ALEXITHYMIC TRAITS IMPACT THE PERCEPTION OF IMPLIED MOTION IN FACIAL DISPLAYS OF AFFECT

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Something akin to motion perception occurs even when actual motion is not present but merely implied. However, it is not known if the experience of implied motion occurs during the perception of faces or even different affects. Moreover, it is not known if implied motion is moderated by individual differences in anxiety, depression or alexithymia. To examine this, participants were presented with picture pairs showing facial affect that implied either a forward or backward motion, i.e., depicting an increasing intensity in affect, or its diminution. Participants indicated whether or not the second face in the pair was the same as, or different from, the first face shown. To measure general affect recognition ability the Ekman 60 faces test was administered, as were the Toronto Alexithymia scale (TAS-20) and the Hospital Anxiety and Depression scale (HADS). Analysis of error rates revealed significant main effects for direction and emotion. There was no significant correlation with overall HADS score for any of the six emotions; there was also no effect of depression, anxiety or general face recognition abilities. Interestingly, the number of errors in the forward condition was negatively related to scores on the difficulty identifying feelings subscale of the TAS-20, which suggests that individuals who have problems identifying their own and others' feelings had experienced a reduction in the experience of implied motion. Results suggest that implied motion may influence the experience of affect recognition and can be applied to clinical groups, specifically those demonstrating deficits in correctly recognising salient social cues.

Key words: implied motion, facial displays of emotion, alexithymia

INTRODUCTION

In our everyday interactions with others the facial displays of emotion that we encounter are dynamic and most people readily recognise a wide range of affective states, even from very slight and nuanced muscular contractions of the face (Matsumoto & Hwang, 2014). Despite this, much of the research into facial emotion recognition has relied on static photographs of posed expressions. Given that dynamic facial displays of emotion provide a more ecologically valid means to examine natural face perception, the emerging body of work that has used dynamic stimuli has, so far, resulted in significant advances in our understanding of facial expression processing (see Krumhuber, Kappas & Manstead, 2013 for a review).

The importance of face-specific motion for communicating complex social information is supported by studies of the McGurk-type illusion (McGurk & McDonald, 1976). By attaching small retro-reflective targets to various points on a dynamic face it is possible to extract the McGurk-specific motion that engenders the illusion. Indeed, it is possible to produce the McGurk illusion when observers are shown dynamic point-light displays with a reduced number of retro-reflective targets i.e., 10 vs 32. More interestingly, with point-light displays of less than 10 facial targets observers still report experiencing the effect, even when they are unaware that they are observing a dynamic face (Rosenblum & Saldana, 2013). The fact that observers still report experiencing the illusion while being unaware of the fact they are actually watching a face does suggest that face-specific motion facilitates access to semantic information about a face.

That said the sensitivity of the human visual system for the detection of motion is so acute that a process very similar to motion perception occurs when actual motion is absent, but merely implied (Hubbard, 2017). This implied motion effect is measured by examining the presence of a very small distortion in recognition memory. This memory distortion is called representational momentum (RM) and is commonly defined as the forward extrapolation of an object in the direction of that object's implied trajectory (Freyd & Finke, 1984). It is traditionally explored by comparing stimulus pairs that depict a target object implying forward motion, i.e., the object is further along its implied trajectory, or backward motion where the object has reversed its location on the implied trajectory. Stimuli where motion is implying a forward direction tend to evoke greater memory distortion than those implying backward motion (see e.g., Senior, Ward & David, 2002). Interestingly, Reed and Vinson (1996) reported that implied motion from pairs of static images was influenced by the type of noun that was used to describe the images, with nouns that implied motion (e.g., rocket) facilitating RM compared to nouns that did not imply motion (e.g., steeple). RM, therefore, reflects high-level cognitive processing rather than low-level psychophysiological processes, for example, the motion after-effect, which is relatively impervious to conceptual modulation (but see Parks & Coss, 1998).

There is a growing body of work examining RM in the perception of facial expressions. For example, Yoshikawa and Sato (2008) presented videos where a face morphed from a neutral expression towards an emotional expression, and then

asked participants to select the last image that they had perceived. The authors reported that participants tended to choose an image of greater emotional intensity than was actually presented, which they interpreted as the result of RM. This anticipation effect for faces has since been replicated (Marian & Shimamura, 2013; Palumbo & Jellema, 2013; Uono, Sato & Toichi, 2014). It is noticeable that these studies used either videos of faces morphing from neutral towards an emotion, or relatively long sequences of static images, beginning with a neutral face and ending at an emotion. Both of these types of stimuli are likely to be perceived as moving, thus it is probably not surprising that an overshoot in the perception of emotional intensity was observed. However, videos, in particular, are markedly different from stimuli that were utilised in initial RM studies (e.g., Freyd & Finke, 1984). Palumbo and Jellema (2013) proposed that one explanation for the emotional anticipation effect is 'embodied simulation', that is, simulating the emotional expressions of others induces movement within the perceiver's motor system. If this is the case, then spontaneous imitation of a face should lead to more implied motion, thus there should be RM even if only two static faces are presented consecutively.

It is also plausible that individual differences in the ability to recognise faces, and specifically emotional expressions might influence the degree of implied motion that is experienced. For example, alexithymia - a personality trait that is characterised by difficulties identifying and labelling one's subjective feelings, problems in differentiating bodily sensations and feelings, and a tendency to focus on external, as opposed to internal, experiences (Taylor, Bagby & Parker, 1991) - is associated with poorer facial emotion recognition (Lane, Hsu, Locke, Ritenbaugh & Stonnington, 2015), possibly due to reduced imitation of facial expressions (Sonnby-Borgström,

2009). Likewise, in patients with anxiety and/or depression, deficits in facial affect recognition (e.g., Gollan, McCloskey, Hoxha, & Coccaro, 2010; Tseng et al., 2017) as well as biases towards negative evaluations of emotional information have been reported. Such deficits were mediated emotion intensity (improved accuracy for higher-intensity emotions) and degree of symptomatology, i.e., increase in depressive symptoms resulted in increased recognition accuracy for sad faces, but decreased accuracy for other emotions (Gollan et al., 2010). It might therefore be expected that individual characteristics, such as alexithymia but also depressive or anxious temperaments influence the degree of implied emotion experienced on a facial RM task. The current research study addresses these questions. Here it was hypothesised that presentation of facial displays of emotion in an RM-type task would engender the experience of implied motion and there would be an effect of the specific emotion displayed i.e., there would be a direction-by-emotion interaction. Finally, we explored the relationship between alexithymic, depressive and anxiety traits and performance on the RM task.

METHODS

Participants

83 participants (11 males) with a mean age of 19.7 years (range: 18-45 years) volunteered to take part in this study for partial course credit. All experimental procedures were in accordance with the Declaration of Helsinki and approved by the Aston University Ethics Committee. Before partaking in any research activities, participants provided informed consent.

Procedure

Figure 1: An overview of the RM paradigm used in the current study. Participants were first presented with a fixation cross on the screen (not shown) and then initiated each trial with a key-press which resulted in (A) the presentation of an image of a face depicting a facial expression at 100% intensity which was on the screen for 250 milliseconds. This was then followed by (B) an isoluminant blank screen inter-stimulus interval for 250 milliseconds. After this, participants were shown a face of the same identity and affect but displaying either 25% more (125% as is depicted above) or less intense (75%) expression. This image remained on the screen until participants indicated whether or not this second facial image was the same as, or different from, the first. In total a set of six identities (taken from the Facial Expressions of emotion: Stimuli and Test series (Young et al, 2007), displaying six emotions (sadness, fear, anger, disgust, surprise and happiness) were shown to participants. This paradigm has been shown to reliably allow the study of implied motion. Each of the trials displayed a stimuli pair as either invoking a particular facial expression (which implied forward motion) or shown the same expression with its intensity reduced (implying backward motion). A third set of image pairs depicting the same image twice are also shown – as control condition. This resulted in a total of 108 pairwise trials. Participants also completed a small practice session.

All participants were tested individually and were first asked to complete the Hospital Anxiety and Depression scale (HADS; Zigmond & Snaith, 1983) and the Toronto Alexithymia Scale (TAS-20; Bagby, Parker & Taylor, 1994). Then, participants completed a computerised emotion recognition task ('Ekman 60 Faces Task'; Young, Perrett, Calder, Sprengelmeyer & Ekman, 2002). For the RM task, participants were presented with an image on the computer screen displaying a particular emotion. This first face was on the screen for a very short time only. They were then shown a second face and asked to indicate whether or not the second face was the same as, or different to, the first. Participants were asked to respond with their dominant hand, via a keypad, and to do so as quickly and as accurately as possible (see Figure 1).

RESULTS

Questionnaire measures

Mean scores for the anxiety (Mean=6.94, SD=3.55) and the depression subscales of the HADS (Mean=2.89, SD=2.97) were within the normative ranges for healthy participants (Crawford, Henry, Crombie & Taylor, 2001). Total scores on the TAS-20 (Mean=45.76, SE=10.82) and scores on the *difficulty identifying feelings* (M=12.24, SD=4.21), *difficulty describing feelings* (M=14.77, SD=5.54) and *externally oriented thinking* (M=18.75, SD=4.13) subscales of the TAS-20 were also consistent with published norms for healthy participants (Parker, Taylor & Bagby, 2003).

Representational Momentum (RM) of Faces

To examine RM a comparison of the errors between the forward and backward conditions was carried out. This revealed a significant main effect of direction, with a greater number of errors in the forward (Mean=6.7, SD=1.8) vs the backward condition (Mean=4.11, SD=1.9; $F(1, 79)=296.30$, $p<.001$, $\eta^2_p=.79$). There was also a

significant main effect of emotion; $F(4.5, 352.8)=53.20$, $p<.001$, $\eta^2_p=.40$ (Greenhouse-Geisser) as well as a significant direction-by-emotion interaction $F(4.4, 350.6)=19.5$, $p<.001$, $\eta^2_p=.20$ (Greenhouse-Geisser).

Figure 2: Bar chart showing the number of errors per affect for both the forward and backward conditions. Black bars denote number of errors for the forward condition; here error rates were significantly higher for displays of sadness than all other expressions, all tests $p<.01$, and significantly lower for happiness than all other emotions, all tests $p<.01$ (anger and disgust, $p<.05$). There was no difference between the errors for the forward conditions for displays of anger and disgust. White bars denote number of errors for the backward condition; here error rates were significantly higher for displays of sadness; error rates for happy faces were significantly lower than for all other expressions, all tests $p<.01$. This confirms that regardless of condition happy expressions led to fewer errors and sad expressions led to the greatest number of errors. Mean difference in errors and SD of that mean (Forward-Backward) is shown above each of the affect categories. It is worth noting that analysis of the response time data did not reveal a main effect of direction or emotion and no direction x emotion interaction, all $p>.05$.

Interrogation of this interaction revealed that the difference between the forward and backward conditions was greatest for displays of fearful - compared to all other - emotions, except for happiness, all tests $p < .001$ (see Figure 2). There was also a greater difference for happiness compared to all other emotions, all tests $p < .01$, and a greater effect for disgust than for anger or sadness, both tests $p < .05$. However, there were no differences between the forward and backward conditions for sadness, anger and surprise, all tests $p > .05$.

Correlational Analysis

Accuracy on the Ekman 60 faces test approached ceiling level ($>95\%$) and was not correlated with depression or anxiety scores (both tests $p > .05$), but was negatively correlated with alexithymia (TAS-20 total), $r(75) = -.4$, $p < .001$, and remained so even after controlling for depression and anxiety. Total number of errors for both the forward and backward conditions was not related to depression, anxiety or scores on the Ekman 60 Faces task, all tests $p > .05$. Interestingly, the number of errors in the forward condition was negatively related to scores on the 'difficulty identifying feelings' subscale of the TAS-20, $r(75) = -.23$, $p < .05$, which suggests that individuals who have problems identifying their own and others' feelings had reduced RM. In support of this it is worth highlighting that scores on the 'difficulty identifying feelings' subscale were also positively related to reaction time in the forward condition, $r(75) = .38$, $p < .01$ ¹. When examining the increase in errors in the forward condition compared to the backward condition, the size of the increase was positively associated with scores on the Ekman task, $r(75) = .24$, $p < .05$. There was also a non-

¹ Response time and accuracy rate were not correlated which excludes a speed accuracy trade-off occurring, $r(80) = -.14$, $p = .23$.

significant trend suggesting that the size of increase was negatively related to alexithymia, specifically the 'externally oriented thinking' subscale, $r(75) = -.21$, $p = .07$.

DISCUSSION

We demonstrate that the experience of implied motion is perceived from facial displays of emotion, and that this effect is attenuated by an observer's inability to name a particular emotion. This effect is not an artefact of a general deficit in the ability to recognise facial expressions and was not influenced by individual differences in depression or anxiety. However, RM was modified by alexithymia, notably the factor relating to difficulty identifying feelings. The key finding is that participants in this study made a greater number of errors for face pairs which implied forward motion, compared those which implied backward motion - this is a stereotypical RM effect (see, e.g., Freyd & Finke, 1984). This finding is consistent with previous work examining emotional anticipation in response to facial cues (e.g., Marian & Shimamura, 2013). However, as mentioned above, these studies exclusively used series of facial images depicting an increasing or reducing intensity of emotion to examine the effect, whereas we used a single image of a facial expression to induce this effect. Thus, we can be certain that RM was not driven by low-level change detection processing of the different facial features that would be evident in a series of facial images presented in succession.

Interrogation of the direction-by-emotion interaction revealed that it was driven by greater RM for fear and happiness, compared to facial displays of sadness, anger and surprise. Fear and happiness have a privileged position in our ability to recognise them (Öhman, Lundqvist & Esteves, 2001; Kirita & Endo, 1995). For

example, whilst recognition of facial displays of emotion tend to be processed in the amygdala at a latency of approximately 200 milliseconds (ms), displays of fear and happiness are recognised significantly faster i.e., at 110-150ms (Liu, Ioannides & Streit, 1999). We cannot exclude the possibility that this effect could have been driven by differences in the amount of facial motion in these expressions compared to others, e.g., sadness. Future work should be carried out to explore this further.

There is evidence showing that displays of fear, in addition to those of happiness, may engender approach-like behaviours in order to fully assess the nature of a potential threat (Marsh, Ambady, & Kleck, 2005). The fact that displays of fear and happiness produced such similar pattern of results suggests that RM may underlie a preparatory mechanism for some form of approach behaviour. There is clearly a need for additional work that focuses on understanding further the role that implied motion may play in the initiation of behaviours along the approach - avoidance dichotomy.

Returning to both main effects, it is worth noting that these cannot be attributed to variations in the ability to recognise facial expressions, as scores on the Ekman 60 faces task were (a) at ceiling, and (b) not correlated with the numbers of errors for any of the categories. Nor were they correlated with measures of depression or anxiety. However, scores on the Ekman 60 faces task and total scores on the alexithymia questionnaire did show a significant negative correlation that remained in place even after taking measures of depression into account. Nevertheless, scores on the difficulty identifying feelings subscale of the TAS-20 were related to smaller

RM. Alexithymic individuals regularly report problems correctly identifying facial displays of emotion, and may have had even more problems with the images displayed in this study, specifically those in the forward condition. Indeed, also revealed was a significantly negative correlation between the number of errors and the scores on the difficulty naming emotions subscale of the TAS-20 measure. It is also worth mentioning that comorbid presentation of depression has no effect on emotion recognition deficits that are manifested in alexithymia (Pedrosa, Ridout, Kessler, Neuffer, Schoelin, Traue & Nickel, 2008).

The results of this study provide insight into the role that facial displays have in our everyday social interaction. First, implied motion can be perceived from a single static facial display of emotion. Our findings add to the emerging body of work in this area, which has traditionally used series of images to examine the RM effect. This shows that the idiosyncratic muscular trajectories specific to a particular facial display are encoded within a very short presentation period, and are subsequently used to facilitate recognition of that affect. The encoding of these trajectories may specifically assist the recognition of fear and happiness. Secondly, the experience of an emotion-specific implied motion effect is reduced by individual differences in alexithymia, and, in particular, the ability to identify one's own or another person's feelings. These findings, therefore, show that participants who may have problems identifying their own and others' feelings have a reduced ability to perceive facial-specific implied motion. Further work is needed to examine the role that implied motion may play in the experience of affect recognition in clinical groups, specifically in those who have shown to have deficits in correctly recognising salient social cues.

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