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# Facial expression recognition across the adult life span

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**Abstract**

We report three experiments investigating the recognition of emotion from facial expressions across the adult life span. Increasing age produced a progressive reduction in the recognition of fear and, to a lesser extent, anger. In contrast, older participants showed no reduction in recognition of disgust, rather there was some evidence of an improvement. The results are discussed in terms of studies from the neuropsychological and functional imaging literature that indicate that separate brain regions may underlie the emotions fear and disgust. We suggest that the dissociable effects found for fear and disgust are consistent with the differential effects of ageing on brain regions involved in these emotions.


*Keywords:* Fear; Disgust; Ageing; Emotion; Facial expression; Vocal expression; Amygdala; Insula; Basal ganglia

## 1. Introduction

It is well established that normal ageing causes a gradual decline in certain cognitive and perceptual functions [7,37], particularly the mental processes relating to so-called frontal tasks. These findings are generally attributed to neurological factors, such as the disproportionate effects of ageing on the prefrontal regions. The effects of ageing on emotion-related functions are less clear, and while this area has not been neglected, the majority of research has focused on the manner in which ageing affects the experience and regulation of emotion [21]. In general, these studies have found a reduction in the frequency of negative emotions expressed/experienced by older participants; in addition, some studies have also found corresponding increase for positive emotions. In the social cognition literature this is normally interpreted as an increased ability to regulate and control emotions with age. However, human emotional functioning does not only involve monitoring one's own emotional state, but also the emotions experienced by others. Consequently, it is important to examine the extent to which ageing affects the *recognition* of human signals of emotion.

On the basis of the social cognition research showing preserved, and even enhanced, experience and regulation of emotion in older participants, one might predict that recognition of emotion would show a similar benefit with age. Conversely, given the neurological decline associated with ageing, and its detrimental effects on certain aspects of cognition, it is possible that emotion recognition is adversely affected. As far as we are aware, however, few studies have investigated the recognition of facial expressions across different age groups of participants.

In one of these studies, Malatesta et al. [24] investigated the recognition of facial expressions of anger, fear and sadness, in three age groups of female participants—young (25–40 years), middle aged (45–60 years), and older (65–80 years). The results showed that the recognition of all three facial expressions decreased with increasing age. A second study, by Moreno et al. [26], contrasted the recognition of negative (sad and disgust) and positive (happy and surprise) facial expressions in female participants in similar age bands to those used by Malatesta et al. The results showed that, with increasing age, happiness improved slightly and sadness decreased slightly. The ceiling levels of recognition for disgust and surprise preclude clear interpretation of age effects for these expressions.

The general pattern that emerges from these studies is that recognition of certain facial expressions decreases with age, while the recognition of others remains relatively

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stable, or even improves. But exactly which facial expression categories are more affected than others is unclear because there is little consistency in the emotions tested. In addition, the fact that Moreno et al. [26] restricted their stimulus set to just four examples of each facial expression category makes it difficult to judge the effects of age on the recognition of the individual emotions.

At the time these two studies were conducted, the prevailing view in human neuropsychology was that all emotions were processed by a single integrated system. Consequently, less interest was shown in participants' recognition rates for individual emotion categories. Recent neuropsychological research, however, has highlighted the importance of assessing the recognition of the individual emotions effectively because it is now clear that damage to different neural regions can affect the recognition of certain emotions more than others (for a recent review see [10]. For example, bilateral amygdala damage impacts primarily on peoples' ability to recognise signals of fear and, to a lesser extent, anger [1,11,38,43]. In contrast, Huntington's disease, an autosomal genetic disorder that principally affects the striatal regions of the basal ganglia, can cause a disproportionately severe impairment in recognising disgust [16,41]. Similarly, Calder et al. [9] have recently reported a case-study of a patient who shows a highly selective deficit in recognising facial and vocal signals of disgust following damage to the left insula and basal ganglia. The above findings are supported by recent brain-imaging research showing that viewing facial expressions of fear engages the amygdala [5,27,44], whereas viewing facial signals of disgust produces increased signals in the insula and basal ganglia [33,34,40].

A clear message of these studies is that investigations of facial expression recognition should use tests that tap individual basic emotions. Consequently, our present study used tests that were originally used in a number of the neuropsychological studies discussed [6,9,23,41,42]. In an initial exploratory study (Experiment 1) we compared the recognition of facial affect in younger (20–30 years) and older (60–70 years) age groups. Experiments 2a and 2b provide detailed assessments of facial expression recognition across the full range of adult ages between 20–75 years.

## 2. Experiment 1

### 2.1. Method

#### 2.1.1. Participants

Forty-eight participants from the MRC Cognition and Brain Sciences Unit volunteer panel took part in the experiments for payment. Half ($n = 24$) of the participants were aged between 18 and 30 years (mean age = 25.00 years, S.D. = 3.84), and half were aged between 58 and 70 years (mean age = 65.08 years, S.D. = 3.84). Each age group contained equal numbers of men and women ($n = 12$). Participants in the two groups were matched for estimated IQ (NART-R) [30] (younger participants, mean IQ = 113.21, S.D. = 7.22; older participants, mean IQ = 114.08, S.D. = 10.49). A *t*-test comparison (equal variance not assumed) of the younger and older participants' IQ scores produced no significant difference ($P > 0.5$). All participants had normal or corrected-to-normal vision and no known neurological damage.

#### 2.1.2. Materials

Photographs of six facial expressions (happiness, sadness, anger, fear, disgust and surprise), posed by each of 10 models (six female, four male), were taken from Ekman and Friesen's [12] pictures of facial affect series; a total of 60 pictures. The 10 models were selected so that each emotion was well recognised in Ekman and Friesen's [12] norms.

#### 2.1.3. Design, and procedure

The faces were presented individually in random order on a computer monitor and participants were asked to select one of the six expression labels (listed above) that best described the emotional expression. The labels were visible throughout testing and participants were given as much time as they needed to make their selection. No feedback was given regarding the appropriateness of any response.

### 2.2. Results

Participants' mean correct recognition rates are summarised in Fig. 1. The correct recognition rates were submitted to an ANOVA with Greenhouse–Geisser corrections. The factors of interest were emotions tested anger, disgust, fear, happy, sad, and surprise; repeated measures), age group (younger and older participants; between subjects), and sex of participant (between subjects). The results of these analyses are described below. The results of the ANOVA showed a significant main effect of emotion, $F(3.6, 167) = 25.68$, $P < 0.0001$, qualified by a significant interaction between emotion and age group, $F(3.6, 167) = 8.73$, $P < 0.0001$. There was also a border-

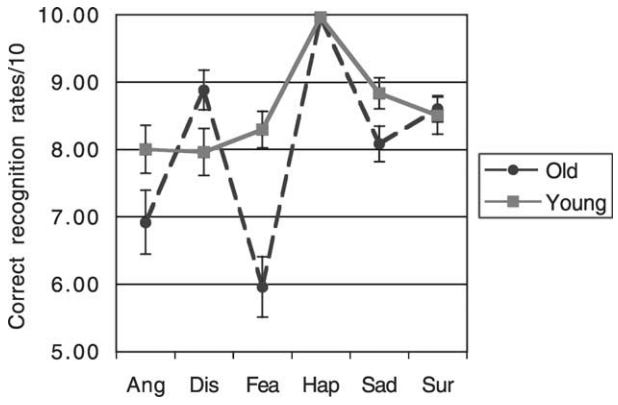


Fig. 1. From Experiment 1: younger and older participants' correct recognition rates for the Ekman 60 test of facial expression recognition [46]. Error bars show standard errors.