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ERP and fMRI effects of lag on priming for familiar and unfamiliar faces

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Introduction

There are reasons to believe that repetition of stimuli has qualitatively different effects when repetition is immediate than when it occurs after multiple intervening stimuli. For example, behavioural priming has been found for both familiar and unfamiliar faces when repeated immediately, but only for familiar faces when repeated after a delay [1]. Neural evidence for this qualitative difference across lags is less clear however. The N250r, an ERP correlate of face repetition, is only found for repetition after short lags, and is generally bigger for repetition of familiar than unfamiliar faces [2], though the interaction between lag and familiarity has not be tested explicitly in a task orthogonal to face familiarity. We consistently find greater reductions in the fusiform fMRI response associated with repetition of familiar than unfamiliar faces, but have not tested this interaction at short lags [3]. The present experiment was a 2x2x2 design with factors of lag (immediate vs. delayed by at least 90 intervening faces), familiarity (familiar vs. unfamiliar faces) and repetition (repeat vs control) during sex-decisions to a continuous stream of faces conducted on two separate groups of subjects under either EEG or fMRI.

Methods

16 participants in the EEG group and 11 in fMRI group provided adequate data. Immediate repetition involved a SOA of 2.4s with no intervening stimuli; delayed repetition involved at least 90 intervening stimuli (over 3 minutes gap). Faces were either famous or novel, with familiar/unfamiliar defined for individual participants by correct decisions during a debriefing session. Each face Repeat was paired with a randomly selected non-repeated Control, balanced for time. EEG was recorded from 31 scalp sites in Falk Minow Easycap "montage 10" and subsequently re-referenced to average of left and right mastoids. Blinks were corrected and other artifacts rejected. Mean ERP amplitude during selected timewindows were analysed with ANOVAs including electrode as a factor. fMRI was recorded on a 2T Siemens VISION scanner using EPI. Contrasts of the repetition effect (Controls – Repeats) using a canonical haemodynamic response function were entered into a random effects analysis, implementing ANOVAs at each voxel, and the resulting SPMs thresholded at $p<.001$ uncorrected.

Results

The behavioural data showed reliable priming of sex-decision reaction times for immediate repetition (120+/-12ms and 117+/-11ms for unfamiliar and familiar faces respectively) but not delayed repetition (-1+/-10ms and 11+/-10ms respectively, unlike [3]). The earliest repetition effect in the ERP data was between 250 and 350ms poststimulus, with a central positivity / lateral occipitotemporal negativity for Repeats (the N250r), which was reliable for immediate but not delayed repetition (Fig 1). Unlike [2], and despite a trend at temporal sites, there was no reliable evidence of a greater N250r for immediate repetition of familiar than unfamiliar faces, possibly reflecting our use of an orthogonal task. There was also a later, repetition-related parietocentral effect between 400 and 600ms that was reliable for delayed repetition (and immediate repetition, though of different polarity), and for both familiar and unfamiliar faces, replicating [3] (Fig 2). The fMRI data showed regions in left middle (-45 -51 -18) and right middle (+45 -42 -27) and anterior (+36 -33 -30) fusiform cortex with greater repetition-related reductions for immediate than long lags (Fig 3). None of these regions showed a significant interaction with familiarity however (even at a more liberal threshold of $p<.05$). Given our previous findings [3] of a familiarity effect on repetition-related responses at long lags, we tested long lags alone and replicated a greater repetition-related reduction for familiar than unfamiliar faces in a slightly more dorsal right middle fusiform region (+48 -45 -18; Fig 4). The same region however showed greater reductions under immediate repetition that appeared comparable in size for familiar and unfamiliar faces; a pattern much like the other fusiform regions.

Conclusion

While we clearly found greater effects for immediate than delayed repetition of faces, we failed to find reliable evidence for a qualitative difference between these effects in terms of an interaction with familiarity, in any of the behavioural, ERP or fMRI data. Thus, contrary to expectations, lag may have quantitative rather than qualitative effects on priming. Having said this, there were trends for a familiarity-by-lag interaction at selected electrodes (Fig 1) and selected parts of fusiform cortex (Fig 4), suggesting that a more powerful design may give better evidence for qualitative effects of lag.

References

1. Bentin & Moscovitch, 1988, Journal Experimental Psychology: General.
2. Schweinberger et al, 1995, Journal Experimental Psychology: Learning, Memory & Cognition.
3. Henson et al., 2003, Cerebral Cortex.

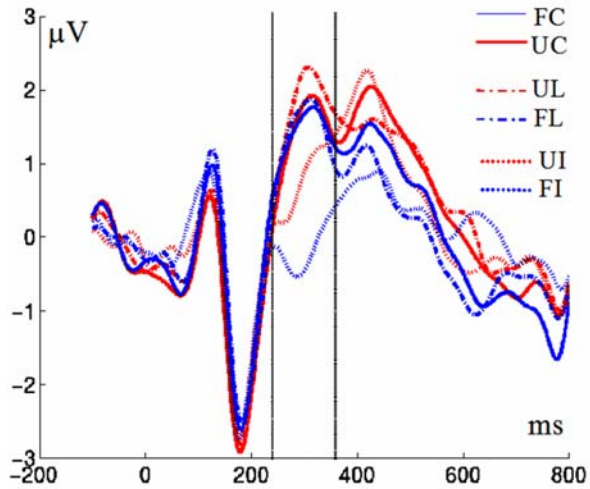

Fig 1. ERPs at Site 40

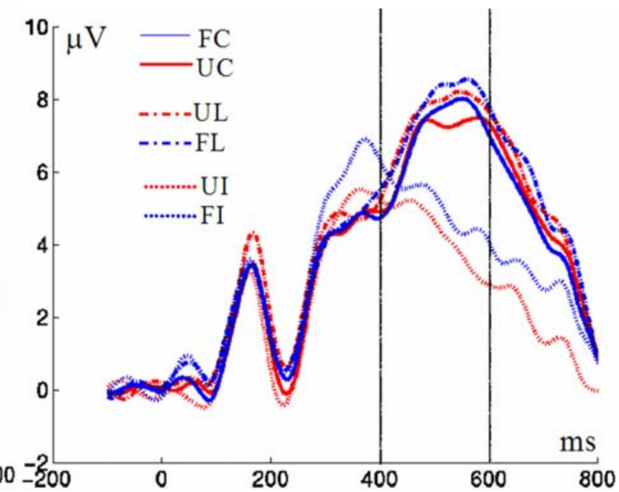

Fig 2. ERPs at Site Pz

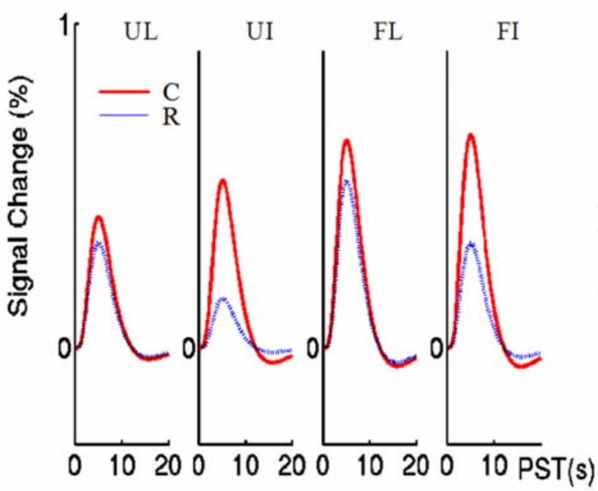

Fig 3. fMRI signal in right anterior fusiform

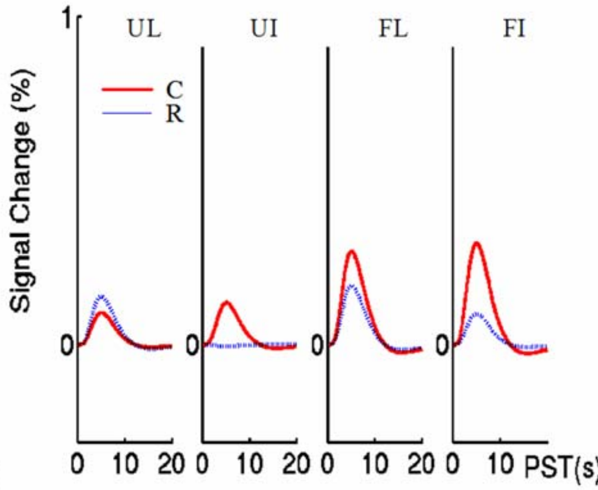

Fig 4. fMRI signal in right middle fusiform