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Effects of attractiveness on face memory separated from distinctiveness: Evidence from event-related brain potentials

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ABSTRACT

The present study examined effects of attractiveness on behavioral and event-related potential (ERP) correlates of face memory. Extending previous reports, we controlled for potential moderating effects of distinctiveness, a variable known to affect memory. Attractive and unattractive faces were selected on the basis of a rating study, and were matched for distinctiveness. In a subsequent recognition memory experiment, we found more accurate memory for unattractive relative to attractive faces. Additionally, an attractiveness effect in the early posterior negativity (EPN) during learning, with larger amplitudes for attractive than unattractive faces, correlated significantly with the magnitude of the memory advantage for unattractive faces at test. These findings establish a contribution of attractiveness to face memory over and above the well-known effect of distinctiveness. Additionally, as the EPN is typically enhanced for affective stimuli, our ERP results imply that the processing of emotionally relevant attractive faces during learning may hamper their encoding into memory.

1. Introduction

Attractive people profit from multiple advantages in social interactions due to their appealing looks. For instance, attractive children achieve both better marks and more attention in class (Lerner & Lerner, 1977), and as adults, beautiful individuals are more successful in their professions and are helped more readily in dire situations (Benson, Karabenick, & Lerner, 1976; Harrell, 1978; Mims, Hartnett, & Nay, 1975). Whereas attractiveness is thus usually considered a highly desirable attribute, it is largely unclear whether attractive people are also particularly memorable.

A number of studies examined memory for attractive and unattractive faces, with rather discrepant results. Several studies reported more accurate memory for attractive relative to unattractive faces (Cross, Cross, & Daly, 1971; Marzi & Viggiano, 2010; Zhang et al., 2011), whereas others either found the opposite pattern (Light, Hollander, & Kayra-Stuart, 1981; Sarno & Alley, 1997), or no difference in memory (Brigham, 1990; Wickham & Morris, 2003). We considered that this inconsistency may be partly related to other facial characteristics which were not systematically controlled in previous research. A particularly important characteristic in this context is distinctiveness. Highly distinctive faces strongly deviate from an average or prototypical face, as they, for instance, contain unusually sized or shaped facial features (such as particularly small eyes), or unusual facial texture or coloration. By contrast, less distinctive or typical faces are perceptually closer to the prototype. Importantly, it is well known that distinctive faces are remembered particularly well (e.g., Valentine, 1991), such that more accurate memory for either attractive or unattractive faces in previous studies may have been influenced by differences in distinctiveness in the respective sets of faces.

Most theoretical accounts on facial attractiveness suggest a systematic relationship to distinctiveness. The direction of this relation, however, is a matter of scientific debate. Initially, it had been suggested that attractive faces are ‘average’, and thus typical rather than distinctive. This suggestion is supported by results indicating that an average face, created by merging a number of individual faces into a single face morph, is typically rated as more attractive than the individual faces that constitute the morph (Langlois & Roggman, 1990). Averageness per se, however, cannot fully explain why certain faces are judged as more attractive than others. For instance, DeBruine, Jones, Unger, Little, and Feinberg (2007) demonstrated that a morph across highly attractive faces was rated as more attractive than a morph across randomly chosen faces. In addition, systematic deviations from the average towards increased sexual dimorphisms (such as pronounced cheek bones in male faces) are perceived as more attractive than average characteristics (Perrett et al., 1998). Recently, it has been reported

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that averageness is attractive in some dimensions (especially those related to shape information) but not in others (particularly those related to reflectance information; Said & Todorov, 2011). In sum, it seems justified to conclude that distinctiveness (or averageness) explains variance in attractiveness ratings, and thus may affect memory differences between attractive and unattractive faces. Critically, the main question for the present study was whether and how attractiveness modulates face memory, even when distinctiveness is held constant for attractive and unattractive faces.

Distinctiveness is traditionally measured with so-called face-in-the-crowd (FITC) ratings, in which participants indicate how likely they would spot a given face in a crowd of people (e.g., Valentine & Endo, 1992). This measure, however, may not be ideal in the present context, as attractiveness potentially biases such ratings, i.e., participants may have a tendency to indicate a high probability of detecting a face in a crowd because it is attractive, independent of whether the face is typical or distinct ('I would notice such a beautiful person'). Deviation measures have therefore been introduced as an alternative to assess distinctiveness (Wickham & Morris, 2003). Here, participants rate how strongly a face deviates from typical or average familiar faces. We considered that these two measures of distinctiveness might only partially relate to the same construct, and would not necessarily relate to attractiveness in the same manner.

Apart from distinctiveness, other factors may also influence memory for attractive versus unattractive faces. For instance, a recent socio-cognitive account suggests that participants' motivation to individuate faces affects memory (Hugenberg, Young, Bernstein, & Sacco, 2010). In support of this, participants have been reported to more accurately recognize faces randomly assigned to their own university, compared to faces assigned to a different university (Bernstein, Young, & Hugenberg, 2007), a finding which was thought to reflect the higher motivation to individualize social in- relative to out-group faces. Of relevance, it has been reported that attractive faces are more likely categorized as belonging to the viewer's social in- rather than out-group (Johnson, 1981), and that participants are more motivated to view attractive faces (Aharon et al., 2001). Accordingly, socio-cognitive accounts would predict more accurate memory for attractive relative to unattractive faces, an effect which should be more likely detected if other contributing factors such as distinctiveness are controlled for.

Importantly, behavioral measures of recognition memory only depict the outcome of a cascade of cognitive sub-processes. By contrast, the analysis of event-related potentials (ERPs) allows investigating neural correlates of these processes as they unfold over time, and by inference to identify the underlying cognitive or affective mechanisms. The first component typically examined in face processing studies is the P1, a positive peak at occipital sites occurring approximately 100 ms post stimulus presentation. This component is sensitive to physical stimulus characteristics, such as luminance or contrast (Luck, 2005), and may thus reflect early stages of visual processing.

The following occipito-temporal N170 (Bentin, Allison, Puce, Perez, & McCarthy, 1996), a negative peak at approximately 170 ms, is typically larger for face stimuli relative to other object classes (see e.g., Eimer, 2011). It is commonly assumed to reflect structural face encoding (Eimer, 2000) or the detection of a face-like pattern in the visual field (Amihai, Deouell, & Bentin, 2011; Schweinberger & Burton, 2003). Previous reports of attractiveness effects on the N170 are inconsistent, with some studies reporting larger N170 to unattractive faces (experiment 2 in Halit, de Haan, & Johnson, 2000), others reporting larger amplitudes to attractive faces (Marzi & Viggiano, 2010), and still others reporting no difference (Roye, Höfel, & Jacobsen, 2008; Schacht, Werheid, & Sommer, 2008).

Subsequent to N170, a positive occipito-temporal peak is observed at approximately 220–250 ms. This P2 has been interpreted to reflect the processing of metric distances between facial features (e.g., Latinus & Taylor, 2006) or the perceived typicality of a face (e.g., Wiese, Kaufmann, & Schweinberger, in press), and is modulated by an observer's expertise with a specific facial category (Stahl, Wiese, & Schweinberger, 2008). Interestingly, a number of recent studies found smaller P2 components for naturally distinctive relative to more typical faces (Schulz, Kaufmann, Kurt, & Schweinberger, 2012), as well as for spatial caricatures relative to veridical faces (Kaufmann & Schweinberger, 2012; Schulz, Kaufmann, Walther, & Schweinberger, 2012). To the best of our knowledge, no previous study examined attractiveness effects on P2 using natural faces (though Halit et al. (2000, experiment 1), report a smaller P2 for unattractive faces with artificially increased distances between features).

The following negative wave, the N250, is known to be larger for learned relative to novel facial identities (Kaufmann, Schweinberger, & Burton, 2009; Tanaka, Curran, Porterfield, & Collins, 2006). Previous recognition memory studies observed stronger memory effects in the N250 time range for specific categories of faces, for instance for young relative to old faces in young participants (e.g., Wiese, Schweinberger, & Hansen, 2008). Moreover, distinctive faces have been reported to elicit larger N250 amplitudes than typical faces (Schulz, Kaufmann, Kurt et al., 2012; Schulz, Kaufmann, Walther et al., 2012). Importantly, previous studies also reported more negative amplitudes for attractive relative to unattractive faces in the so-called early posterior negativity (EPN; e.g., Werheid, Schacht, & Sommer, 2007). EPN is typically interpreted as reflecting enhanced perceptual processing of affective stimuli, and has been found to be larger for emotional relative to neutral faces (Rellecke, Sommer, & Schacht, 2012; Schupp et al., 2004) and for affective relative to neutral pictures (Schupp et al., 2007). The N250 and EPN originate from different research traditions, and may therefore be assumed to reflect different processes. However, they substantially overlap with respect to timing and scalp topography, which may complicate an unequivocal interpretation of a given ERP effect as reflecting an N250 or EPN in this time range. For the present study, it was of particular interest whether or not any larger N250/EPN amplitudes for attractive faces in previous studies were related to enhanced distinctiveness.

Finally, a late posterior component (LPC) typically occurs at centro-parietal scalp sites and is maximal between 300 and 700 ms. The LPC has been observed to be larger for affective than neutral pictures (Schupp et al., 2007), for emotional than neutral facial expressions (Schacht et al., 2008; Schupp et al., 2004), and for distinctive than typical faces (Schulz, Kaufmann, Kurt et al., 2012; Schulz, Kaufmann, Walther et al., 2012). The LPC has been interpreted as reflecting an engagement towards motivationally significant stimuli (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000), and has also been shown to be larger for attractive relative to unattractive faces (Schacht et al., 2008; Werheid et al., 2007). Importantly, ERP effects of episodic memory occur in a similar time range. These so-called old/new effects reflect more positive amplitudes for correctly remembered learned (i.e., hits) relative to correctly rejected new items (i.e., correct rejections) and are commonly subdivided into an earlier frontal (300–500 ms) and a later more posterior effect (500–700 ms; see e.g., Rugg & Curran, 2007). While most researchers agree that the later old/new effect reflects recollection, i.e., the conscious retrieval of study phase detail, the exact processes reflected by the earlier effect are still debated (e.g., Curran, 2000; Paller, Voss, & Boehm, 2007). Of particular interest, Marzi and Viggiano (2010) found an early old/new effect for attractive but not for unattractive faces, which they interpreted as enhanced familiarity-based recognition, i.e., a stronger feeling of knowing for attractive faces.