RES MEDICA
Journal of the Royal Medical Society

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Method : University of Edinburgh students were shown short exposures of faces showing emotional expressions (affective primes) ranging from 12.5 ms to 44 ms. This was followed by a mask and then a neutral face which they were asked to rate for likeability on a scale from 1 to 5. Their recognition of the emotional face was tested by a separate experiment at each exposure time.

Results: No affective priming effect was found either when there was no recognition of the affective prime above chance or when recognition was significantly above chance. However, the results do suggest that recognition of the polarity of emotion shown occurs before the recognition of the specific emotion.

Conclusion: This study does not support Murphy and Zajonc's (1993) affective priming hypothesis. The findings do suggest that the primary recognition of faces may be towards a positive/negative judgement with the identification of the specific emotion shown occurring later.

ISSN: 2051-7580 (Online) ISSN: ISSN 0482-3206 (Print)
Res Medica is published by the Royal Medical Society, 5/5 Bristo Square, Edinburgh, EH8 9AL

Res Medica, Summer 2003 : 9-15
doi:10.2218/resmedica.v0i0.1007

Is Affective Priming Possible?

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INTRODUCTION: This study is a replication of Murphy and Zajonc (1993), Jenner (2000), and Chalmers (2000) in order to test the affective priming hypothesis.
METHOD: University of Edinburgh students were shown short exposures of faces showing emotional expressions (affective primes) ranging from 12.5 ms to 44 ms. This was followed by a mask and then a neutral face which they were asked to rate for likeability on a scale from 1 to 5. Their recognition of the emotional face was tested by a separate experiment at each exposure time.
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CONCLUSION: This study does not support Murphy and Zajonc's (1993) affective priming hypothesis. The findings do suggest that the primary recognition of faces may be towards a positive/negative judgement with the identification of the specific emotion shown occurring later.

DUNCAN: There's no art
to find the mind's construction in the face.
Macbeth I iv

As King Duncan found out, the facial expression of an emotion is not so simple to interpret as it might seem. Even though 'emotion' is such a central concept to the human condition, it eludes precise definition.

What is an emotion?

William James (1884) answered this question by posing another: "Do we run from a bear because we are afraid or are we afraid because we run?" The first answer seems intuitively correct, but James' "thesis on the contrary [was] that the bodily changes follow directly on the perception of the exciting fact, and that our feeling of the same changes as they occur is the emotion" (James, 1884), i.e. we are afraid because we run away.

Furthermore James proposed that emotions were differentiated from each other by the physiological changes that 'caused' them. James' theory of emotion held a dominant position. until Cannon's (1927) claim that bodily changes in various emotions were not distinctive enough for James to be correct. However he did agree that it was the physiological changes that differentiated emotions from other states.

Following a dearth of research, the 1960s marked a period of change in the psychological attitude to emotions. Schachter and Singer (1962) synthesised James' and Cannon's theories and added a cognitive component. They suggested that the previously mentioned physiological changes result in a state of non-specific increased autonomic arousal. We then interpret this heightened arousal in the light of our situation *i.e.* social context, knowledge, and expectation. In effect they claim the emotional experience is a label given to a general physiological state which depends on a cognitive interpretation of the context the person finds themself in.

Schachter and Singer provided empirical evidence for their theory by injecting people with epinephrine and providing either pleasant, unpleasant or emotionally neutral situations, thus varying the mood reported by the participants.

Lazarus (1982, 1984) developed this school of thought and provided evidence that emotions are dependent on the unconscious appraisal (*i.e.* interpretation) given to them. He goes so far as to say that "appraisal is a necessary as well as sufficient cause of emotion" (Lazarus, 1991, p. 352). In order to support his point he showed a film of a gruesome circumcision ritual with a narrative which either played up or played down the disturbing content of the film. The commentary significantly affected the subjects' autonomic responses and self-reports afterwards, leading him to his conclusion about the importance of appraisal.

Fundamental feelings or cognition the King?

Appraisal is still a major component contemporary psychological theory of emotion. However Zajonc (1980) has tried to turn the tide of cognitive psychology's influence in emotion by proposing that emotion and cognition are independent.

He first put forward this idea in 1980 by publishing a "rather speculative article" (Zajonc, 1984, p. 117) entitled "Feeling and Thinking: Preferences Need No Inferences". In essence his main question was whether we can "like something or be afraid of it before we know precisely what it is" (Zajonc, 1980, p. 154).

The paper referred to a large amount of empirical evidence involving the *mere exposure effect*— the phenomenon that repeated exposure to a stimulus "enhances [one's] attitude toward it" (Zajonc, 1968, p. 1), *i.e.* mere exposure to something can create a preference for it. Importantly however, this effect is still observed if the stimuli are presented subliminally, *i.e.* unconsciously (Kunst-Wilson & Zajonc, 1980). The participants will still prefer the stimuli they have already seen to new ones but will not be able to consciously differentiate between the new and old stimuli. More recently Murphy and Zajonc (1993) have investigated the phenomenon of *affective priming*, where "positive and negative affective reactions can be evoked with minimal stimulus input and virtually no cognitive processing" (p. 723). They found that sub-optimal exposure to an affective prime (facial expressions) could bias subjects' judgement of a neutral stimulus (Chinese ideograms) presented afterwards. The subjects were unable to recognise which face they had seen when presented with the face and a foil.

That preferences can be formed without any conscious recognition of the stimulus leads Zajonc to the conclusion that the emotional judgements (preferences) were formed without the involvement of cognition- in effect that affect and cognition are separate and partially independent systems, citing neuroanatomical separation of affect and cognition in support of his theory.

The debate in the psychological literature between Lazarus and Zajonc is quite involved and slightly confusing. They both base their theories on different definitions of emotion and they both admit that neither position is disprovable: "...the question contested here cannot be fully resolved unless we have a full understanding of consciousness" (Zajonc, 1984, p. 118); "...at this stage of theory, knowledge and methods, Zajonc can no more prove that cognition is not present in any emotion, much less before it occurs, than I can prove it is present" (Lazarus, 1984, p. 126).

Surely a feasible hypothesis would be that affect is primary, i.e. preferences can be formed without the involvement of cognition, but they seldom are. This fits in with Zajonc's explanation and also with Lazarus' dual neural pathways (sub-cortical and indirect, via the cortex). If cognition (which would react after affect) contradicted the emotional reaction, the cognitive reaction would predominate, as Lazarus' gruesome film experiment suggests. In other words, they could both be correct.

How do our faces relate to our emotions?

There is not room here to discuss theories of why we express our emotions in our faces. However, cross-cultural data suggest that there is universal expression of a number of so-called basic emotions (e.g. Ekman and Friesen, 1971; Ekman, et al. 1987; Ekman, 1992a, 1992b). These basic emotions including at least happiness, anger, fear, surprise, sadness, and disgust (Ekman, 1984), though there is some discussion about exactly how many and which emotions should be included. Ekman (1992) uses 'basic' in terms of having a biological basis, as well as combining to form more complex emotions. He cites evidence of "different patterns of autonomic activity for the emotions of anger, fear, sadness and disgust" (p. 552), echoing James' original theory from 1884. He suggests that happiness or contempt wouldn't have distinct patterns of ANS activation because "it is unlikely that any specific pattern of motor activity [for such emotions] would have been relevant to survival. ... [However,] I do expect to find distinctive patterns of central nervous system activity marking each of the basic emotions" (p. 552).

A currently popular theory of the relation between emotions and facial expression is the *facial feedback hypothesis*— that "expressive behaviour plays a role in activating and regulating emotion experience" (Izard, 1990, p. 488). This idea dates back to Darwin (1872) ("even the simulation of an emotion tends to arouse it in our minds").

Where is emotion found in the brain?

An attempt has been made to describe the nature of emotions and their relation to cognition and an explanation of facial expressions of emotion has been touched on. Unfortunately there is not room for a thorough discussion of the neuroanatomical and neurophysiological findings regarding emotion. Therefore the discussion will be confined to two areas: the Papez circuit and recognition of disgust.

The most famous neural theory of emotion must be the Papez circuit (Papez, 1937). This derives from Broca's (1878) structural definition of 'le grand lobe limbique' (limbus = rim *(latin)*) and a distinction between the more primitive medial cortex and the lateral (neo-)cortex involved in thought processes and sensory/motor functions. The Papez circuit explains "the subjective experience of emotion in terms of the flow of emotion through a circle of anatomical connections from the hypothalamus to the medial cortex and back to the hypothalamus" (LeDoux, 1998, p. 87). Papez thought of the sensory inputs to the thalamus being split into a stream of thought and a stream of feeling.

The former was directed to the neocortex to form perceptions, thoughts, and memories and the latter was directed to the hypothalamus to form emotions. The cingulate cortex was where affective flavouring was thought to be given to everyday events.

MacLean (1949) took this model further and explained our frequent inability to adequately describe our emotions with the idea that the emotional 'visceral brain' and the 'word brain' used different languages. In 1952 he renamed the visceral brain the limbic system (harking back to Broca, 1878) to avoid confusion with the physiological concept of 'viscera'.

People with Huntington's disease or even merely the gene for it show impairments of emotion recognition with severe specific impairment of recognition of disgust (Sprengelmeyer et al., 1996; Gray et al., 1997). This differential impairment of different basic emotions (a similar situation occurs for fear with damage to the amygdala) gives weight to the theory that there are separate neural systems for the recognition of certain emotions.

Pathologically Huntington's disease is characterised by atrophy of the caudate nucleus and putamen (collectively, the striatum) and, to a lesser extent, the globus pallidus. There is also dilation of the lateral and third ventricles and frontal lobe atrophy (Cotran et al., 1999). This pathological data, along with the specific impaired recognition of disgust in those with Huntington's disease, implicates the basal ganglia and specifically the striatum in the recognition of disgust. Similarly impaired recognition of disgust is seen in obsessive compulsive disorder and Gilles de la Tourette's syndrome with co-morbid obsessive-compulsive behaviour (Sprengelmeyer et al., 1997) adds weight to the involvement of the fronto-striatal region in the mediation of disgust. Furthermore, fMRI studies have added even more support to the involvement of the striatum and the anterior insula in the recognition of disgust (Phillips et al., 1997; Phillips et al., 1998).

Method.

Participants

Twelve undergraduate students (8 female and 4 male in 12.5ms conditon or 7 female and 5 male in 25ms and 44ms conditions), mean age = 23.2 (12.5ms); 20.9 (25ms); 20.9 (44ms).

Materials and apparatus

Faces were from Ekman and Friesen's (1976) selection (Happy: PE, JB, JM, SW; Angry: EM, WF, NR, SW; Disgusted: JB, WF, JM, MO). Masking ideogram was constructed to provide optimal masking of the mouth and eyes of the primes. (Editor's note. To reproduce these would have infringed copyright. Instead, we took our own pictures. See figure 1).

Procedure

The participant was shown the twelve neutral faces in a random order preceded by a 12.5ms, 25ms, or 44ms exposure to an affective prime and a 30 ms ideogram mask. After each face the participant was asked to give a rating for how much they liked the face from 1 ('not at all') to 5 ('quite a bit'). They were asked to respond within the first few seconds of seeing the face. This was carried out on three separate occasions so that each face could be rated after priming with each emotion but the effect of the memory of seeing the same face earlier in the experiment would be minimised.

In each trial four of the faces followed happy primes, four followed angry primes and four followed disgusted primes. Each participant saw one of six arrangements of primes in relation to neutral faces (e.g. faces A to D primed with happy on one day, then angry, then disgusted or faces A to D primed with angry on one day, then happy, then disgusted etc.)

After each session the participant was shown exposures of the twelve primes (for an appropriate duration), each followed by the mask, and after each one asked to identify the emotion (out of happy, angry, or disgusted). This was to test recognition of the emotions of the primes.

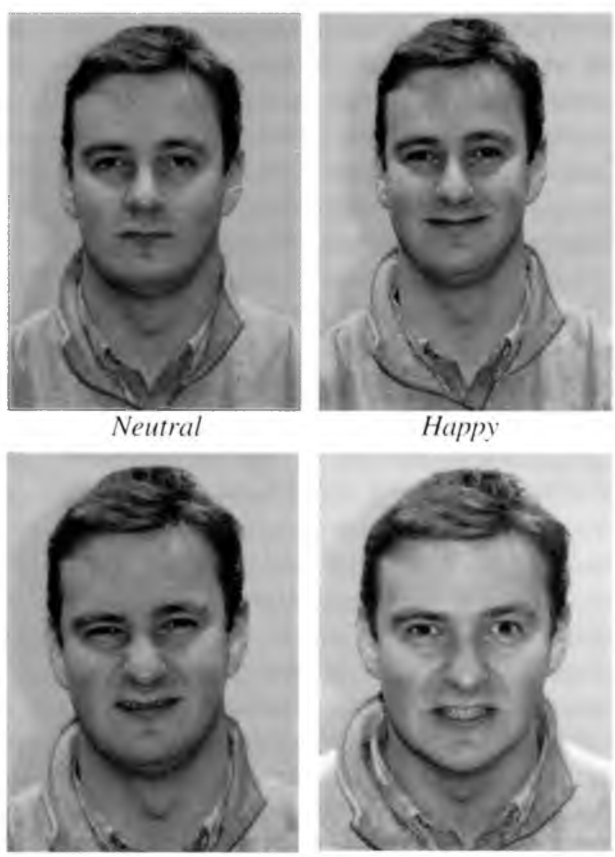
Results.

Figure 2 shows mean correct identification of specific emotions and emotion polarity (*i.e.* recognising angry or disgusted as 'negative'; happy was the only 'positive' emotion). At 12.5 ms exposure neither emotion nor polarity could be identified above chance. At 25 ms exposure happy and angry, but not disgust, and positive and negative polarity were recognised above chance. At 44 ms only happy and negative polarity for angry were recognised above chance.

Figure 3 shows the mean 'likeablilty' rating of a neutral face following affective primes at 12.5 ms exposure. As can be seen there is no significant difference between rating of the faces. In other words, no affective priming effect was seen.

Figure 4 shows the mean number of misidentifications of angry or disgusted (the negative emotions). At 12.5 ms there is no difference in misidentification to positive or negative, at 25 ms there is a significantly higher number of misidentifications to the other negative emotion for angry and disgusted. This remains at 44 ms for disgust, but not angry.

Figure 5 shows misidentification of happy primes. Again, at 12.5 ms, there is no difference in positive or negative misidentifications. At 25 and 44 ms there is a significantly lower misidentification to negative emotions.



PHOTOGRAPHER: ALASTAIR JARDINE

Disgusted *Angry*

Figure 1. Reconstructions of the images used.

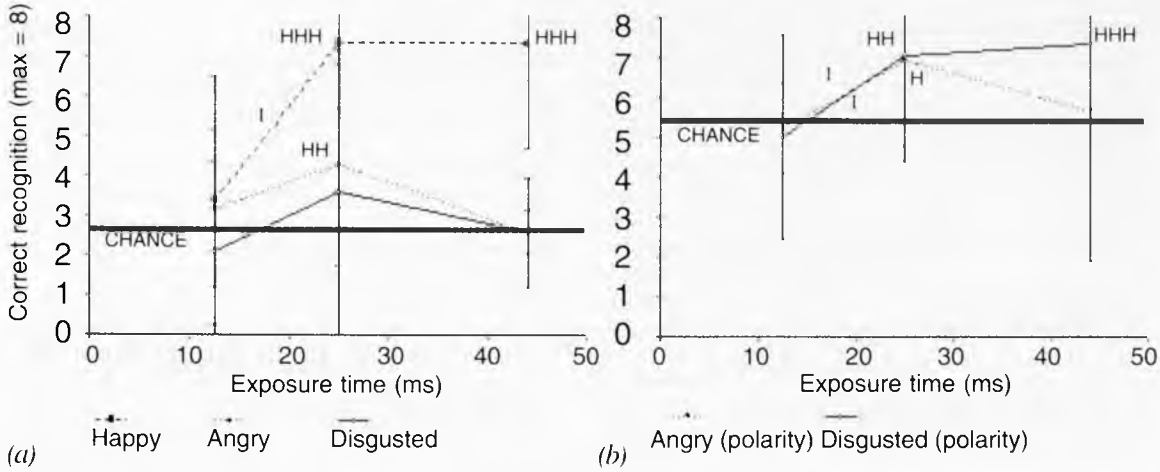


Figure 2 Mean correct recognition (± 2 SD) of individual emotions (a) and emotions categorised by polarity (b) at exposure times of 12.5, 25 and 44 ms. H = identification significantly above chance (H p < .05, HH p< .01, HHH p< .001). I = significant difference in identification between exposure times (I p< .05).

Discussion.

This study has found no evidence of affective priming with or without recognition of facial primes. Subliminal presentation of an affective stimulus before a neutral face failed to bias a judgement of likeability of the face.

Jenner (2000) and Chalmers (2000) found that happy was correctly identified by 29 ms exposure and anger and disgust were only correctly identified at 53 ms exposure. In the present study the results were not dissimilar: happy was correctly identified by 25 ms exposure and angry and disgust were not correctly identified above chance at 44 ms (the longest exposure time used), except for angry at 25 ms exposure (this identification was not evident at 44 ms). However the polarity of both angry and disgust were identified significantly above chance at 25 ms exposure and the polarity of disgust was correctly identified significantly above chance at 44 ms. Figure 2 summarises these findings.

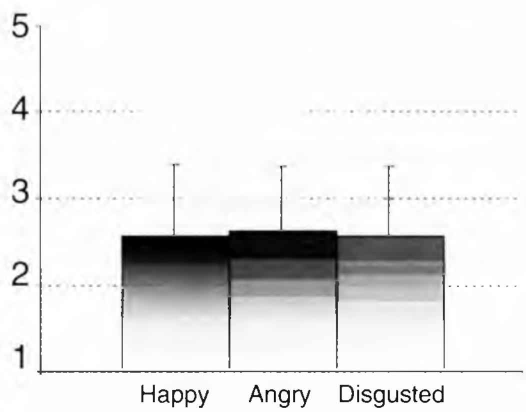


Figure 3. Mean rating of neutral face following affective primes (+ 2 SD). Rating was on a scale of 1 (don't like face at all) to 5 (like the face quite a bit).

It was noticed that angry primes were often mistaken for happy, possibly because of the bared teeth of half of the angry primes being mistaken for a smile. It is possible that the negative polarity in angry primes wasn't correctly identified at 44 ms because of this. Too little data in this experiment (12 subjects each identifying 12 primes) could possibly also play a part.

Furthermore, as the exposure time increases the number of errors which attribute the wrong polarity to disgusted primes decrease, leaving most of the errors to be errors of specific emotion but with the correct polarity being identified. At 12.5 ms exposure time there is no significant difference in the number of errors identifying the prime as the wrong polarity or the correct polarity for either angry or disgusted primes. By 25 ms exposure, the number of errors misidentifying the polarity of the emotion has decreased leaving a significant difference between misidentifications of the correct polarity and those of the wrong polarity. This continues at 44 ms exposure for disgusted primes but not for angry primes. Overall for angry primes there is no significant relationship between type of errors

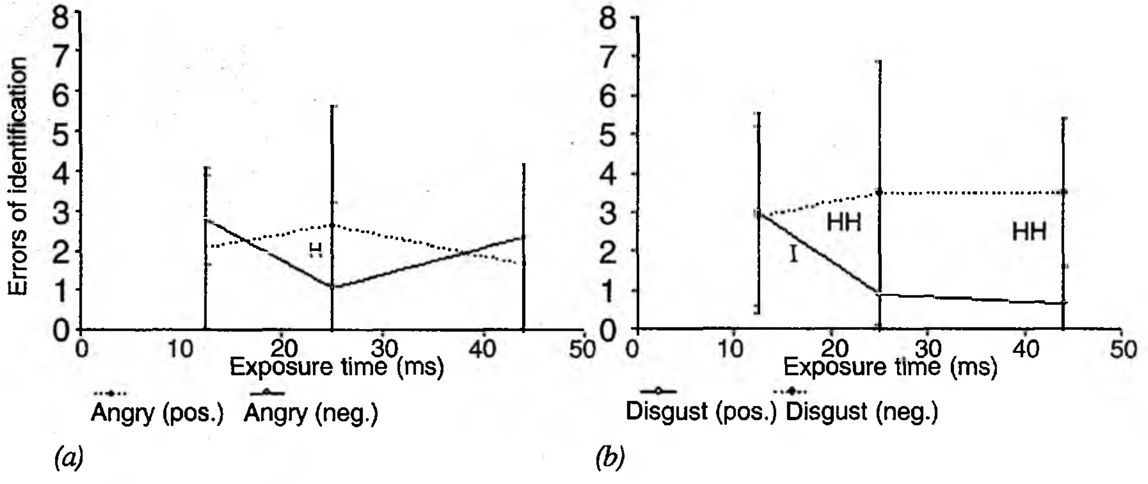


Figure 4 Mean number (± 2 SD) of misidentifications of angry (a) or disgusted (b). The polarity of the misattributed emotion is given in brackets. H = significant difference in identification between emotions (H p < .05, HH p < .01). I = significant difference in identification between exposure times (I p < .05).

and exposure time. These results are shown in Figure 4.

These findings, along with those for happy primes (Figure 5), suggest that the primary recognition of faces could be a positive/negative evaluation with recognition of the specific expression (happy, angry, or disgusted) coming in. at a longer exposure. The lack of such an effect for angry primes could be partly because of misrecognition of bared teeth as smiles, as mentioned above.

There are obviously weaknesses to this study, not least the number of subjects and the paucity of neutral faces available to rate (there are only 14 in the Ekman and Friesen (1976) series).

It would have been useful to analyse the rating of individual neutral faces when primed positively and negatively. Another positive emotion (*e.g.* surprise) would allow more useful comparisons of recognition of polarity.

In conclusion, this study does not support Murphy and Zajonc's (1993) findings and suggests that conscious exposure to affective primes, at least up to 44 ms, does not affect judgements of preference either. However it does suggest that recognition of polarity of emotion of a facial expression may occur before recognition of the specific emotion shown by the prime.

Acknowledgements.

I would very much like to thank my supervisor, Dr. T.K. Pitcairn, whose help was invaluable. I would also like to remember Richard Lazarus, a great psychologist, who died recently.

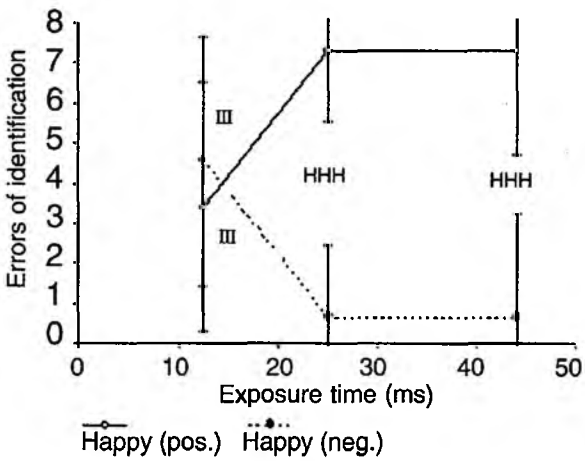


Figure 5. Mean number (± 2 SD) of misidentifications of happy primes. The polarity of the misattributed emotion is given in brackets. H = significant difference in identification between emotions(HHH p < .001). I = significant difference in identification between exposure times (III p < .001).

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