Neuropsychologia 93 (2016) 218–228

Contents lists available at ScienceDirect

Neuropsychologia

journal homepage: www.elsevier.com/locate/neuropsychologia

Elements of person knowledge: Episodic recollection helps us to identify people but not to recognize their faces

Graham MacKenzie*, David I. Donaldson

University of Stirling, UK

A R T I C L E I N F O

Keywords:
Person identification
Face recognition
Episodic memory
Recollection

A B S T R A C T

Faces automatically draw attention, allowing rapid assessments of personality and likely behaviour. How we respond to people is, however, highly dependent on whether we know who they are. According to face processing models person knowledge comes from an extended neural system that includes structures linked to episodic memory. Here we use scalp recorded brain signals to demonstrate the specific role of episodic memory processes during face processing. In two experiments we recorded Event-Related Potentials (ERPs) while participants made *identify*, *familiar* or *unknown* responses to famous faces. ERPs revealed neural signals previously associated with episodic recollection for *identify* but not *familiar* faces. These findings provide novel evidence suggesting that recollection is central to face processing, providing one source of person knowledge that can be used to moderate the initial impressions gleaned from the core neural system that supports face recognition.

1. Introduction

When we encounter somebody our response depends on whether we know who they are. Even unknown faces contain information that provides immediate clues to a range of characteristics, from trustworthiness (Fenske et al., 2005) to likely aggressiveness (Lefevre and Lewis, 2014). When we know a person, stored representations in long term memory are also activated, providing access to knowledge that may moderate immediate impressions. Whilst early models of face processing focussed predominantly on semantic memory as the source of person knowledge (e.g., Bruce and Young, 1986), more recent neuroanatomical accounts have highlighted the additional importance of episodic memory (Gobbini and Haxby, 2007). This merger of face processing and memory models leaves open an intriguing question – in what way does episodic memory contribute to person knowledge? To address this issue we present a study of person identification using a neural marker of episodic memory. Before outlining our study, we first briefly introduce the key elements of face processing models, the retrieval processes that support episodic memory and the brain signals that can be used to study them.

The experience of recognizing a face yet being unable to identify the person is relatively common and has stimulated theories of how person identification is achieved, in both face processing (Bruce and Young, 1986) and episodic memory (Mandler, 1980) fields. Common to both classes of model is the idea that recognition and identification are supported by distinct processes. Cognitive models of face perception (e.g., Breen et al., 2000; Bruce and Young, 1986; Burton et al., 1990) converge on the view that face recognition occurs when incoming sensory information is matched with a unique memory representation, and that person identification occurs when biographical information is retrieved. Complementary neuroanatomical models (Gobbini and Haxby, 2007; Haxby et al., 2000) describe a core system involved in analysis of visual appearance (supporting recognition) and an extended system involved in retrieval of person knowledge (supporting identification). Critically, the extended system also clearly implicates episodic memory as one element of person knowledge (see Ferreira et al. (2015) and Lundstrom et al. (2005)) along with semantic representations. What face processing models do not describe is precisely how episodic memory contributes to person knowledge.

Episodic memory models describe two retrieval processes: recollection and familiarity (Mandler, 1980; Jacoby and Dallas, 1981; Tulving, 1985; Yonelinas, 1994). Recollection involves recovery of contextual information present at encoding, while familiarity simply signals previous occurrence. These two retrieval process are dissociable on several grounds, including their differential sensitivity to experimental manipulations (see Yonelinas, 2002) and different forgetting patterns (Sadeh et al., 2016). The aim of the current investigation is to ask whether episodic memory contributes to person knowledge through recollection or familiarity. Importantly, both retrieval processes have been associated with distinct brain signals. Scalp recorded Event-

* Correspondence to: Psychology, Faculty of Natural Sciences, University of Stirling, Stirling FK9 4LA, UK.
E-mail address: graham.mackenzie@stir.ac.uk (G. MacKenzie).

http://dx.doi.org/10.1016/j.neuropsychologia.2016.11.001
Received 2 August 2016; Received in revised form 28 October 2016; Accepted 1 November 2016
Available online 02 November 2016

Related Potentials (ERPs) have been widely used to investigate the ability to discriminate between recently studied and non-studied stimuli. ERP findings provide strong evidence for dual-process models of recognition memory (Rugg and Curran, 2007). Studies using mainly lexical stimuli have identified ERP components for familiarity and recollection, the midfrontal and left parietal old/new effects, respectively. However, this standard model is challenged on two fronts from claims that the midfrontal effect actually reflects conceptual priming (Voss et al., 2010) and that recollection for unfamiliar faces elicits an anterior effect (MacKenzie and Donaldson, 2007, 2009; Galli and Otten, 2011). Importantly, the current investigation examines memory for famous faces, which have been shown to elicit the standard left parietal effect (Nie et al., 2014). In this context ERPs provide a robust means of measuring the contribution of episodic retrieval to performance. Furthermore, the high temporal resolution of ERPs can help to dissociate phenomena thought to occur in series, such as face recognition and person identification.

Two famous face identification experiments are described below. In each experiment, a series of faces was shown to participants, who designated each one as either familiar, identified or unknown. *Familiar* faces were recognized but could not be identified, while *identify* faces elicited retrieval of person-specific information, such as the person's name or occupation. These response options are inspired by Tulving's (1985) Remember/Know procedure, in which Remember and Know responses provide indices of recollection and familiarity, respectively. The Remember/Know procedure has been used to investigate whether semantic memories have autobiographical content in behavioural studies investigating famous names (Westmacott and Moscovitch, 2003) and famous faces (Damjanovic and Hanley, 2007). Here we use a modified version of Tulving's procedure, combined with ERP measures of retrieval processing, to identify how episodic retrieval processes (recollection and/or familiarity) support face recognition. According to the Gobbini and Haxby (2007) model, episodic memory supports person identification via the extended system but not face recognition via the core system. Thus, brain signals associated with episodic retrieval processes - recollection or familiarity - should be observed only for faces that are identified and not for faces that are recognized without being identified. The critical question is which of the two brain signals linked episodic retrieval will be observed.

2. Experiment 1

2.1. Materials and methods

The experimental design and procedures conform to the principals of the Declaration of Helsinki and were approved by the University of Stirling Psychology Ethics Committee. Twenty-eight right-handed participants reported having normal or corrected-to-normal vision, and received £5 per hour. The sample size was determined by consideration of typical sample sizes for recognition memory tasks using EEG reported in the literature. Data from 8 participants were discarded due either an insufficient number of responses in one or more experimental conditions or the contamination of EEG with artifacts. Data from the remaining 20 participants (13 females) with a mean age of 21 years (range: 18–31) were used to form the grand-average ERPs reported here.

Faces were shown on a 17″ LCD monitor; stimuli were presented and behavioural data were recorded with E-Prime (Psychology Software Tools; www.pstnet.com). Participants sat on a chair approximately one meter away from the monitor, with a button box on a desk in front of them. All faces were of famous people selected to be recognizable by a cohort of undergraduate students at the University of Stirling. These famous people included actors (e.g., Jennifer Aniston, Al Pacino), musicians (e.g., Kylie, David Bowie), politicians (e.g., Hillary Clinton, Alex Salmond), television personalities (e.g., Oprah, Terry Wogan) and members of the British Royal family. The full range of identities was chosen with the aim of capturing a spectrum from well-known to lesser-known people. Facial images were sourced from an internet image search. All images were cropped of hair and set against a black background, before being resized and positioned in the centre of the display. Faces subtended a maximum horizontal visual angle of 2° and a maximum vertical visual angle of 5°.

Greyscale images of 200 unique identities were presented as stimuli across 4 blocks of 50 faces. Each face appeared in the centre of the screen for 500 msec and was followed by a blank screen, during which participants made one of three responses: *identify, familiar*, or *unknown*. Participants were instructed to make an *identify* response if they recognized a face and could retrieve unambiguous person-specific information about the person (such as their name, or the name of a character they had played, or film they had starred in) that would be sufficient to identify them. A *familiar* response was required if a face was recognized but the person could not be identified; finally, an *unknown* response was required in cases where a face was not recognized. Following an *identify* response, a visual prompt asked the participant to identify the person verbally. Any trials where participants were unable to retrieve any information associated with the face were excluded from analysis. The experimenter pressed a button to initiate the next trial. In contrast, following a *familiar* or an *unknown* response the participant's button press initiated the next trial.

EEG was recorded from 62 electrodes embedded in an elasticized cap (Neuromedical Supplies: http://www.neuro.com). Electrode positions were based on the extended International 10–20 system (Jasper, 1958). All channels were referenced to an electrode positioned between CZ and CPZ; two further electrodes were placed on the mastoid processes. Muscle activity associated with blinking and eye movements was recorded from electrodes placed above and below the left eye and on the temples. Data were recorded and analyzed using Scan 4.3 software (http://www.neuro.com). Impedances were below 5 kΩ before recording commenced. The data were band pass filtered between 0.1 and 40 Hz and sampled every 4 msec. EEG was segmented into 1100msec epochs, including a 100 msec pre-stimulus interval. Epochs were time-locked to stimulus onset rather than to participant response due to interest in access to memory representations instead of decision processes or motor preparation. Response time differences across conditions in recognition memory research are more likely to be due to decision processes than to any delay in accessing mnemonic information (Dewhurst et al., 2006). Stimulus-locked ERPs therefore permit scrutiny of how the processing of stimuli might differ and can be interpreted in light of any response time variation across experimental conditions. Blink artifacts were removed using a regression procedure (Semlitsch et al., 1986), and voltages were baseline corrected by subtracting the mean voltage from the pre-stimulus interval from each point in the epoch. Trials were excluded from averaging if drift exceeded ± 50 μV (measured by the difference between the first and last data points in the epoch) or where activity in any of the EEG channels at any point during the epoch exceeded ± 100 μV. Data were re-referenced off-line to recreate an average mastoid reference. Waveforms were smoothed over a 5-point kernel. To enhance the signal-to-noise ratio, a minimum of 16 artifact-free trials per condition was set as a criterion before an individual participant's data were included in grand-average ERPs.

Grand-average waveforms were quantified by computing the mean amplitude in two consecutive latency periods: from 300 to 500 msec and 500 to 800 msec. Data were initially analyzed using three-way repeated-measures ANOVA with factors of condition (*familiar/identify/unknown*), location (frontal/parietal) and hemisphere (left/right) before planned comparisons between *familiar/unknown* and *identify/familiar* were performed separately. The ANOVA model restricted electrode factors to two levels to avoid potential breaches of sphericity (see Dien and Santuzzi (2005)). The specific electrodes used for analysis were: F3, F4, P3 and P4. Only main effects and interactions