Influence of Robot-Gaze Aversion on Human-Behavioral Dynamics and Perceptual Cognition

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Abstract

The paper investigates the impact of robot gaze aversion on human-robot interactions, focusing on how different gaze patterns influence human perception of the robot. Prior research has established that naturalistic human-like gaze behavior by robots improves the interaction quality, while a lack of gaze aversion by robots leads to increased gaze aversion by human participants. Contrarily, findings indicate that periodic gaze aversion by robots does not necessarily improve human comfort or disclosure. This research examines how the robot's aversion behaviour affects fixation durations of interactants on the robot in different experimental conditions. The inappropriate gaze aversion by the robot is rated low on the perception questionnaire, especially when participants are speaking. The results show that random gaze aversion by the robot negatively influenced participants' perception.

1 Introduction

Gaze aversion can convey emotions such as discomfort, shyness, or disinterest. Previous research has mainly assessed human gaze aversion as an indicator of the uncanniness of a robot. Also, the more a participant gazed at the robot the worse they performed in a joint task (Parreira et al., 2022). But how does robot gaze aversion affect human perception of the robot? In human-robot interaction, we previously showed that different patterns of gaze can influence perception of the robot by humans during a social interaction (Somashekarappa et al., 2023). It was determined that the gaze behaviour is better in the experimental condition where the gaze was modified to mimic more naturalistic human-like behaviour. But what are the differences in these conditions that lead to these differences? Here we focus on the aversion behaviour of the robot to investigate its effects on perception by a human interlocutor.

It has been shown that a lack of gaze aversions by a robot leads to an increase in gaze aversions by participants when they are speaking (Mishra et al., 2023). In contrast, Andrist et al. (2014) show that a robot that displayed periodic gaze aversions while listening did not influence a human interlocutor's comfort or elicit more disclosure than robots that did not display gaze aversions or displayed gaze aversions with inappropriate timings. Humans may attribute intentionality to a robot's gaze aversion, interpreting it as a sign of the robot's internal states or processes. When a robot detects gaze aversion, on the other hand, it might be appropriate slow down the pace of the dialogue, giving the human more time to think or respond (Koller et al., 2023).

Although this can make interactions smoother and more comfortable for humans, it could also elicit unfavorable conditions when the same behaviour is exhibited during interactants active dialogue. Excessive or poorly timed gaze aversion by a robot may lead to perceptions of disinterest or lack of engagement, negatively affecting the interaction quality. In this short paper we hypothesize that,

1. Gaze aversion of the robot when random during discourse, affects the human perception of the fluency of the conversation especially during speakers turn.

2. Aversion of robot's gaze has less effect when the speaker is listening.

2 Data and Method

The data contains 21 participants social interactions of 30 minutes each with a robot (GHI-HRI Corpus (Somashekarappa et al., 2024)). The interactions were categorised into three different sessions namely experimental, random and neutral where distinct gaze patterns were produced by the robot. The experimental scenario mimicked more naturalistic gaze behaviour drawn from human-human

Figure 1: Interaction session: Robots' gaze aversion

interactions. The random scenario generated un-coordinated gaze behaviour during the interaction while in the neutral condition the robot followed the gaze of the human. After each session the experiment recorded perception ratings from the participants. For this study we specifically consider the aversion behaviour of the robot while the participant was talking in face-face dialogue.

3 Analysis of Aversion

We conducted qualitative analysis on 10 videos with three conditions 'Experimental', 'Random' and 'Neutral'. The aversion behaviour was compared with the perception questionnaire reported in the GHI-HRI study. The questionnaire reported after every interaction session evaluated human perception of 'Anthropomorphism', 'Animacy', 'Likeability', 'Intelligence' and 'Safety' of the robot with mean of 2.63, 3.02, 3.46, 3.34 & 2.94 respectively. The combined average ratings from the questionnaire reported better score for the experimental condition (66%) compared to neutral (60%) and random (58%) with average ratings of 3.32, 3.01 & 2.90.

In scenarios with lower levels of gaze aversion (experimental condition), participants exhibited less reciprocal gaze aversion than anticipated. This suggests that users were averse to the robot's gaze behaviour, potentially finding it unnatural or disruptive. Conversely, participants responded with increased gaze aversion when the robot displayed a high frequency of gaze aversion, indicating discomfort or disengagement.

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U:(GA)last Christmas(R)I celebrated here
in Sweden(GA)with my(R)friends family
R: ((GA))
U:(MA)I am gonna go to an exercise class
R: ((MA)followed by(GA))
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U: User, GA: Gaze Aversion, R: Robot, MA: Mutual Attention

A distinct pattern emerged, where human gaze aversion was significantly higher in response to the robot's random gaze aversions. In contrast, during experimental and neutral conditions, participants showed noticeably lower levels of gaze aversion. This finding underscores that predictable and contextually appropriate gaze behaviours by robots are crucial for maintaining human engagement and comfort.

The random gaze aversion condition had a notably negative influence on participants' perception of the robot, affirming the hypothesis that erratic gaze behaviours disrupt the perceived fluency and naturalness of the conversation. Participants felt less at ease and rated the interaction less favorably when the robot's gaze behavior appeared random and unpredictable.

These findings highlight the critical role of gaze behaviour in shaping human perceptions of robots during interactions. Random and poorly timed gaze aversion disrupts conversational fluency and diminishes the naturalness of the interaction, resulting in discomfort and disengagement. On the other hand, naturalistic and contextually appropriate gaze behavior enhances the interaction experience, making the robot appear more human-like and intelligent

4 Discussion

This paper studies gaze aversion in human-robot interactions, particularly during face-to-face dialogue. Data from the GHI-HRI Corpus revealed that the nature of the robot's gaze behaviour significantly affects human responses and perceptions.

In the experimental condition, where the robot exhibited naturalistic gaze patterns, participants showed less reciprocal gaze aversion, indicating a preference for predictable and contextually appropriate gaze behaviours. Conversely, the random gaze condition, characterized by uncoordinated gaze behaviour, led to higher levels of human gaze aversion.

This study aligns with previous research, such as Pejsa et al. (2015), which linked specific gaze aversions to different conversational goals, further demonstrating that gaze aversion serves as an objective descriptor of interaction quality.

References

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