Gaze Following in Complex Virtual Environments: Comparing Human and Robot Avatars

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Introduction

Gaze behavior is crucial in human communication, influencing social interactions significantly [1]:

➜ From infancy, individuals demonstrate an ability to follow and interpret gaze, signaling others' intentions and attention [2]. Gaze-following behavior observed in real-world settings shows people tend to follow the gaze of others moving in the same direction [3].

➜ The influence of gaze on social perception is key in understanding human interactions and human-robot interactions.

➜ VR paradigms offer controlled settings to investigate social perception, bridging the gap between laboratory and naturalistic environments.

Our study investigates how the gaze of an avatar – human or robot – influences participants' gaze, even without task-relevant information.

Methods

Participants & Task

Participants (N=16) followed an avatar through a series of corridors. Speed and lateral position was controled by a handheld controller and turns by aligning with the respective lane. There was no instruction or task other than to follow the avatar.
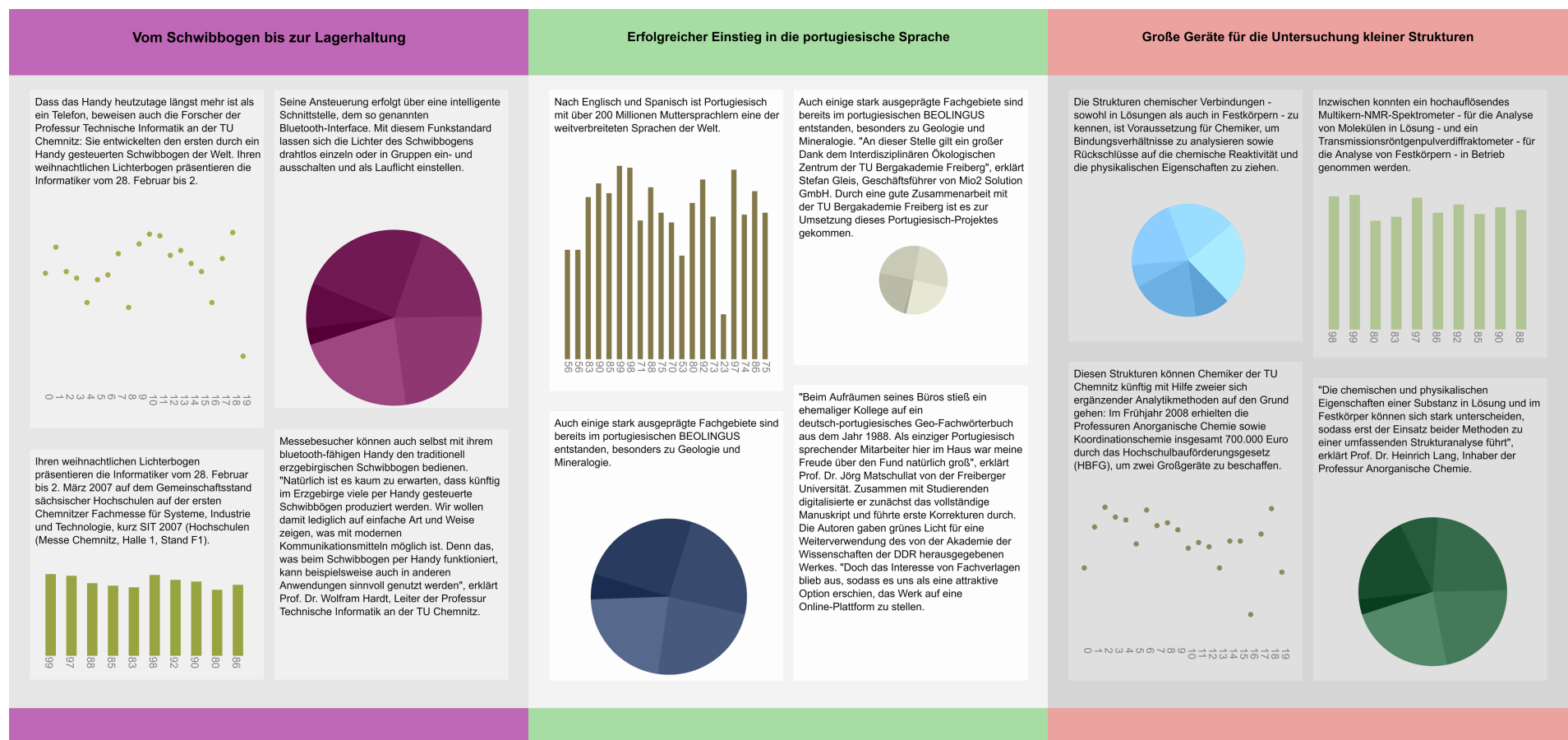
Avatar looking behavior

In half of the corridors the avatar directed its gaze to posters at the side walls, either 3 on the same side, or 2 on one side and 1 on the other.
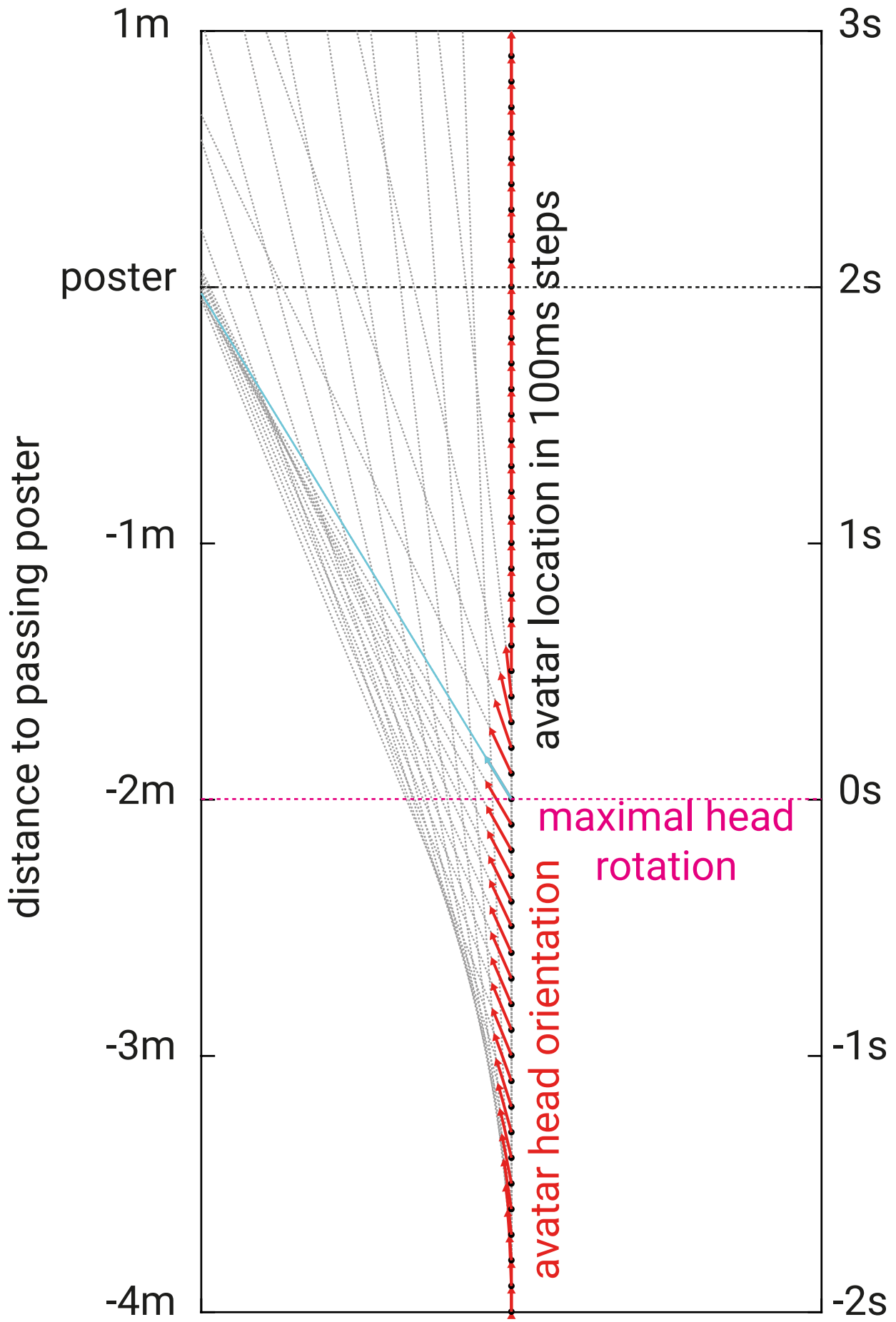
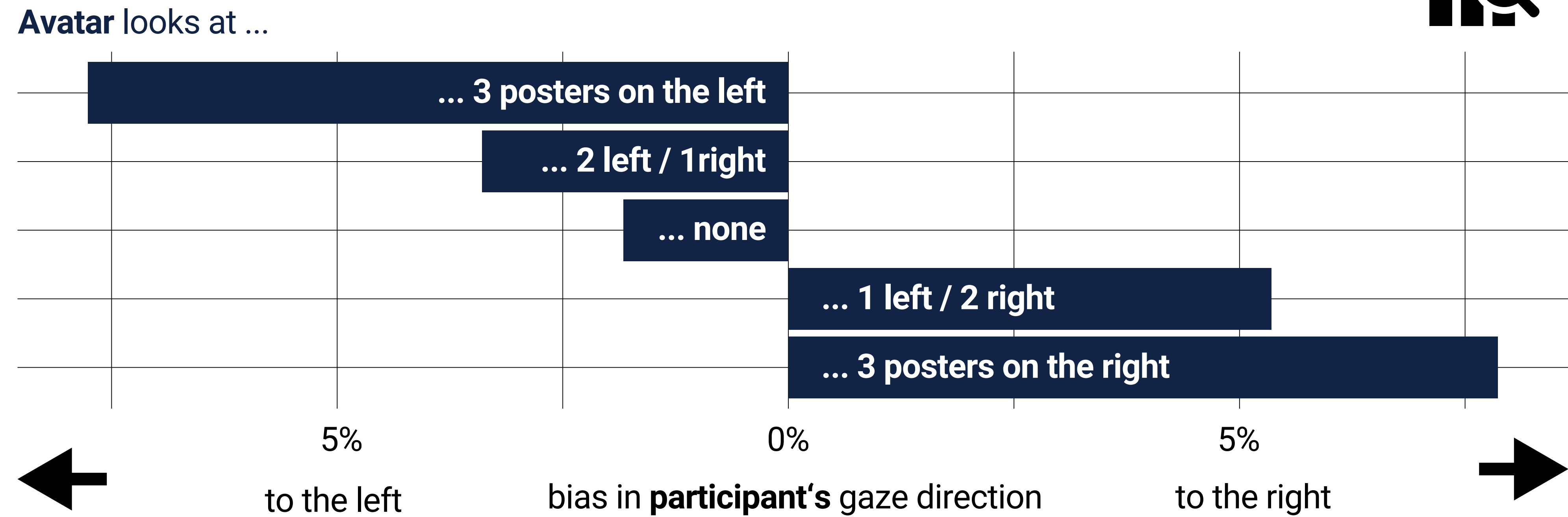Bird's-eye view of avatar looking to a poster on the left (adapted from [4])

Corridor design

Posters had the appearance of scientific posters, were diverse in appearance but of similar style. They were created automatically with texts from a university news page and randomly generated graphic elements, layouts and color schemes.
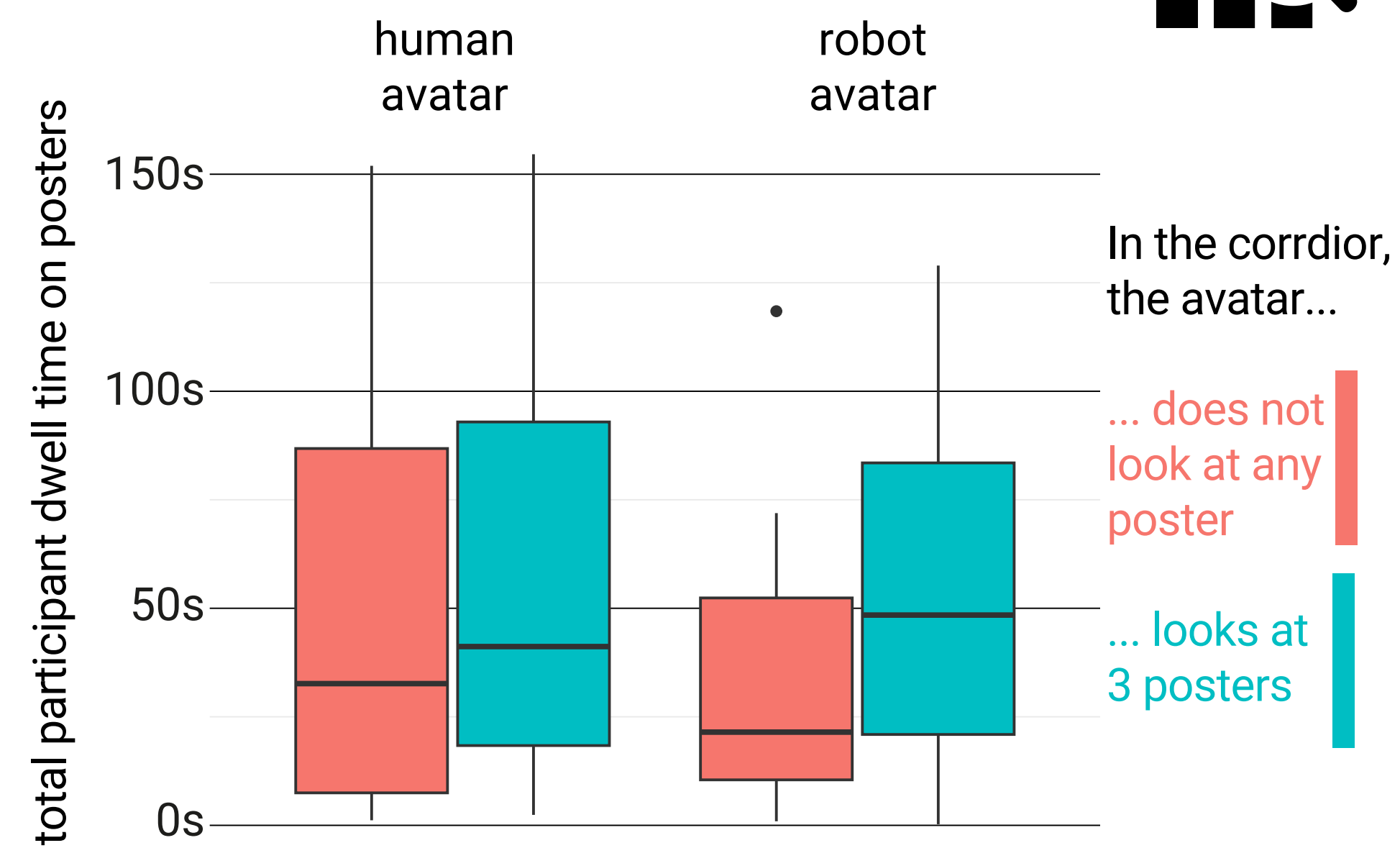

Examples of automatically created posters.

Virtual Reality

Result I: Following gaze direction

Avatar looks at ...

... 3 posters on the left
... 2 left / 1 right
... none
... 1 left / 2 right
... 3 posters on the right

5% to the left   0%   5% to the right
bias in **participant's** gaze direction

Although there is no information in the avatar's gaze patterns, participants' gaze direction is significantly affected by the avatar's looking behavior in the respective corridor ($F_{(4,60)}$=3.93, p=.036). We found no difference between avatars types (human/robot; $F_{(1,15)}$=0.47, p=.504) and no interaction between avatar type and avatar looking behavior ($F_{(4,60)}$=0.13, p=.903). **Participants show similar gaze following to human and robot avatars.**

Result II: Dwell time

human avatar   robot avatar

total participant dwell time on posters

In the corrdior, the avatar...
... does not look at any poster
... looks at 3 posters

When participants follow a human, they look longer at posters than when following a robot ($F_{(1,15)}$=7.02, p=.018). There is trend towards longer dwell times when the avatar itself looks at the posters ($F_{(1,15)}$=3.81, p=.070) and also a trend to an interaction ($F_{(1,15)}$=3.88, p=.067).

Discussion

We find that participants' gaze follows an avatar's gaze even if it contains no information and there is no relation or interaction possibility with the avatar.

➜ Findings align with recent real-world studies, showing complex interplay of social cues and gaze dynamics.

➜ Results provide insights for designing embodied digital technologies (EDTs) for better human-robot interaction.

➜ Future studies will assess direct encounters from the front and closed-loop interactions.

➜ On a more general level, our study demonstrates the potential of VR to study social interactions that are realistic *and* under good experimental control.

References

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