

# **NAMING EMOTIONS IN MOTION: ALEXITHYMIC TRAITS IMPACT THE PERCEPTION OF IMPLIED MOTION IN FACIAL DISPLAYS OF AFFECT**

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Something akin to motion perception occurs when actual motion is not present but implied. However, it is not known if the experience of implied motion occurs during the perception of static faces nor if the effect would vary for different facial expressions. To examine this, participants were presented with pairs of faces where successive expressions depicted either increasing emotional intensity or its diminution. Participants indicated if the second face in the pair was the same as, or different from, the first face shown. To measure general facial emotion recognition ability the Ekman 60 faces test was administered. As individual differences in depression, anxiety and alexithymia have been shown to influence face processing we measured these factors using the Hospital Anxiety and Depression scale (HADS) and the Toronto Alexithymia scale (TAS-20). As expected, participants were more likely to endorse the second face as being a match to the first when its expression implied forward motion compared to backwards motion. This effect was larger for happiness and fear and positively related to accuracy on the Ekman 60 faces task. The effect was not related to depression or anxiety but it was negatively related to scores on the difficulty identifying feelings subscale of the TAS-20, suggesting that individuals who have problems identifying their own and others' feelings experienced a reduction in implied motion. Observers process implied motion from some facial expressions of emotion but the experience is modified by the ability to recognise one's own feelings and those of others.

**Key words:** implied motion, facial expressions of emotion, alexithymia, representational momentum, affect perception

## 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 – a perceptual phenomenon that results in the fusion of aural, i.e., the sound of a simple phoneme /baa/ and a visual percept, i.e., a silent moving mouth uttering another phoneme /gaa/ to result in the sensation of a third, cognitively-generated or phantom percept, e.g., /daa/ (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 this effect. 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 unaware that they are watching a face

suggests 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, and 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 picture 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 its implied trajectory. Stimuli where motion is implying a forward direction tend to evoke greater memory distortion than those implying backward motion (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 (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 of a face being morphed from a neutral expression towards an emotional expression to observers who were

then asked to make a forced choice response 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 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 a neutral display towards an emotion, or relatively long sequences of static images, beginning with a neutral face and ending with a full display of 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 possible 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. Therefore, it is plausible that individual differences in the ability to recognise emotional expressions might influence the degree of implied motion that is experienced.

It is notable that individual differences in mood and personality have been shown to influence perception of facial emotion. 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 (Sonnyby-

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 (e.g., Bradley, Mogg, Falla, & Hamilton, 2010) have been reported. Such deficits were mediated by emotion intensity (improved accuracy for higher-intensity emotions) as well as the 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 differences in alexithymia, depression and/ or anxiety could influence the degree of implied emotion experienced on a facial RM task.

The aims of the current study were threefold: (i) to determine if an RM effect is evident from static images of faces, (ii) to determine if the perceived motion was influenced by the type of facial expression, and (iii) to determine if the RM effect was modified by individual differences in mood and/or alexithymia.

Participants were presented with pairs of faces, where the second face in each sequence was either identical (control, or match, condition) or featured a more intense (implied forward motion) or less intense emotional expression (implied backwards motion). It was expected that participants would make significantly more errors (saying the faces were the same when they were in fact different) in the forward condition compared to the backward condition, which would support the presence of implied motion. As motion may be more important for the perception of some emotions compared to others, it was expected that the RM effect would vary as a function of the type of emotional expression. Finally, we expected that the size of the RM effect would be related to scores on measures of depression, anxiety and alexithymia.

## 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

# FACE ONE

# FACE TWO

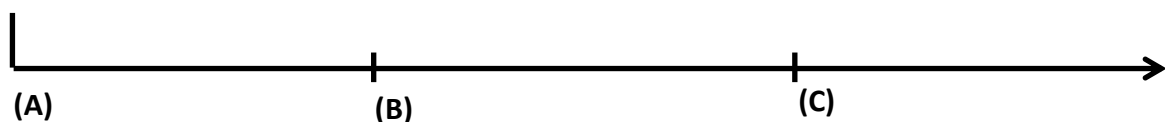


Figure 1: An overview of the RM paradigm used in the current study. Participants were first presented with a fixation cross on the screen (not shown) and then initiated each trial with a key-press which resulted in (A) the presentation of an image of a face depicting a facial expression at 100% intensity which was on the screen for 250 milliseconds (Face one). 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 (Face two). 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. Participants also completed a small practice session.

Participants were tested individually and were asked to complete the Hospital Anxiety and Depression scale (HADS; Zigmond & Snaith, 1983) and the Toronto Alexithymia Scale (TAS-20; Bagby, Parker & Taylor, 1994). Participants also completed a computerised emotion recognition task ('Ekman 60 Faces Task'; Young, Perrett, Calder, Sprengelmeyer & Ekman, 2002). This is a standard test of affect recognition which uses six basic emotions from the Ekman and Friesen (1976) series (anger, disgust, fear, happiness, sadness, and surprise) and neutral expressions to test participants' recognition of facial expressions of emotion. Single images that have been computer manipulated to depict different intensities of a specific affect are shown, and participants select which of the emotion labels shown below each face best describes the affect presented.

For the RM task, participants were presented with pairs of facial images on a computer screen that displayed a particular emotion. This first face was on the screen for a very short time only. They were then shown the second face and asked to indicate whether or not the second face was the same as, or different to, the first. Here, participants were also told that the identity of the face as well as the specific affect would be the same across both faces within each pair but that there may or may not be some difference in the affect between the two faces. 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). The dependent variables of interest were response time in milliseconds and the number of errors made. In forward and backward conditions, every instance when the second face in the pair was judged to be the same image as the first (when in fact it was different) was considered an error. In the match condition, instances when the second face in the pair was judged to be different from the first



was considered an error. The order in which the participants completed the Ekman 60 faces and RM face tasks were fully counterbalanced.

## RESULTS

### *Questionnaire measures*

Mean scores for the anxiety (Mean=6.94, SD=3.55) and the depression (Mean=2.89, SD=2.97) subscales of the HADS were within the normative ranges for healthy participants (Crawford, Henry, Crombie & Taylor, 2001). Total scores on the TAS-20 (Mean=45.76, SD=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, backward and match (control) conditions was carried out using a 3 (condition) x 6 (emotion) repeated measure ANOVA. This revealed a significant main effect of condition;  $F(1.63, 133.55)=361.19, p<.001, \eta^2_p=.82$  (Greenhouse-Geisser), such that participants made a greater number of errors in the forward (Mean=6.7, SD=1.8) vs the backward condition (Mean=4.11, SD=1.9),  $p<.001$ . Importantly, participants made significantly fewer errors in the match condition where the same image was presented in both instances (M=1.18, SD=.20) compared to either the forward or backward conditions; both tests  $p<.001$ . There was also a significant main effect of emotion;  $F(5, 410)=44.5, p<.001, \eta^2_p=.35$  as well as a significant condition-by-emotion interaction;  $F(8.24, 675.57)=23.94, p<.001, \eta^2_p=.23$  (Greenhouse-Geisser). 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  $p > .05$ .

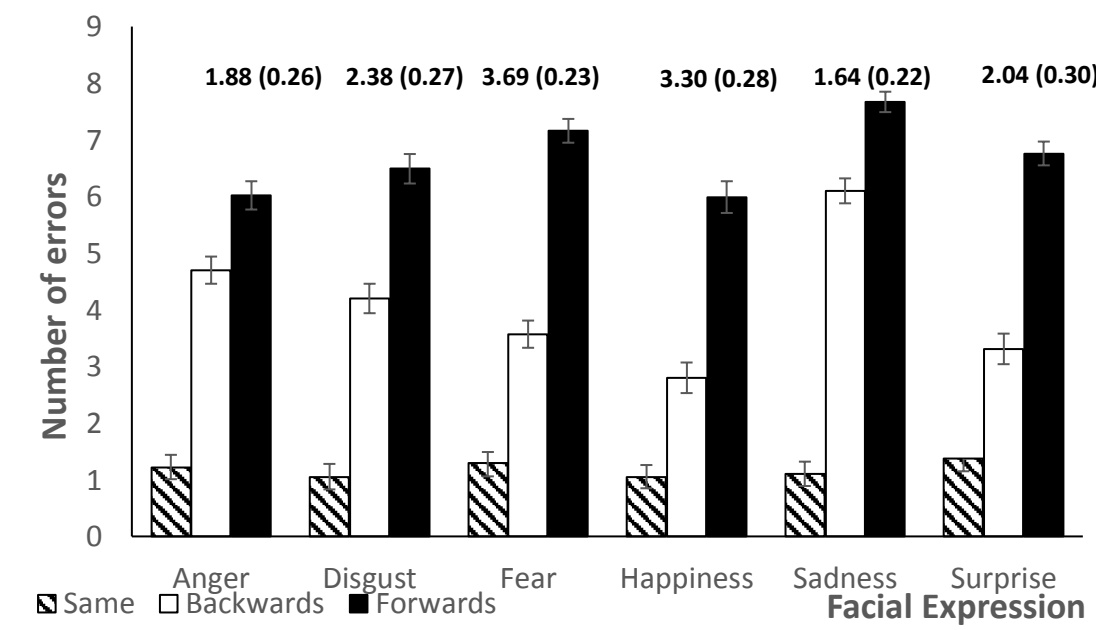


Figure 2: Bar chart showing the number of errors per affect for both the forward and backwards conditions. The black bars denote the errors for the forward conditions and here the error rates were significantly higher for displays of sadness than all other expressions, all tests  $p < .01$ , and significantly 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. Similarly, the comparison of the errors for the backward condition, as indicated by the white bars, again show that the greater number of errors was revealed for sadness and the error rates for happy faces was 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. The mean difference in errors and SD of that mean (Forward-backward) is shown above each of the affect categories. Also depicted by the thatched bars are the errors made for each expression for the matched condition where the same images was presented in both instances. Analysis of the response time data did not reveal a main effect of direction;  $F(1,79)=1.98$ ,  $p > .05$ , or emotion;  $F(4.36, 344.7)=1.40$ ,  $p > .05$  (Greenhouse Geisser) and no direction x emotion interaction,  $F(5, 395)=1.25$ ,  $p > .05$ .

### *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 may experience reduced RM for facial displays of affect. 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,  $r(75)=.38$ ,  $p<.01$ <sup>1</sup>. 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-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**

Our aims were to determine if an RM effect would be evident from static images of faces, if the effect would be influenced by the type of facial expression, and whether individual differences in mood and/or alexithymia would modify this experience. Our key finding was that, as expected, participants made a greater number of errors for

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

face pairs which implied forward motion, compared to those which implied backward motion - this is a stereotypical RM effect (see e.g., Freyd & Finke, 1984). This finding is also 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. 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.

Our findings revealed that the observed RM effect was larger when the faces showed happiness and fear, compared to the other emotions. This is consistent with previous work showing that fear and happiness hold a privileged position in our ability to recognise them (Öhman, Lundqvist & Esteves, 2001; Kirita & Endo, 1995). 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). However, 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 the others, so future work is needed to rule this out. 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 a 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.

The size of the RM effect was not related to depression or anxiety, but it was positively related to facial emotion recognition accuracy (score on the Ekman 60 faces task) and negatively related to self-reported difficulties in identifying one's own and others' feelings (scores on the '*difficulty identifying feelings*' subscale of the TAS-20). Both of these findings suggest that the likelihood that a participant would experience implied motion from the static faces was influenced by their ability to correctly recognise the emotion expressions of others, as those with good facial emotion ability experienced a larger RM effect and those with poorer ability (i.e., those with high alexithymia scores) experienced a smaller RM effect. It is plausible that the perceived motion may have been influenced by the extent to which the participants spontaneously imitated the initial expression, as those with good emotion recognition ability may have been more likely to mimic the expression, and those with higher alexithymia scores may be less likely to do so (Sonnby-Borgström, 2009). The experience of perceived motion, or lack of, from the faces may therefore be a consequence of movement, or lack of, engendered in the participants' own face. However, further work, e.g. using electromyography, is required to test this proposal.

Bearing in mind the early nature of the current findings there is an obvious need for replication. That said the results of this study provide some 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. Work exploring the nature of any response bias across different displays of affect would be informative. 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

In conclusion, our findings suggest that implied motion is perceived from static facial displays of emotion, and that this effect is stronger for expressions of fear and happiness compared to other emotions. Interestingly, this effect appears to be attenuated by an observer's ability or inability to recognise facial displays of emotion. However, this effect was not influenced by individual differences in depression or anxiety.

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