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Research report

Visual search for facial expressions of emotion is less affected in simultanagnosia

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ABSTRACT

Evidence in healthy human subjects has suggested that angry faces may be enhanced during spatial processing, perhaps even “popping-out” of a crowd. These contentions have remained controversial, but two recent reports in patients suffering from unilateral spatial neglect have lent some support to these views, suggesting that emotional faces capture attention more efficiently than neutral stimuli in the neglected field.

Here, we investigate this phenomenon in a patient suffering from severe Balint's syndrome and consequent simultanagnosia. Using a visual search paradigm, we studied differences in the detection of angry, happy and neutral faces, as well as non-emotional stimuli.

Results revealed that emotionally expressive faces, in particular anger, were detected more efficiently than other stimuli.

These findings corroborate claims that facial expressions of emotion constitute a specific category of stimuli that attract attention more effectively, and are processed prior to attentional engagement.

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1. Introduction

In 1988, Hansen and Hansen (1988) reported that healthy control subjects could detect an angry face among a series of distracters consisting of happy or neutral faces more rapidly than the converse condition (i.e., detecting happy or neutral faces in an angry crowd). This so-called “face in the crowd effect” led to the contention that faces were processed pre-attentively for characteristics of threat, and consequently produced a pop-out phenomenon for angry faces. Subsequent research (Hampton et al., 1989; Nothdurft, 1993) refuted the pop-out

effect due to the observation that subjects' reaction times in these visual search tasks varied with the position of the target in the crowd, or with its size. Indeed, an increase in visual search time with a greater number of distracters is taken as an indication of attention being allocated to each element of the population in serial succession. Pre-attentive processing, or “pop-out”, requires the absence of any effect of population size on reaction time, denoting simultaneous processing of all elements in parallel (Treisman and Gelade, 1980). Since the findings with emotional faces demonstrated a serial search, a pop-out phenomenon for angry faces was ruled out. Further

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evidence (Purcell et al., 1996) demonstrated that the pop-out phenomenon obtained in Hansen and Hansen's original experiment was due to a low-level visual artefact that had appeared in the black on white versions of the (originally grey-scale) photographs used in the experiment. Indeed, when replicating the paradigm, this time with the original grey-scale pictures, happy and angry faces were detected after a self-terminating visual search.

Fox et al. (2000) suggested a possible alternative while maintaining a special status for angry faces. Based on the reaction time data of a control population, these investigators noted that angry faces were searched at an estimated 16 msec per item and happy faces at 29 msec per item, compared to an expected <10 msec per item in automatic search. This, they pointed out, implied that angry face detection was not carried out in a fully automatic manner, although these stimuli were searched for and detected more efficiently.

Clearly though, the effect of angry faces on attention remains controversial (see also Fox et al., 2000; Suzuki and Cavanagh, 1992; White, 1995). However, two recent studies (Fox, 2002; Vuilleumier and Schwartz, 2001), in patients suffering from unilateral spatial neglect following right hemisphere damage, suggested that brain damage did not affect attention for emotional faces and neutral stimuli to the same degree, again suggesting that emotional faces might constitute a particular category of stimuli.

In this investigation, we examined whether a similar conclusion could be arrived at in a patient suffering from another spatial disorder, simultanagnosia, which occurred in the context of acute Balint's syndrome following bilateral parieto-occipital injury.

This syndrome is relatively rare and was first described by Balint himself at the turn of the last century (Balint, 1909). It includes three major symptoms: optic ataxia, oculomotor apraxia and, of particular interest here, simultanagnosia (see Coslett and Chatterjee, 2003 or Rafal, 2001 for reviews). In simultanagnosia, patients are unable to perceive more than one object at a time, even though single stimuli are generally perceived correctly. This deficit occurs independently of the size of the objects, and is present even when they are in close proximity, or indeed superimposed (e.g., Luria, 1959; Luria et al., 1963). Contrary to unilateral spatial neglect, simultanagnosia appears as an object-based constriction of the attentional field and is independent of the spatial location of the stimulus (Rafal, 2001). Obviously, this disorder produces severe difficulties in visual search and target detection tasks, and occurs independently of the visual field (Coslett and Saffran, 1991).

The present study required that the simultanagnosic patients perform a series of visual search tasks in which emotional or non-emotional targets had to be detected among a series of distracters. The aim was to establish if target detection was impaired differentially for non-emotional stimuli or emotional faces despite severe simultanagnosia.

2. Case history

The patient MC was a 48 year-old right-handed woman, who had followed a normal education until the age of 15. She had

then pursued an apprenticeship as a watch-case maker and had worked in this field until her cerebrovascular accident.

She was admitted to hospital after sudden onset of violent headaches and vomiting with a score of 10 on the Glasgow Coma scale due to a subarachnoid haemorrhage. By the 15th day, her condition had improved (Glasgow Coma scale 15) and was stable, and she was transferred to the neurology clinic for further evaluation.

A CT scan performed on the 20th day, and a subsequent MRI scan the following week, showed the presence of bilateral occipito-parietal lesions (Fig. 1), as well as a left cerebellar lesion.

MC was oriented to time and place. She was cooperative but showed a certain slowing of her mental functions. She was worried by her difficulties, complaining mainly of visual disturbances that she described as a "deformation of space". Indeed, she stated that she saw persons and objects in places that were "different from where they really were", an observation that she based on the fact that she could not grasp or touch them. She also later described that she could not establish the direction or speed of moving objects, and preferred closing her eyes and relying on hearing alone.

Her neurological examination revealed brisk tendon reflexes, more marked on the right, a slight decrease in vibration sense in the inferior limbs, and a positive Hoffman response bilaterally. Graphesthesia was impaired on the right. Cranial nerve testing suggested both left ear and left visual field extinction. Cerebellar tests were unimpaired.

The neuropsychological evaluation showed no aphasic signs in oral comprehension and expression, and MC scored within normal limits (see Table 1 for details of scores on neuropsychological tasks) on an abridged French version of the Boston naming task (Colombo-Thuillard and Assal, 1992). Written language was, by contrast, severely impaired. She

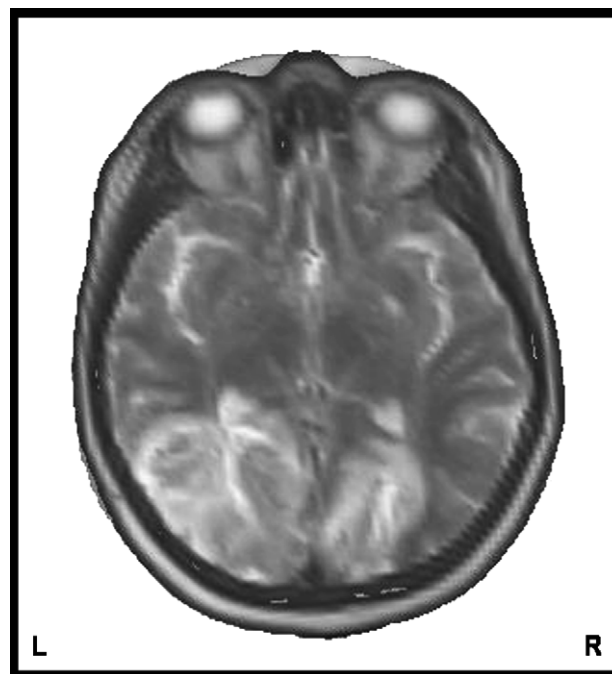


Fig. 1 – MRI axial image showing part of MC's bilateral parieto-occipital damage.

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