The judgment of agency in gaze joint actions

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Introduction

Objective: The goal of this study was to examine the sense of control that an individual has on the gaze of another individual when the latter follows the gaze of the former.

Background: Gaze is pivotal in joint attention and joint attention is a crucial element of joint action. For joint attention to emerge, an individual needs to feel that her/his own eye movements have some influence on her/his social partner’s gaze orientation. Hence, the gaze cueing action that causes a social partner to follow one’s gaze yields a natural paradigm for studying the sense of agency. Given the pivotal role of gaze cueing in social communication, adults human beings must arguably possess acute sensory expertise in monitoring gaze following reactions of other human beings. The present study examined the influence of such sensory expertise on the sense of agency. Furthermore, the effect of delay in gaze following feedback was assessed.

Method

To evaluate sensory expertise, we compared agency judgements when participants faced an avatar that simulated human gaze following movements with an uncommon gaze following feedback supplied via a nonfigurative object, that is, an arrow. Twenty four participants (11 women, 13 men, mean age: 23.25 [S = 3.63]) were recruited for this experiment. Using eye-tracking technology, we varied the control exerted by participants’ gaze on the graphic model (avatar vs arrow) and the latency of the feedback. Participants were seated in front of a laptop computer equipped with a 60 Hz eye-tracker, model X2-60 from Tobii. A gaze contingent interface was developed to control the avatar (respect. arrow) displayed on the screen (Courgeon, Rautureau, Martin, & Grynszpan, 2014).

![Figure 1: Screenshots of the two graphic models displayed, that is, an avatar (left) and an arrow (right). Participants had to look first at number “1” and second at number “2”. They then had to rate the degree to which they controlled the avatar (respect. arrow) with their gaze.](image)

The avatar (respect. arrow) was shown in 80 trials, where it was flanked by a “1” and a “2” that were randomly positioned on the left or on the right (Figure 1). Participants were instructed to first look at “1” and then “2”. Subsequently, they had to rate the degree to which they controlled the avatar (respect. arrow) on a scale ranging from 0 to 9. The avatar (respect. arrow) moved according to 8 conditions: A “SAME” condition, where the avatar (respect. arrow) moved in the same direction as the participant, but was not controlled by her/him; an “OPPOSITE” condition, where the avatar (respect. arrow) moved in the opposite direction to the participant and was not controlled by her/him; and six conditions, where the avatar (respect. arrow) followed the eyes of the participant with delays of 100 ms, 300 ms, 500 ms, 700 ms, 900 ms and 1100 ms.

Results

An analysis of variance on rating scores yielded significant main effects for the graphic model \(F(1, 23) = 12.02 \ p = 0.002 \ \eta^2 = 0.34\) and the movement condition \(F(7, 161) = 147.34 \ p < .0001 \ \eta^2 = 0.86\). The arrow yielded higher scores than the avatar. A significant stepwise decrease was observed for gaze following delays from 500 to 900 ms [all \(p < .0001\)] (Figure 2). There was also a significant interaction between the graphic model and the movement condition \(F(7, 161) = 4.90 \ p < .001 \ \eta^2 = 0.18\). The “same” condition was the only one where scores for the arrow were significantly higher than for the avatar \(p < .0001\) (Figure 2). A linear regression analysis between scores and delays yielded an adjusted \(R^2 = 0.82\) for the avatar and \(R^2 = 0.84\) for the arrow (Figure 2).

Discussion

Results showed that participants were better at discriminating external agency when they were facing the avatar. This should arguably be attributed to participants’ expertise in detecting gaze following on human-like faces. The fact that the avatar yielded lower scores than the arrow independently of the movement condition suggests that participants tended to consider the avatar as more autonomous due to its resemblance with a real human being. Additionally, results revealed a linear relationship between rating scores for agency and delays in gaze following movements.

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References