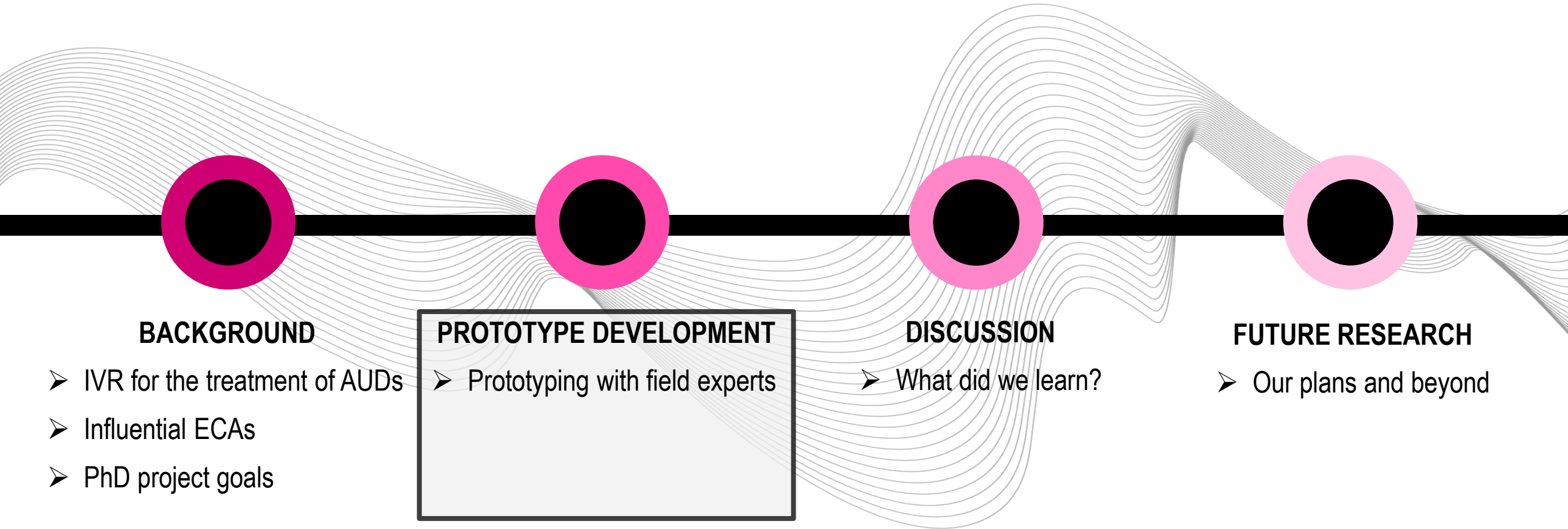
[8] JUNKER, A., HUTTERS, C., REIPUR, D., EMBØL, L., ADJORLU, A., NORDAHL, R., SERAFIN, S., PETERSEN, D.T., and FINK-JENSEN, A., 2021. Fighting Alcohol Craving Using Virtual Reality: the Role of Social Interaction. In *2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW) IEEE*, 257-263.



PhD project goals

- **Feasibility:** Can we use persuasive techniques to elicit peer pressure in patients with MBID & AUD?
- **Perception:** How is the persuasive ECA perceived?
- **Acceptability:** What is the effect on the patient?

Content

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- BACKGROUND**
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- PROTOTYPE DEVELOPMENT**
- Prototyping with field experts

- DISCUSSION**
- What did we learn?

- FUTURE RESEARCH**
- Our plans and beyond

Prototype development

- According to the Persuasive System Design (PSD) model [9]
 - Theoretical analysis of the persuasion context
 - Integration of PSD principles

Table 1. Persuasive system design using the PSD model.

PSD category	Design principle	Application level
Primary task support	Simulation	IVR application
	Rehearsal	
	Tunneling	Dialogue interface
Dialogue support	Social role	Persuasive ECA(s)
Social <i>influence</i> ¹	Normative influence	Persuasive ECA(s)
	Social facilitation	Persuasive ECA(s)

¹ Original ‘social support’ may be misleading, hence changed to ‘social *influence*’.

[9] OINAS-KUKKONEN, H. and HARJUMAA, M., 2009. Persuasive systems design: Key issues, process model, and system features. *Communications of the Association for Information Systems* 24, 1, 28.

Prototype development

- Identifying requirements with field experts ($n = 5$)

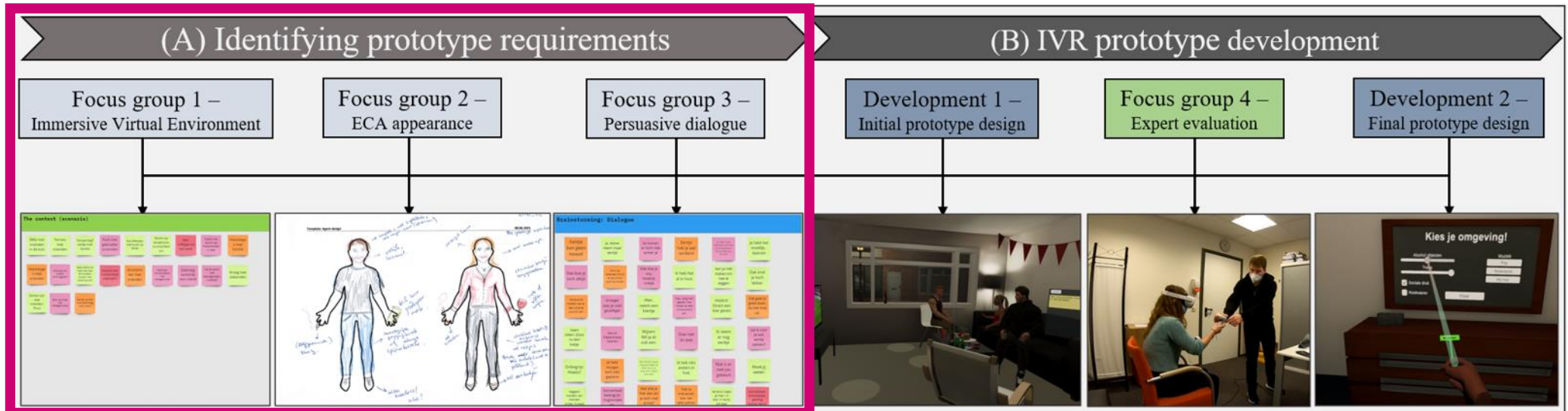


Figure 1. The co-creation approach: (A) Identifying the initial prototype requirements throughout three focus groups using the Miro platform and (B) the IVR prototype development, along with an expert try-out and focus group to refine our initial design.

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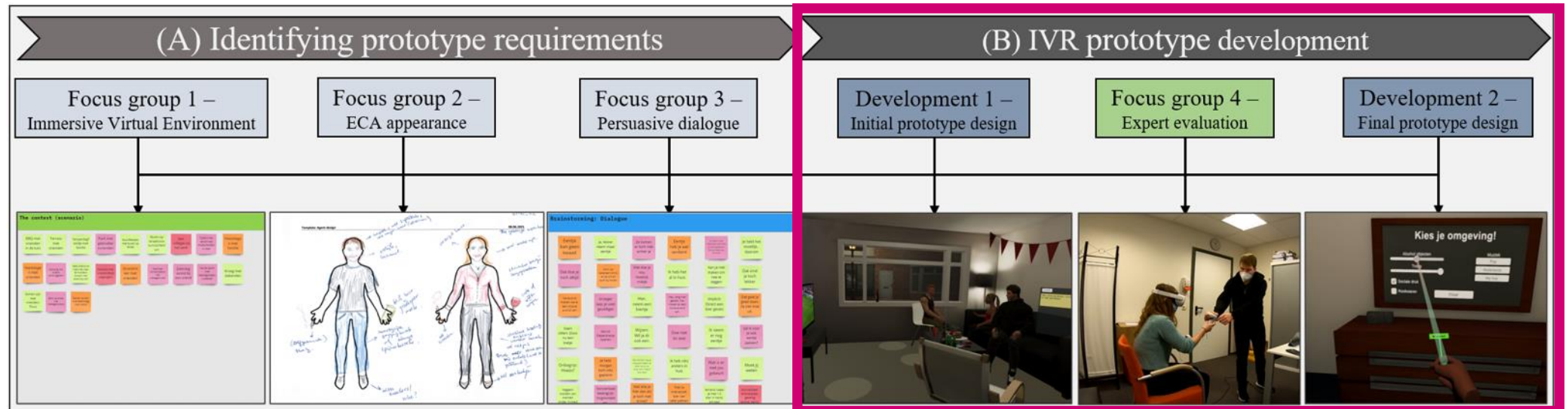


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Prototype development

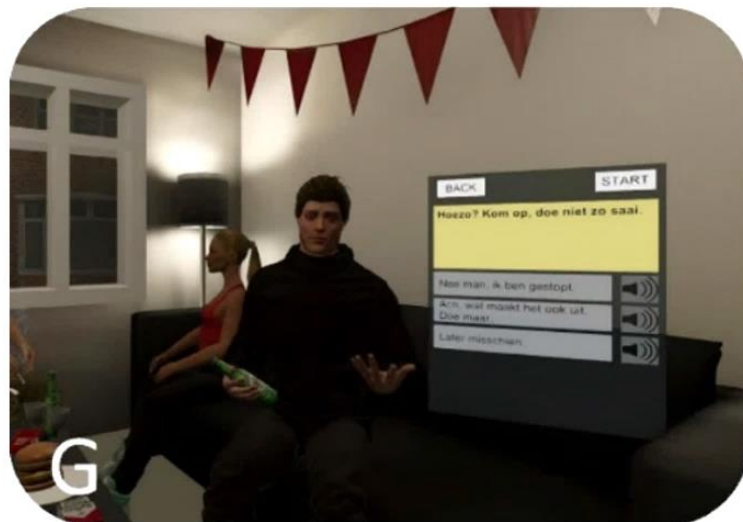


Figure 2. The initial prototype: (A) living room with agents sitting on a couch/chair, alcohol-related cues, TV streaming soccer, and wireless speaker shuffling Dutch party music (B) small kitchen with interactable fridge to grab beer or liquor, (C) ECA persuading toward drinking, and (D) self-monitoring on dialogue UI to indicate riskiness levels of the selected refusal responses.

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Prototype development

- Prototype evaluation with the same field experts ($n = 5$)
 - Reduce text and improve accessibility
 - ECA perceived as low is persuasive power
 - Artificial voice lacks paralinguistic features (e.g., intonation)

Facilitators:

- Group dynamics (e.g., two against one)
- Animations (e.g., drinking, offering)
- Narrative immersion for rapport building

Final prototype



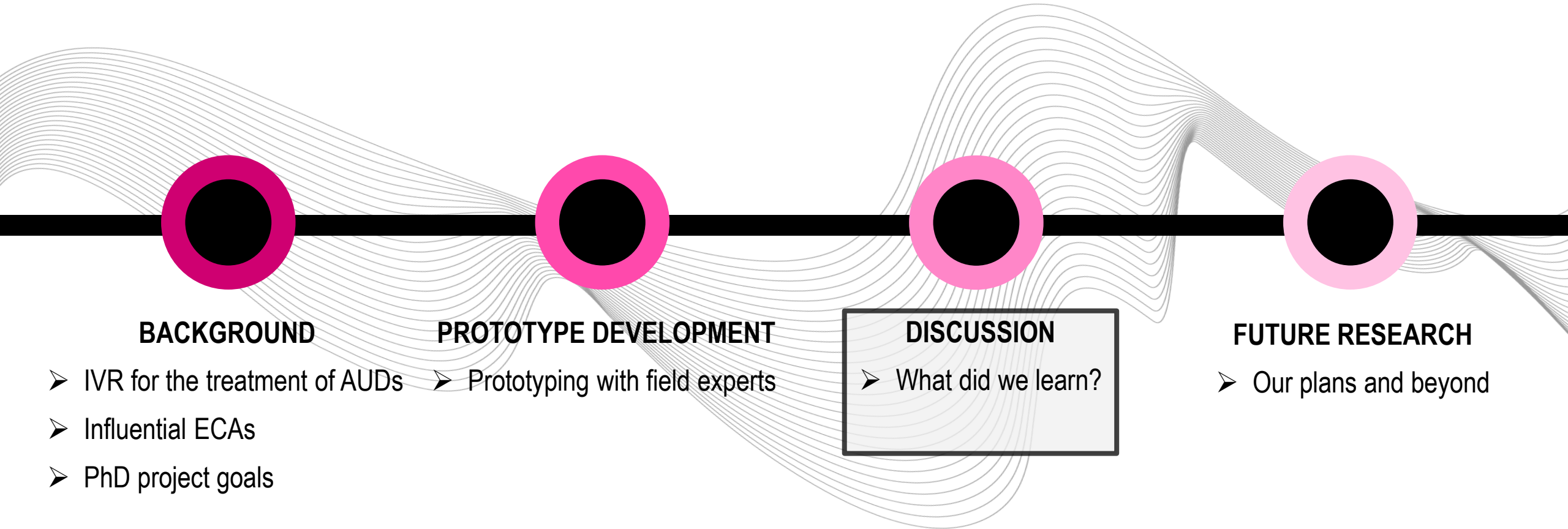
Figure 3. The final IVR prototype with narrative immersion: (A) friend inviting to a party this evening, (B) dressing room to customize the IVR simulation (i.e. virtual hands skin tone, difficulty, IVE), (C) IVE customization (i.e. alcohol cues, messiness, social pressure, smoking cues, music), and (D) persuasive ECA interaction using refusal responses of different riskiness levels.

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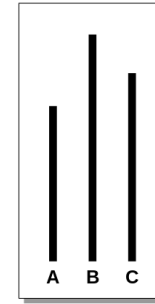
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FUTURE RESEARCH

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Discussion

- Patient evaluations are required
 - Feasibility and acceptability to elicit peer pressure?
- Paralinguistics transfer emotional and attitudinal information
 - Critical factor to convey appeals to emotion?
 - Perception as cognitively capable entity?
- Group dynamics may boost the power of agents
 - Multi-agent interactions for credibility?



From Wikimedia

Future work

- How to translate PSD principles to interpersonal behavior?
 - ECAs might suffer a “power” problem
 - The informal authority of group leadership

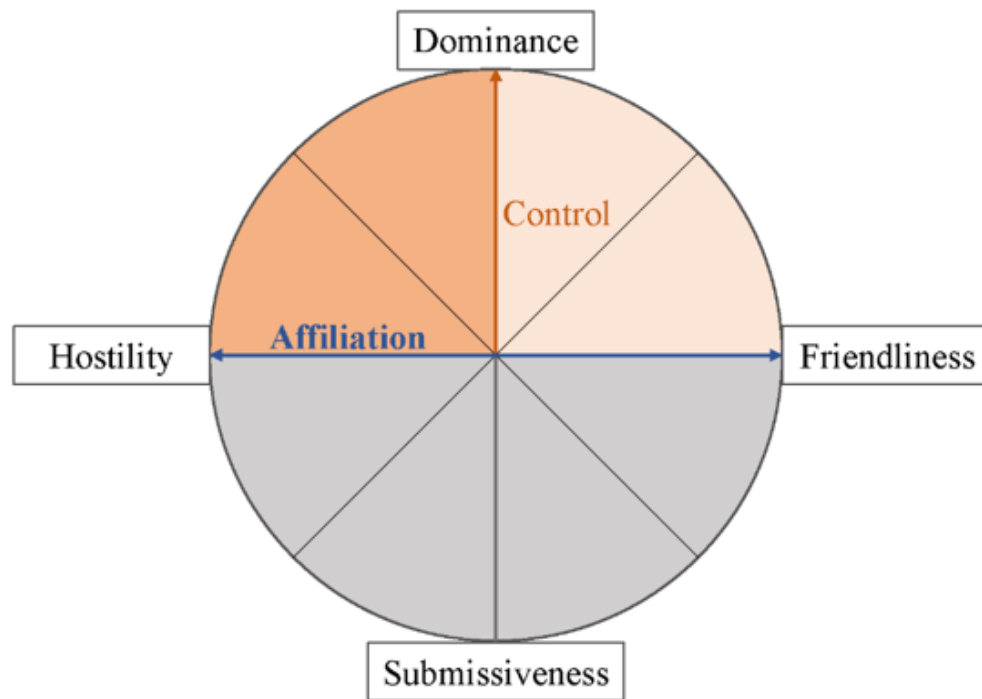


Figure 4. The interpersonal circumplex model (simplified). We manipulated the affiliation with the ECA to connect persuasive design principles with the friendliness (high likability, lower authority) and hostility (low likability, high authority) dimensions, given the primarily dominant dialogue for peer pressure developed with field experts.

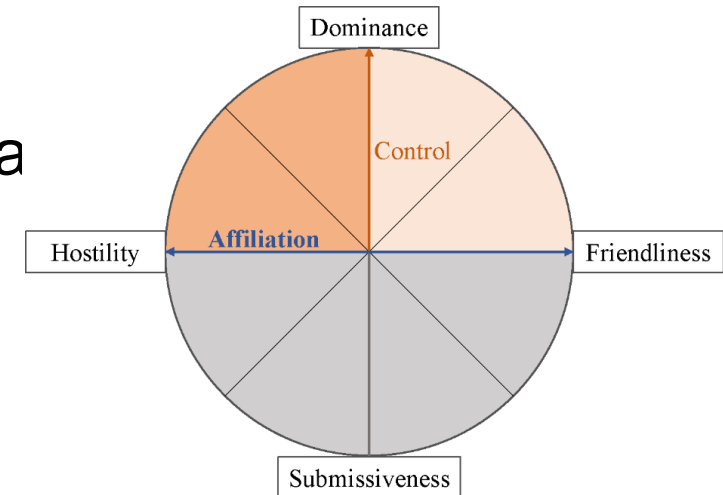
Future work

- Natural persuasive speech – An interpersonal circumplex approach

- We recorded 9 (11) Dutch males aged 25-40 yea
- Acted dialogue in a hostile or friendly manner

- Preliminary findings

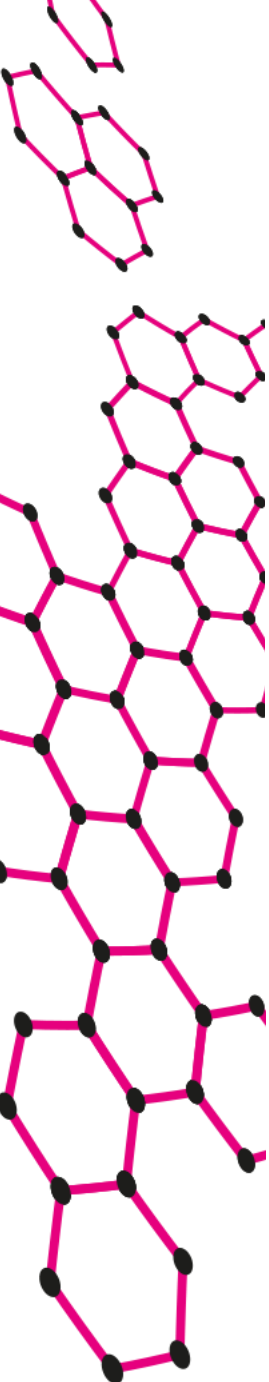
- Mean/minimum pitch and mean intensity higher for hostile speaking style
- **But:** Speakers express themselves differently
- Correlation between acoustic parameters and arousal (e.g., cold vs. hot anger)? -> grasping valence is key?





Future work

- **Feasibility:** Can we use Persuasive System Design (PSD) techniques to elicit peer pressure in patients with MBID & AUD?
 - Perceived persuasiveness
- **Perception:** How is the persuasive ECA perceived?
 - Interpersonal circumplex dimensions (i.e., affiliation, power)
 - Godspeed questionnaire items
- **Acceptability:** What is the effect on the patient?
 - Emotional state (i.e., anxiety, cravings)



THANK YOU FOR YOUR ATTENTION.



s.Langener@utwente.nl

<https://twitter.com/LangenerSimon>

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