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Joint Perception: Gaze and Beliefs about Social Context

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Abstract

The way that we look at images is influenced by social context. Previously we demonstrated this phenomenon of *joint perception.* If lone participants believed that an unseen other person was also looking at the images they saw, it shifted the balance of their gaze between negative and positive images. The direction of this shift depended upon whether participants thought that later they would be compared against the other person or would be collaborating with them. Here we examined whether the joint perception is caused by beliefs about shared experience (looking at the same images) or beliefs about joint action (being engaged in the same task with the images). We place our results in the context of the emerging field of *joint action*, and discuss their connection to notions of group emotion and situated cognition. Such findings reveal the persuasive and subtle effect of social context upon cognitive and perceptual processes.

Keywords: vision; joint action; eye movements; social cognition, situated cognition

Introduction

Cognition is enveloped by social context. It is rare that we use our cognitive or perceptual faculties outside of the world of social influence, what Allport (1954/1979) described as the real or imagined presence of other people. Yet in cognitive and perceptual laboratories, we typically place participants in experimental quarantine away from the confounds of social interaction. The risk of this strategy is that we overlook the ways in which cognitive and perceptual processes interact with social context.

It is now well demonstrated that social cues such as eye contact and gaze direction are attended to in fundamentally different ways from non-social stimuli, both in terms of higher-level attentional selection (e.g. Birmingham, Bischof & Kingstone, 2008a, b, 2009; Frischen, Bayliss & Tipper, 2007; Senju & Johnson, 2009) and their different neurological subsystems (e.g. Greene et al., 2009; Itier & Batty, 2009; Ristic, Friesen & Kingstone, 2002). These studies, and many others, show how perceptual processing differs for social and non-social stimuli (Cacioppo, Visser & Pickett, 2005).

In studies of *joint perception*, this relationship is turned on its head; we keep the stimuli constant and examine how different social cues exert an influence on perceptual processing. The first demonstration (Richardson, Hoover & Ghane, 2008) presented participants with a set of four images on screen for eight seconds. On different trials, participants either believed that in a cubicle next door another participant was looking at the same images, or that the person next door was looking at a set of unrelated symbols. In each set of images, there was one picture with a negative valence (such as crying child), one with a positive valence (a smiling couple) and two neutral images with no strong valence. When participants believed that they were the only ones currently looking at the images, they looked more at the unpleasant ones. When they thought they were looking jointly with another, they looked more at the pleasant images.

Participants in this experiment could not see or interact with each other. Yet their gaze was systematically shifted if they imagined that another person was looking at the same stimuli. There have previously been similar demonstrations of the influence of social context on social or affective responses, for example, that people will smile and laugh more if they imagine that a friend elsewhere is currently watching the same comedy clip as themselves (Fridlund, 1991). However, the joint perception result showed that, on a trial-by-trial basis, social context can shape a low level perceptual/cognitive process.

The original experiment was carried out at UC Santa Cruz in the US. A replication was soon performed at University College London in the UK (Richardson et al., 2009). The same pervasive effect of social context was found. Gaze patterns shifted in response to joint perception. However, in this case, when participants believed that they were looking together, they looked more at the negative images. The contrasting US and UK data is shown in the top panel of *Figure 1*. What is depicted is the total fixation duration for the positive and negative images during joint and alone looking. Each study found a significant interaction between picture valence and social context, and between the two experiments there was a significant three way interaction, showing that the direction of the effect changed.

Though there were many differences between the laboratories' set up and the participant populations, we hypothesised that an important determinant might be how participants construed that task. One criticism of the first study was that participants did not know why they were looking at the images, and why the person next door was (sometimes) doing the same thing. So, in subsequent research in London (Richardson et al., 2009), we repeated the experiments but told pairs of participants either that we would be comparing their picture preferences (comparison task), or that they would be collaborating on a memory task afterwards (collaboration task). As *Figure 2* shows, we found a pattern of results that mimicked the US / UK differences, and also produced a significant three way interaction. People who thought they were being compared to each other tended to look at the negative and positive images equally in the joint condition, like the US participants. People who thought that they were

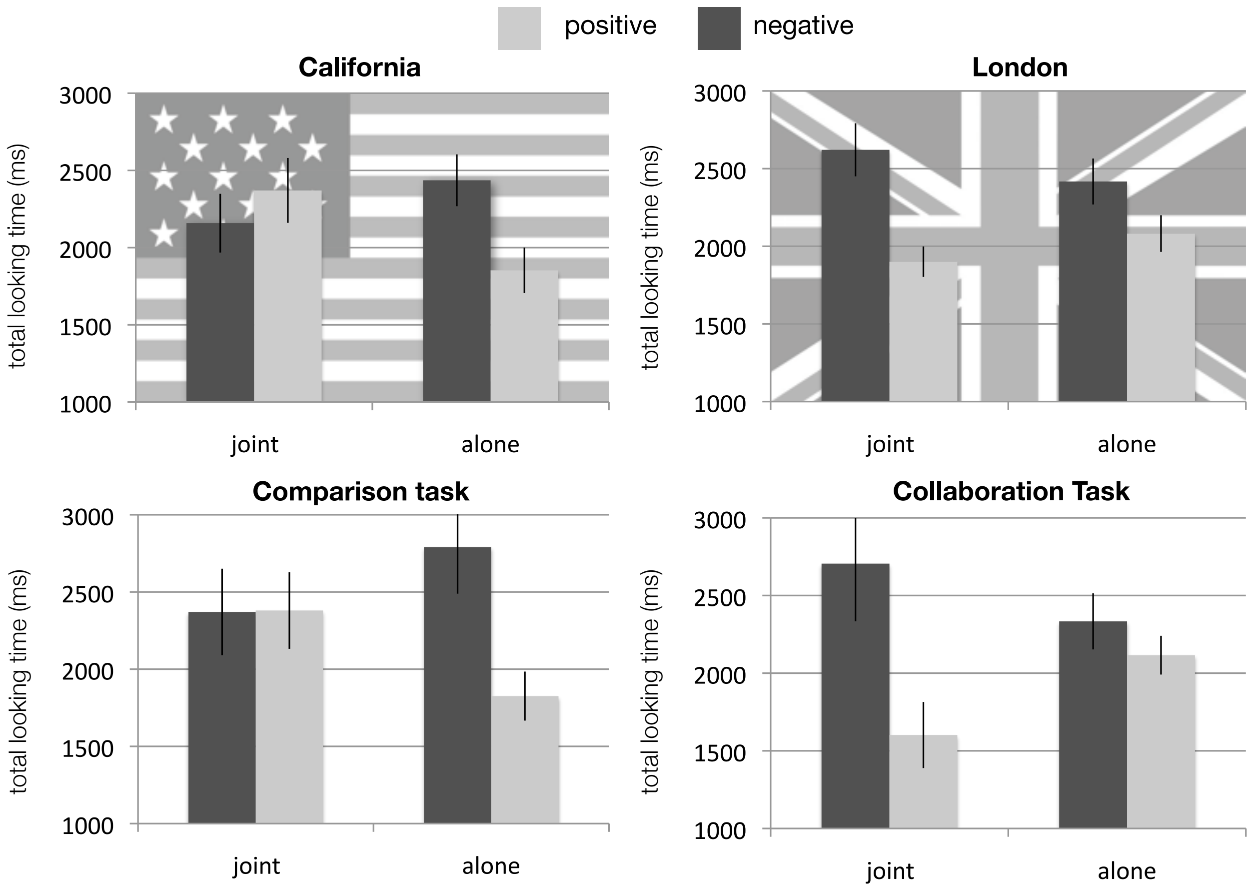

Figure 1. Results from Richardson, Hoover and Ghane (2008) and Richardson *et al.* (2009).

collaborating looked more at the negative images in the joint condition, like the London participants who did not get task instructions. There could be other reasons, of course, why the US and UK participants differed, but one plausible reason appears to be that in the absence of instructions, they interpreted the task in opposite ways. We can only speculate as to the reason the US participants might felt that they were being compared (they are academically evaluated more frequently than UK students), or it might have been that the physical setup of the lab (two adjoining cubicles, rather than one big room) engendered a feeling of being contrasted.

These previous studies have shown that gaze patterns can by systematically influenced by beliefs about social context, and that the direction of this influence is sensitive to differences in how participants construe their task. In the current experiment, we zoom in to this concept of looking at something 'together'.

For the joint perception effect to occur, is it enough to *experience* a set of stimuli at the same time as another person? Or do participants have to believe that they are engaged in the *same task* as the other person? In this experiment, unlike those described above, the participants always believed that they were looking at the same images as each other. What changed, trial-by-trial, was the task that they were doing, and the task that they believed their partner was doing. Inspired by the seminal work on *joint action* (Sebanz, Bekkering & Knoblich, 2006) that we discuss below, we predicted that joint perception effects would be strongest when participants believed that they were not just passively sharing an experience, but acting jointly.

Methods

Participants

32 University College London students (9 male) participated voluntarily or for course credit. Data from 4 participants were unusable due to equipment calibration problems.

Note that although we actually ran pairs of participants simultaneously in the lab, their experiments were run and their data analysed independently from each other. This is because participants could not see or interact with each other during the experiment. In effect, they acted as a mute social context for each other.

Procedure

Participants provided informed consent and then sat in opposite corners of the laboratory with their backs to each other, facing their display monitor. They could not see each other or each other's display. A brief 9-point calibration was carried out for each, and then task instructions were presented on screen. Two tasks were defined for the subjects. In the memory task they had to remember as many of the pictures as possible for a later test. In the search task, they had to look for a translucent X superimposed on one image, and press the mouse button that they held in one hand if they detected it. They were informed that their task could change from trial to trial, but that their partner would always be looking at the same pictures as them.

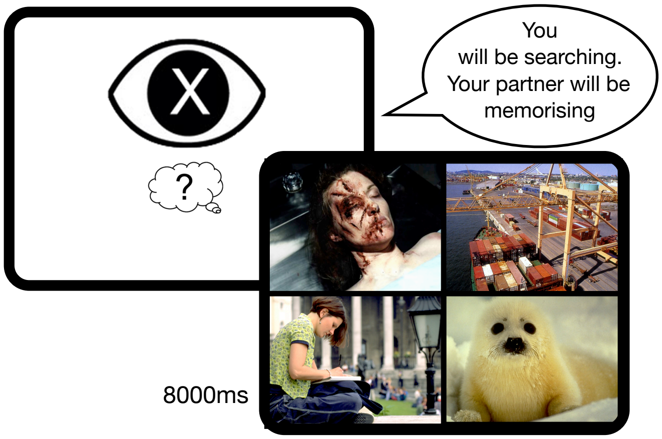

Figure 2. Trial schematic

Design

At the start of each trial, participants were told their task for the upcoming presentation. A large icon at the top of the screen showed their task (visual search or memory), and a smaller icon below that showed their partner's task (*Figure 2*). They also heard a voice say "You will be [memorising/searching]. Your partner will be [memorising/searching]".

Participants then saw one negative, one positive and two filler images in random positions in a 2x2 grid (see *Figure 2*). They were presented for eight seconds, during which time their gaze was tracked. There was a 1 second interval, and then the instructions for the next trial began.

There were 40 trials. In half the participant was told that they were to memorise the stimuli and in half they were told that they were searching for an X. Similarly, they were told that their partner performed the memory task half the time, the search task the other half. These task conditions were counterbalanced so that half the time the participant and their partner were doing the same task, half a different task. On eight trials (spread evenly across conditions), an X appeared at a random location on one of the images.

Stimuli

Images were taken from the International Affective Picture System (IAPS), a set of photographs that have been extensively normed on a range of attributes (Lang, Bradley & Cuthbert, 2005). We chose 40 negative items with valence ratings from 1.6 to 2.4 and a mean of 2, 40 positive items from 7.6 to 8.3 and a mean of 8, and 80 filler items from 4.8 to 5.2 and a mean of 5. For each trial, stimuli were chosen at random from these categories.

Apparatus

The stimuli were presented on 19" LCD screen at a distance of approximately 60cm. Beneath each display was a *Bobax3000* remote eye tracker that sampled fixations at 100 Hz. iMac computers behind a partition presented the stimuli, calculated gaze position, and collected the data.

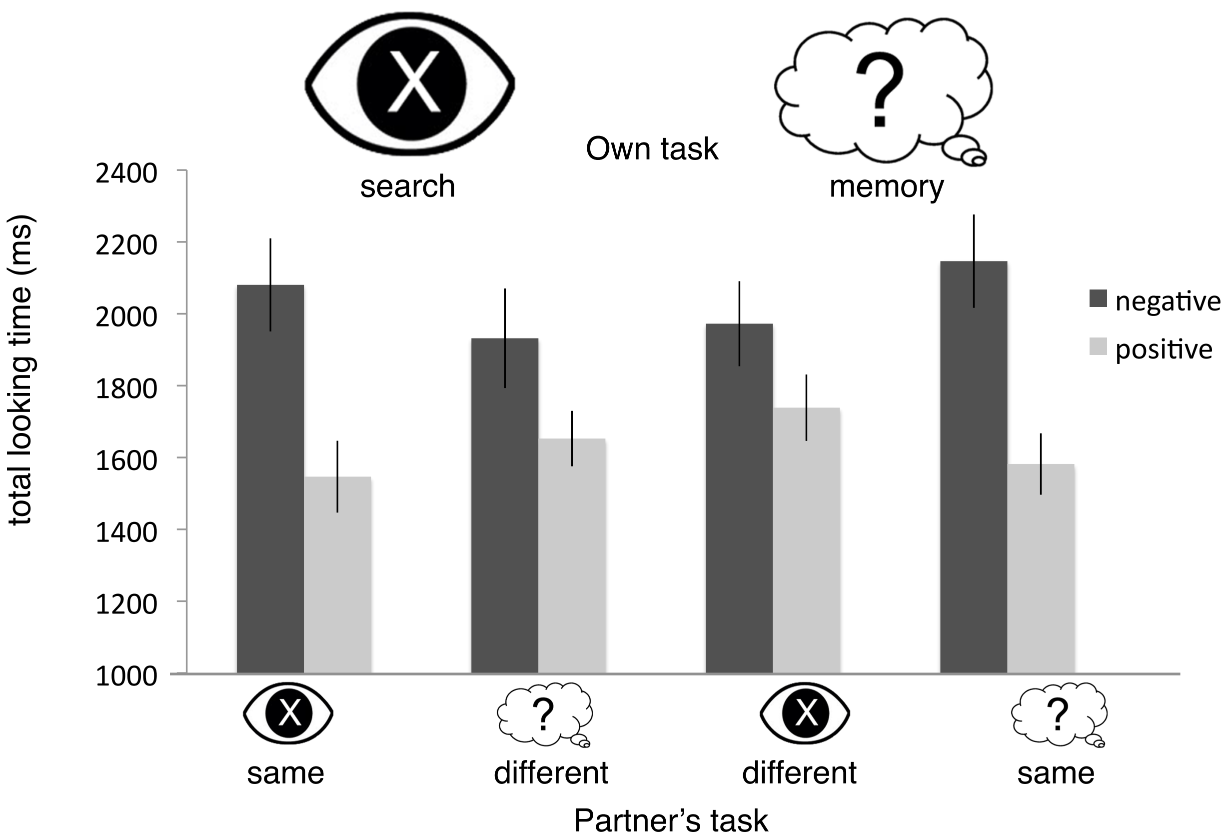

Figure 3. Looking times showed a significant interaction between valence and whether or not the participant's partner was believed to be doing the same or a different task

Results

Participants looked more towards the negative images when they believed that their partner was doing the same task as them, regardless of what the task was. We did not analyse the 20% of trials when there was an X present, as X and participants' responses to it would interfere with how they allocated their attention to each image. We calculated the total amount of time spent looking at the critical negative and positive images on trials where there was not X present. A 2 (valence: negative/positive) x 2 (own task: memory/search) x 2 (other's task: same/different) ANOVA was performed, and the means for each cell are displayed in *Figure 3*. There was a significant two way interaction between valence and other's task ($F(1,27)=10.08$, $p=.004$). Post hoc tests show that the difference between positive and negative images was significant when the participants believed they were doing the same task (using Tukey's at 0.01), but did not reach significance when they were doing a different task. There was also a main effect of valence ($F(1,27)=19.19$, $p<.0001$), but all other main effects and interactions were non significant (all *F*s <1).

General Discussion

The effects of joint perception do not occur simply when someone believes that another person is experiencing the same stimuli as themselves. We have shown that it is necessary that they believe that the other, unseen person is engaged in the same task as themselves. This task could be to memorise the pictures, which presumably would engage processing something of the meaning of an image, or the task could just be to search for a visual feature, which requires only superficial processing: regardless, the effect of joint perception arises whenever these tasks are believed to be done together. In each case, the effect of this co-engagement is to fixate the negative images more than the positive. Below, we discuss other areas of research that throw light on joint perception, and the direction of its effects in this situation.

Joint Action

Though the standard cognitive model marginalises social context, there have been notable exceptions. Studies of situated cognition (Barsalou, Breazeal & Smith, 2007; Robbins & Ayded, 2009) show that cognition 'in the wild' is intimately linked not only to representations of the external world, but also to the cognitive processes of others. Hutchins (1995) observed the ways that navy navigators distribute cognitive processes between themselves by using external tools and representations, such as maps and notations.

Recently, experimental methods are starting to reveal the mechanisms involved in such joint action (Galantucci & Sebanz, 2009; Sebanz, Knoblich & Bekkering, 2006). Social context can modulate even the simplest of tasks. For example, in a traditional stimulus-response compatibility task, participants make a judgment about one stimulus property (color) and ignore another stimulus property (location). If there is an incompatibility between the irrelevant property and the response (such as different spatial codes) then reaction times increase (Simon, 1969). Sebanz, Knoblich & Prinz (2003) divided such a task between two people. The participants sat next to each other, and each person responded to one colour: in effect, each acting as one of the fingers of a participant in Simon's (1969) experiment. Though each person had only one response to execute, they showed an incompatibility effect when acting together. There was no incompatibility effect when performing the same single response task alone. When acting jointly, participants represented their partners' actions as if they were their own.

Joint action effects do not occur if the participant is simply sat next to another person (Tsai et al., 2006), or if that person's button pressing actions are not intentional (their finger is moved by a mechanical device). Also, if the participant is acting jointly, but with a computer program (Tsai et al., 2008) or a marionette's wooden hand (Tsai & Brass, 2007) there is not a stimulus-response incompatibility effect. Therefore, participants only form representations of another when that person's genuine, intentional actions are engaged in the same task.

Our results fill out this picture. We have shown that a participant's perceptual process is changed when they believe that another person is co-acting with them: they do not have to see the person (c.f. Tsai et al., 2008), and the 'actions' do not have to be overt behaviour. If the participant thinks that the other person is memorising or scanning the images together with them, then that mutual cognitive process will shape their gaze patterns.

Focal Images

The term 'focal image' comes from Schelling (1960) who found that people were very good at guessing what images others would find salient. Schelling realised that everyday cases of verbal reference are often ambiguous. We say, 'Hand me the fork,' in the presence of many such items, yet listeners unproblematically infer the same referent. For example, when presented with a page full of items, such as watches from a catalog, participants agreed with each other which one was most likely to be referred to as 'the watch' (Clark, Schreuder & Buttrick, 1983).

When we enter into any joint activity, such coordination is all important (Clark, 1996). When we talk, we implicitly agree upon names for novel objects (Clark & Brennan, 1991), align our spatial reference frames (Schober, 1993), use each others' syntactic structures (Branigan, Pickering & Cleland, 2000), sway our bodies in synchrony (Shockley, Santana & Fowler, 2003; Condon & Ogston, 1971) and even scratch our noses together (Chartrand & Bargh, 1999). We also coordinate our gaze patterns with each other (Richardson & Dale, 2005), taking into account the knowledge (Richardson, Dale & Kirkham, 2007) and the visual context (Richardson, Dale & Tomlinson, 2009) that we share. Perhaps participants in our experiment, anticipating a future discussion of the stimuli, attempted to coordinate gaze patterns with their partner when they believed they were acting jointly. In other words, they looked at the pictures they thought another person would look at: the focal image.

Responses to Negative Stimuli

Our discussion so far has not touched upon one question: why is it that the effect of joint perception is sometimes to increase looks to the negative pictures, and sometimes to the positive images? It seems plausible that participants who thought that they were being compared to each other might want to look equally at the positive and negative images, since they may feel that ogling a disturbing image might not reflect well upon them. However why is it that in the collaborative memory task and the joint visual search tasks, the participants looking together tend to look at the negative images?

We are generally very responsive to unpleasant or threatening things. Negative images are considered more potent than equivalently-valenced positive images, so much so that when combinations of equivalent positively and negatively valenced stimuli are presented simultaneously participants rate the overall set as unpleasant (for reviews, see Baumeister et al., 2001; Lewicka, Czapinski & Peeters, 1992; Rozin & Royzman, 2004; Skowronski & Charlston, 1989). Negative stimuli are likely to receive attention more quickly (Norris et al., 2004, Smith et al., 2003) and for longer (Hajcak & Olvet, 2008). But why might this bias towards negative images be amplified during joint perception?

Emotion and Social Interaction

When people collaborate in groups, they tend to align with the group emotion (Barsade, 1998; Hatfield, Cacioppo & Rapson, 1993; Wageman, 1995). That emotion arises from the majority's personal disposition for positive or negative mood states (George, 1990). Since, as we've seen, negative stimuli are usually attended to more by individuals, when they cooperate together this would serve to amplify the negativity bias (Taylor, 1991). Affect can influence behaviour without necessarily having to personally experience the emotion (Winkielman, Berridge & Wilbarger, 2005). In this light, our joint perception phenomenon could be seen as a form of minimal, imagined cooperation that is sufficient to produce an alignment of group emotional biases.

Conclusion

How we move our eyes is swayed by a belief that others are looking at the same scene and thinking the same thing. These results broaden the notion of joint action to include perceptual processes, unseen collaborators and mental actions such as remembering and visual search. They also suggest a possible experiment to perform at a poster session. Sidle up to another conference attendee gazing over the results of an experiment. If our results generalise, a slight cough will alert them to your presence, engage their feeling of joint perception and perhaps sway their gaze towards more negative aspects of the poster, demonstrating that an effect of social context can even be found at a cognitive science conference.

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