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Valence specific laterality effects in free viewing conditions: The role of expectancy and gender of image

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ABSTRACT

Recent research has looked at whether the expectancy of an emotion can account for subsequent valence specific laterality effects of prosodic emotion, though no research has examined this effect for facial emotion. In the study here ($n = 58$), we investigated this issue using two tasks; an emotional face perception task and a novel word task that involved categorising positive and negative words. In the face perception task a valence specific laterality effect was found for surprise (positive) and anger (negative) faces in the control but not expectancy condition. Interestingly, lateralisation differed for face gender, revealing a left hemisphere advantage for male faces and a right hemisphere advantage for female faces. In the word task, an affective priming effect was found, with higher accuracy when valence of picture prime and word target were congruent. Target words were also responded to faster when presented to the LVF versus RVF in the expectancy but not control condition.

These findings suggest that expecting an emotion influences laterality processing but that this differs in terms of the perceptual/experience dimension of the task. Further, that hemispheric processing of emotional expressions appear to differ in the gender of the image.

1. Introduction

Research looking at the role of emotional processing in the left and right brain hemispheres has been established for some time. Early research using patients with acquired unilateral brain damage discovered a change in emotional language after damage to the left hemisphere (Jackson, 1874, 1880), and a change in emotional expression after damage to the right hemisphere (Mills, 1912). Since then a vast amount of research has been carried out with those who have suffered damage to either of the hemispheres, examining the effects on emotional processing. This has generated a number of hypotheses for the role of each hemisphere in the processing of emotion perception. For example, the right hemisphere hypothesis posits that the right hemisphere alone is specialised for the processing of emotion (Demaree, Everhart, Youngstrom, & Harrison, 2005). Alternatively, the Valence Specific Laterality hypothesis suggests that negative emotions are processed in the right hemisphere (RH) and positive emotions are processed in the left hemisphere (LH) (Silberman & Weingartner, 1986). The Type theory instead proposes that emotions are divided into Basic (happiness, surprise, fear, anger, disgust and sadness) and Complex (e.g. interest or worry) emotions, being processed by the RH and LH respectively (Ross, Homan, & Buck, 1994; Shamay-Tsoory, Lavidor, & Aharon-Peretz, 2008). In contrast, other recent theories argue that emotional processing is more complex than a clear LH (positive) RH (negative) distinction and are better explained by differences in approach/withdrawal motivation (Harmon-Jones, 2004).

In terms of the valence hypothesis, this has been investigated under free viewing conditions, where participants are given as much time as needed to elicit a response. For example, in a face perception task, Rodway, Wright, and Hardie (2003) showed participants a pair of faces with one of six emotional labels (fear, sadness, disgust, anger, happiness and surprise) above them. The emotional label was shown with the presentation of faces and remained on screen until the participant elicited a response. One of the faces was a neutral expression while the other was the neutral expression morphed with an emotional expression congruent with the emotional label displayed. Participants were asked to decide which of the two faces displayed the emotional label presented. (Rodway et al., 2003) found a valence specific laterality effect in female but not male participants, with females discriminating negative facial emotions more accurately when presented on the left-hand side of the screen, engaging the right hemisphere and positive facial emotions more accurately when presented on the right-hand side of the screen, engaging the left hemisphere. In a subsequent study (Rodway & Schepman, 2007) they explored whether these effects might be explained by expectancy effects using Kinsboune's selective hemispheric activation theory (1970).

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This proposes that the expectancy of a specific stimulus engages the relevant hemisphere which is specialised in dealing with that material. This causes attention to be directed towards the contralateral visual hemifield, meaning a stronger consideration of the stimuli in that hemifield. They tested this using a prosodic emotion task, where expectancy was manipulated by visually displaying an emotionally congruent label prior to each pair of prosodic sentences. The findings did not support the expectancy hypotheses proposed by Kinsbourne's activation theory (1970), as prior presentation of a sad word did not result in participants selecting the sentence presented to the left ear engaging the right hemisphere, and vice versa. However, in support of the right hemisphere hypothesis, a left ear advantage was found for the perception of both positive and negative emotions.

Creating expectancy for an emotional stimulus has been investigated in other research, which has mainly endeavoured to localise the brain regions involved (Bermpohl et al., 2006; Breiter, Aharon, Kahneman, Dale, & Shizgal, 2001; Buchel et al., 1998, Buchel, Dolan, Armony, & Friston, 1999; Critchley, Mathias, & Dolan, 2001; Gottfried, O'Doherty, & Dolan, 2002; Jensen et al., 2003; Knutson, Adams, Fong, & Hommer, 2001; Ploghaus, Becerra, Borras, & Borsook, 2003). However, apart from Rodway and Schepman (2007), there has yet to be research looking at whether expecting an emotion can account for valence specific laterality effects.

Therefore, the first aim of the present study was to investigate whether expecting an emotion can account for valence specific laterality effects of facial emotion, using the same task as used previously (Rodway et al., 2003), referred to here as the Face perception' task. Expectancy was manipulated by presenting the emotional label before the face images, similar to the earlier work (Rodway & Schepman, 2007). On the basis of previous research (e.g. Rodway et al., 2003), and the valence specific laterality hypothesis, it was predicted that accuracy would be higher when categorising negatively morphed faces presented on the left side (engaging RH). In contrast, accuracy would be higher when categorising positive morphed faces on the right side (engaging LH). It was further predicted that in accordance with Kinsbourne's hemispheric activation theory (1970), these valence specific laterality effects would be stronger in the expectancy compared to the control condition. Therefore, the first hypothesis was that accuracy would be significantly higher in the expectancy condition compared to the control condition when: (a) the morph appeared on the left compared to the right side when the emotional label was negative (b) the morph appeared on the right compared to the left side when the emotional label was positive.

Additionally, since approach/withdrawal work (Harmon-Jones, 2004) has shown that all emotions *within* an emotional category (positive/negative) are not processed the same way; we also aimed to investigate differences within each emotion. The evidence for this comes from work demonstrating that anger, normally believed to be a withdrawal (negative) emotion can evoke greater activity in the left frontal cortex more akin to approach behaviour (Harmon-Jones, 2004). Additionally, as much of the previous research has used solely male facial images (Jansari, Tranel, & Adolphs, 2000; van Strien & van Beek, 2000; Reuter-Lorenz & Davidson, 1981; Rodway et al., 2003), the current study employed both male and female images to see whether the gender of facial expression had any influence on valence specific laterality effects.

The second aim of the present study was to investigate the expectancy hypothesis further with a new task, which is referred to here as the 'Word task'. Previous research examined the effect of briefly presented emotional pictures had on a subsequent visual discrimination task (Hartikainen, Ogawa, & Knight, 2000). They found that regardless of visual field (Left/Right) presentation, the emotional pictures prolonged reaction times to left visual field targets, suggesting that a right hemisphere advantage in the processing of emotional stimuli. The current study manipulated this task by replacing the discrimination task with positive and negative emotional words presented to the left and right visual fields. In the expectancy condition, either a positive or negative picture was presented before each word, with no pictures presented in the control condition. Since research that presented emotional words to each of the visual fields has shown support for the valence specific laterality hypothesis (Kakolewski, Crowson, Sewell, & Cromwell, 1999), it was expected that a valence specific laterality effect would be observed. Therefore, the second tentative hypothesis was that across both control and expectancy conditions, responses would be faster to categorise positive words presented to the right versus left visual field, with the reverse prediction for negative words. It was further expected on the basis of Kinsbourne's hemispheric activation theory, that this valence laterality effect would be stronger in the expectancy compared to control condition. The same pattern was predicted in terms of accuracy.

The study here used only female participants since the previous study did not observe valence specific laterality effects in males (Rodway et al., 2003). Additionally, baseline mood was also measured as the state of participants has been found to affect their perception of facial affect (Bouhuys, Bloem, & Groothuis, 1995; Rodway et al., 2003) and to influence valence specific laterality effects (Crews & Harrison, 1994).

2. Methods

2.1. Participants

Sixty female participants took part in the study, recruited predominantly through the University of Portsmouth participant pool. Fifty-one participants were right handed and seven were left handed, all of whom were English native speakers. Handedness and principal language spoken were identified along with other demographic data. The mean age of participants was 21 years (SD = 6.77). Two participants were excluded from analysis (3.33%) as they completed the tasks in an incorrect order. Ethical approval was sought and passed through the University of Portsmouth Ethics Committee before the study commenced.

2.2. Design

The study used a mixed design, where participants were randomly allocated to a control or expectancy condition, both completing a Face perception task and a Word task in a counterbalanced order. For both tasks, valence of the emotional label (negative versus positive), side the morphed face image appeared on (left versus right) were within-subject factors. Additionally for the face perception task, the gender of the face image (female versus male) was also a within-subjects factor. The between-subjects variable was expectancy, where for the Face perception task, the emotional label was presented either before (expectancy) or at the same time (control) as the face images. For the Word task, a picture appeared before (expectancy) each word compared to no pictures (control).

2.3. Materials

The experiment was conducted on a standard PC with a 15 in. CRT monitor and standard keyboard. The task was created, presented and responses were recorded using e-prime software (Psychology Software Tools Inc., 2001).

2.3.1. Face task stimuli

A male (JJ3-4) and female (MF1-2) neutral face image were selected by matching them for similar looking ages from Ekman and Freisen's (1976) pictures of facial affect. The male face image