Supplementary experiment: neutral faces

This supplementary experiment had originally served as a pilot test of whether participants would automatically shift their attention towards to objects the seen person typically looks at. It was identical to the experiment reported in the main text, with the exception that the faces of the two individuals had a neutral facial expression when looking at the objects (in contrast to the main experiment, where the faces smiled at the objects they looked at). This supplementary experiment was initially run on a limited sample for purposes of piloting and power analysis, but was, at the request of a reviewer, increased to the same sample size of the main experiment, to test more comprehensively whether smiling faces are necessary to evoke the anticipatory gaze shifts seen in the main experiment, or whether these effects are reduced when the faces only looked at the objects (with a neutral expression). Such a reduction would further highlight the social nature of the predictive gaze cuing effects observed and suggest that these effects do not reflect a mere anticipation of the individuals' gaze towards the objects, but may reflect inferences about the attitudes the individuals have towards the objects, or about the objects' emotional relevance to them.

As in the main experiment, in each trial, a face – a cartoon face for half of the participants, and face photographs for the other half – was centrally presented, with a neutral expression and with gaze straight ahead, and a food and a drink item on either side. After a while, the face blinked, and when it opened its eyes again, the gaze would either be directed to the left (25% of cases), to the right (25% of cases) or straight ahead (50% of cases), with a neutral facial expression. As before, across participants, we manipulated whether the female face would only look at drinks and the male face only at foods, or vice versa. The only difference to the main experiment was therefore that the faces did not smile at the objects when they looked at them, but instead showed a neutral expression.

As in the main experiment, we tested whether the mere presentation of a particular face sufficed to draw participants' attention to the objects this person would typically look at. The key question was whether these effects would be reduced when, here, the individuals did not smile at the objects when they looked at them, but showed a neutral expression.

Method

Participants. Sixty-two students from Plymouth University (10 male), ranging in age from 18 to 32 years, took part in the experiment in exchange for course credits. All participants had normal or corrected to normal vision and all gave informed consent, approved by the School of Psychology ethics committee of Plymouth University. All met the inclusion criterion of making less than 10% errors overall.

Material and apparatus. Before taking part, all participants completed the autism quotient scale (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). This questionnaire measures the presence of autism-like traits in neurotypical individuals. It requires participants to rate fifty statements on a four-point scale with the options "definitely agree", "slightly agree", "slightly disagree" and "definitely disagree". Examples of these statements include; "I prefer to do things with others rather than on my own" and "I prefer to do things the same way over and over again".

The experiment proper was computer based and controlled by Presentation (Neurobehavioral systems, Inc; version 14.9, Build 07.19.11) using a Windows XP SP3 1280x1024 32 bit colour 17" display. All stimuli were assembled by combining seventeen images: a fixation cross (produced using the '+' symbol using Microsoft's Trebuchet MS font), four colour

photographs of food items (orange, cupcake, apple and hotdog), four colour photographs of drink items (Coca Cola can, orange juice, milkshake and coffee) and finally, cartoon images of one male and one female face. Each face could appear in four different configurations: looking straight ahead with a neutral expression, blinking (eyes closed) with a neutral expression, looking to the left and looking to the right.

Design and Procedure. The participants were seated roughly 60 cm away from a colour monitor. They filled out the Autism Quotient and were then given verbal and on screen instructions. They completed 16 practise trials and, after confirming they understood the task, took part in 256 experimental trials. Participants were informed that they could press 'p' at any point if they wanted to take a break.

Each trial started with a fixation cross (400 ms.). After a brief blank screen (600 ms.), one of two faces would appear with one of the four food items and one of the four drink items on either side. Across trials, we counterbalanced on which side the two items appeared (food on left and drink on right, or vice versa). The face looked straight ahead with a neutral expression for a random time interval between 500 and 1100 ms. It was then replaced by a face with the eyes closed (100 ms.), giving the impression of a blink. The next images then showed the face with eyes open, either looking straight ahead in 50% of the trials, or looking to one of the objects in the other 50% of trials. After 400 ms., a blue square appeared on either the left or right item and participants were required to quickly categorise this cued item as either a drink or a food by pressing either the 'h' key or the space bar (response assignment counterbalanced across participants). The final image remained on the screen until participants made a response or a maximum trial time of 4 seconds had passed. If participants made an error or did not respond in time, they received error feedback and were reminded of the key assignment. All of the possible combinations of stimuli were shown in a

randomised order. Unbeknownst to participants, we manipulated the looking behaviour of the two faces in the gaze sideways trials. One face would always look to the drink item and never at foods, while the other face showed the opposite behaviour (counterbalanced between participants). Response times were measured from the onset of the target cue.

After the experiment was completed, participants were asked whether they noticed a pattern in the stimuli and then debriefed. None of the participants reported awareness of the looking pattern of the two individuals, with several expressing surprise and stating that they tried avoided looking at the task-irrelevant faces altogether.

Results

The same exclusion criteria were used across both experiments. Trials were excluded (1.5% in total) if they fell within any of the below criteria: (1) trials with RTs greater than the maximum duration of the response interval, (2) trials with anticipations (i.e., before the cue appeared), (3) trials where Presentation timing was uncertain (>10 ms. measurement uncertainty), and (4) trials with RTs over 3 standard deviations from this participant's condition mean (the average RT for the straight gaze or the sideways gaze trials). As participants initiated and terminated pauses themselves, all trials following or preceding pauses were also excluded.

Regular gaze cuing effects. Our first goal was to verify that our paradigm indeed elicits the gaze cuing effects expected from the prior literature. We therefore analysed the RTs and error rates for the gaze sideways trials in which the face was looking at one of the objects with a repeated measurements ANOVA with the factors Block (1, 2) and Object (looked at, not

looked at), and the between participants factor Group (cartoon faces, photographs). The Block factor was included in the analysis of both the regular and anticipative gaze cuing effects because we hypothesized that any prediction effects would emerge specifically in the second half of the experiment, after participants had learned the implicit behaviour patterns of the individuals.

Table 1. *Regular gaze cuing effects in supplementary experiment, for both response times and error rates. Values in brackets show the standard deviation in the condition.*

	Response Times (ms.)		**Error rates (%)**	
	looked at	**not looked at**	**looked at**	**not looked at**
Cartoons	518 (84)	576 (99)	4.5 (2.5)	5.4 (3.8)
Photographs	530 (112)	568 (112)	4.3 (3.5)	6.2 (4.6)

The analysis of RTs (Table 1, first row, column 2 and 3) revealed no main effect of Block (F[1,60] = 1.888; p = 0.175, η_p^2= 0.031), and no interaction of Block and Object (F<1). However, the expected main effect of Object was confirmed (F[1,60] = 87.604; p < 0.001, η_p^2= 0.594). Replicating the gaze cuing effects from the prior literature, participants were quicker to categorize a looked-at object compared to a not looked-at object, in both block one (F[1,60] = 51.343; p < 0.001, η_p^2= 0.461) and block two (F[1,60] = 53.127; p < 0.001, η_p^2= 0.470). None of the effects interacted with group (all Fs<1), with the exception of a significant interaction of Group by Object, (F[1,60] = 4.983; p < 0.029, η_p^2= 0.077), revealing larger gaze cuing effects for cartoon faces compared to photographs.

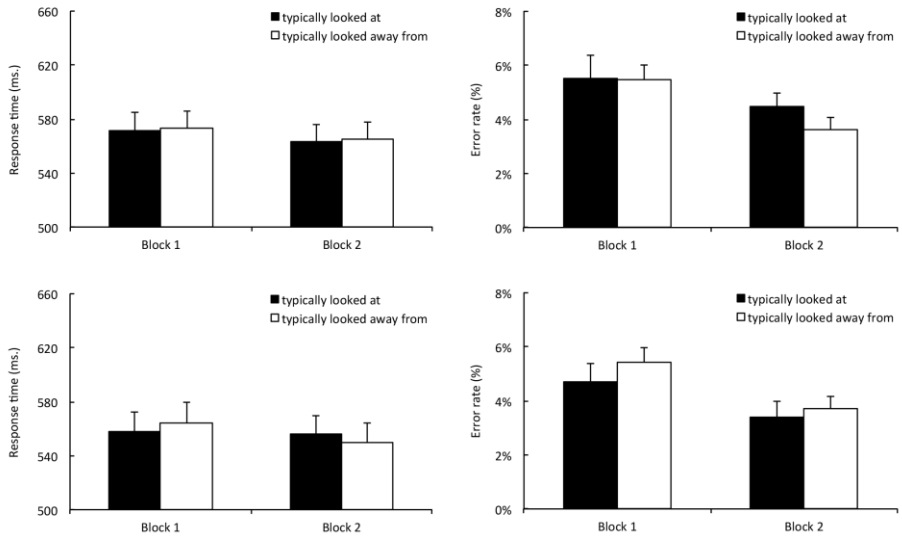
The same pattern was found in the analysis of error rates (Table 1, first row, column 4 and 5). It revealed a main effect of Object (F[1,60] = 7.817; p = 0.007, η_p^2= 0.115) and an effect of Block (F[1,60] = 5.502; p = 0.022, η_p^2= 0.084), but no interaction of both factors (F<1). Step

down analyses revealed that participants made fewer errors categorizing looked-at than non-looked-at objects in block one (F[1,60] = 5.572; p = 0.022, η_p^2= 0.085) but not in block two (F[1,60] = 2.503; p = 0.119, η_p^2= 0.040). None of the effects interacted with Group (All Fs<1.218).

Anticipatory gaze cuing effects. Having established that our paradigm elicits the expected gaze cuing effects, we tested whether observers would also shift their attention to the expected object when the face looks straight ahead. RTs and Error rates were again analysed with a repeated measurements ANOVA with the factors Block (1, 2) and Object (typically looked at, typically looked away from), with Group (cartoon faces, photographs) as a between subjects factor.

The analysis of RTs (Supplementary Figure 1, left panels) neither revealed an effect of Object (F[1,27] < 1) nor of Block (F[1,27] = 1.472; p = 0.230, η_p^2= 0.024), nor a significant interaction of both factors (F[1,27] = 1.056; p = 0.308, η_p^2= 0.017). None of the effects interacted with Group (all Fs < 1). The analysis of error rates (Supplementary Figure 1, right panel) only revealed a main effect of Block (F[1,27] = 7.893; p = < 0.007, η_p^2= 0.116), with fewer errors in the second half of the experiment. There was no significant effect of Object (F[1,27] = 0.001; p = 0.974, η_p^2= 0.000) and no interaction of Object and Block (F[1,27] = 0.357; p = 0.552, η_p^2= 0.006). None of the effects interacted with Group (all Fs < 1).

In sum, the supplementary experiment revealed the same regular gaze cuing effects as the main experiment. However, all indications of anticipatory gaze cuing effects were abolished when, in the current experiment, the faces did not smile at the objects in the trials in which they looked at them.



Supplementary Figure 1. Response times (left panel) and Error Rates (right panel) in the straight gaze trials in the Supplementary Experiment, for the cartoon faces (top row) and real faces (bottom rows) groups separately. In each figure, the left two bars show the data for the first half of the experiment, and the right two bars show the data for the second half of the experiment. The black bars show categorization response for objects that are typically looked at by the shown individual, and the white bars show objects that this individual typically looks away form. Error bars show the standard error of the mean.

Between experiment comparisons. A key question is whether the absence of anticipatory gaze cuing effects could be statistically distinguished from the effects obtained in the main experiment. We therefore re-ran the analysis of the combined data from both experiments with Experiment (neutral expression, smiling expression) as an added between subjects factor. This comparison revealed, first, that the regular gaze cuing effects were statistically identical between experiments for the response times (F<1), and, if anything, slightly larger in the supplementary experiment for error rates (F[1,118] = 3.578; p = 0.061, η_p^2= 0.029).

In contrast, for the anticipatory gaze cuing effects when the faces looked straight ahead, the two experiments differed significant from one another, for both RTs and Error rates. With regard to RTs, the interaction of Block and Object obtained in the main experiment was reduced in the supplementary experiment, as indicated by a three way interaction of Block, Object, and Experiment, F[1,118] = 10.546; p = .002, η_p^2= 0.082). Moreover, these between experiment differences were present both when, in separate analyses, the negative gaze cuing effect in block 1 (F[1,118] = 5.262; p = .024, η_p^2= 0.043) and the facilitation effects in Block 2 were compared with the supplementary experiment (F[1,118] = 4.076; p = .046, η_p^2= 0.033). With regard to error rates, there was no overall reduction of anticipatory gaze cuing effects in the error rates (F[1,118] = 2.224; p = .137, η_p^2= 0.020). However, a significant reduction of anticipatory gaze cuing effects in the supplementary experiment were observed when the effects in Block 2 were compared separately to the main experiment (F[1,118] = 4.150; p = .044, η_p^2= 0.034), but not for Block 1 (F<1).

Power analysis. Based on the standard deviations in the straight gaze trials, power analyses (using G*Power, Faul et al., 2007) were initially run at a subset of the data (n = 28) to establish a minimum number of participants to reliably detect an anticipatory gaze cuing effect in the main experiment. This analysis determined that a sample size of 60 participants would have been required to provide us with .95 power to detect 15 ms. prediction effects across both blocks (SD = 31 ms.) and a .80 power to detect such effects when only present in the second block of the experiment (SD = 41 ms.).

Discussion

This supplementary experiment revealed that, in the absence of faces smiling at the objects when they looked at them, no anticipatory gaze shifts were elicited in the trials in which the

faces looked straight ahead. These data therefore reveal that the effects obtained in the main experiment reflect not only the anticipation of another person's gaze, but also re-activation of the emotional relevance the target object had to the person that had been signalled by the combination of gaze and emotional expression towards the target object

References

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods, 39, 175-191.