You are that smiling guy I met at the party! Socially positive signals foster memory for identities and contexts

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ABSTRACT

The emotional influence of facial expressions on memory is well-known whereas the influence of emotional contextual information on memory for emotional faces is yet to be extensively explored. This study investigated the interplay between facial expression and the emotional surrounding context in affecting both memory for identities (item memory) and memory for associative backgrounds (source memory).

At the encoding fearful and happy faces were presented embedded in fear or happy scenes (i.e.: fearful faces in fear-scenes, happy faces in happy-scenes, fearful faces in happy-scenes and happy faces in fear-scenes) and participants were asked to judge the emotional congruency of the face-scene compounds (i.e. fearful faces in fear-scenes and happy faces in happy-scenes were congruent compounds).

In the recognition phase, the old faces were intermixed with the new ones: all the faces were presented isolated with a neutral expression. Participants were requested to indicate whether each face had been previously presented (item memory). Then, for each old face the memory for the scene originally compounded with the face was tested by a three alternative forced choice recognition task (source memory).

The results evidenced that face identity memory is differently modulated by the valence in congruent face-context compounds with better identity recognition (item memory) for happy faces encoded in happy-scenarios. Moreover, also the memory for the surrounding context (source memory) benefits from the association with a smiling face. Our findings highlight that socially positive signals conveyed by smiling faces may prompt memory for identity and context.

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1. Introduction

After a first encounter with a stranger our cognitive system encodes facial identity, feelings and intentions of that person. Our future approaches will depend on that first interaction and whether or not the person's reaction was happy or fearful at that first meeting. In keeping with this the first emotional impressions may influence, by enhancing or impairing, face recognition memory (D'Argembeau & Van der Linden, 2007; D'Argembeau, Van der Linden, Comblain, & Etienne, 2003; Shimamura, Ross, & Bennett, 2006; Righi, Marzi, Toscani, Baldassi, Ottonello & Viggiano, 2012; Righi, Marzi, Orlando, & Viggiano, 2013) coinciding with the activation of different brain regions when faces were remembered as foes rather than friends (LaBar & Cabeza, 2006; Vrticka, Andersson, Sander, & Vuilleumier, 2009). So far, the research has produced mixed results regarding the effect of specific emotional expressions on memory. On the one hand, the social relevance of smiling faces may facilitate memory through the enhancement

of neural activity of brain regions associated with reward (such as the orbitofrontal cortex) (Tsukiura & Cabeza, 2008). On the other hand, negative emotions, such as anger or fear, may enhance face encoding (Fox, Russo, Bowles, & Dutton, 2001; Sergerie, Lepage, & Armony, 2007) in agreement with the sociobiological perspective that considers the ability to remember fearful or threatening expressions highly advantageous for survival. However, an important remark is that in everyday life faces are seldom memorized isolated and detached from a surrounding context. Hence, if we take into account the associative nature of "real life" episodic memory, a further aspect to consider is the influence of contextual information on memory for emotional faces. This is a crucial topic also considering that recent studies showed that the categorization of facial expressions is systematically influenced by the context (Avizier, Dudarev, Bentin, & Hassin, 2011; Barrett & Kensinger, 2010; de Gelder, 2006; Righart & de Gelder, 2008a, 2008b; Van den Stock & de Gelder, 2014; Van den Stock, Righart, & de Gelder, 2007; Van den Stock, Vandenbulcke, Sinke, Goebel, & de Gelder, 2014; Wieser & Brosch, 2012). We can think of the influence that an incongruent emotional context (e.g. attending funeral) can have on the categorization of a particular face expression (e.g. a happy face). More specifically, some authors (Avizier et al., 2011; de Gelder, 2006; Van den Stock et al., 2007; Righart & de Gelder, 2008a, see Wieser &

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Brosch, 2012) found that an incongruent emotional context (such as a body expressing an incongruent emotion) may alter the recognition of emotions from prototypical facial expressions. In particular, facial expressions were faster recognized when embedded in congruent emotional scenes and, consistently, the errors in expression recognition were biased toward the emotional context that accompanies the facial expression (Righart & de Gelder, 2008a, 2008b; Van den Stock et al., 2007). This raises many questions about how and to what extent the interplay between emotional context and face expression can affect the encoding of face identity. The contextual effects on recognition memory have been investigated mainly considering neutral faces. In this vein, it has been recently evidenced that neutral faces encoded in emotionally arousing contexts are less well recognized than those encoded in neutral contexts (Van den Stock & de Gelder, 2012). This detrimental influence of arousing information on memory for neutral items is called "trade-off effect" (or weapon-focus effect) (Kensinger, Garoff-Eaton, & Schacter, 2007; Murray & Kensinger, 2013). This effect implies that negative affect, particularly if threat-related, may narrow the attentional focus yielding both better encoding for emotionally salient events and impaired source memory for neutral contextual details (Kensinger, 2009). A typical case is when in a robbery people are more apt at remembering the weapon in much detail rather than other contextual details (i.e. how the robber was dressed). However the effects of emotions on neutral information may be more complex and in some cases emotional information may indeed enhance memory encoding for neutral stimuli. This benefic effect is called "unitization" and indicates that when the emotional and neutral features are strictly related the arousing items may benefit memory for neutral contextual details (Murray & Kensinger, 2013). For example, this happens when there is a strong memory binding of features such as perceptual detail, color, or location to the item (e.g., the item "shirt" and the color "blue" are encoded as a "blue shirt"; Diana, Yonelinas, & Ranganath, 2008, Diana, VandenBoom, Yonelinas, & Ranganath, 2011; Yonelinas, 2002).

When considering the emotional memory studies on contextual effects an important remark is that most of them focused on the associative binding of emotionally arousing and neutral objects and contexts (Mather & Sutherland, 2011; Murray & Kensinger, 2013). To date, little attention has been paid to how arousing information that differs for valence may influence memory. Specifically, an open question is whether and to what extent face expression and emotional context may interact in influencing memory for face identity. The main aim of the present work was to address this issue unveiling the effects exerted on face identity memory by the emotional congruency of contextual information and face expression. Specifically this study investigated how emotional valence (positive or negative) may influence memory for faces. Therefore, we sought to uncover whether happy and fearful stimuli may differently influence the way in which arousing materials (i.e. emotional faces and scene) are bound together and retained in memory. As supported by previous works, the memory recognition for both face identity (item memory) and scenes related to faces (source memory) may be modulated by the congruency effect (between scene and face) or by the interaction between congruency and valence. More specifically, based on previous literature three hypothesis may be done. First, taking into account that the processing of emotional expression is facilitated for faces embedded in emotionally congruent contexts (Avizier et al., 2011; Righart & de Gelder, 2008a; Van den Stock et al., 2007, 2014), it may be that the congruency of face-scene compounds yield both better identity and source memory performance regardless of the valence. A second hypothesis is that the congruency interacts with the valence leading to a better recognition performance for fearful stimuli. Given that recognition memory studies on the trade-off effect (Kensinger, 2009; Mather, 2007) showed that treat-related stimuli attract more attention and are better remembered with respect to neutral information we could hypothesized a better memory performance for fearful information (faces and contexts). On this premise, we should expect a better memory recognition for fearful

faces, especially when encoded in happy scenes because the trade-off effect would focus the attention on the negative stimuli (fearful face) to the detriment of the less threatening information (happy scene). Finally, a third possibility is that the congruency interacts with the valence yielding a better recognition performance for happy faces embedded in happy scenes. In fact, taking into account that smiling expressions and happy-scenarios can broaden the visuo-attentional processing (Fredrickson & Branigan, 2005; Shimamura et al., 2006; Tsukiura & Cabeza, 2008) fostering the encoding process (D'Argembeau & Van der Linden, 2007; D'Argembeau et al., 2003; Shimamura et al., 2006; Tsukiura & Cabeza, 2008) it may be that happy faces benefit both memory identity (item memory) and memory for encoding contexts (source memory). In keeping with this, smiling identities may be better remembered because of the involvement of reward mechanism mediated by the OFC.

To explore these issues we used a two phase recognition procedure. In the study phase we presented emotionally congruent (fearful or happy faces in fear- and happy-contexts respectively) and incongruent (fearful or happy faces in happy- and fear-contexts respectively) face-scene compounds. In the test phase (recognition) all the old faces were presented with neutral expressions and intermixed with neutral new faces. Participants were asked to perform an old/new judgment on the face identity (item memory). In addition, three scenes were presented for each old face and subjects had to indicate which was associated with the face at encoding. This was a source memory task because the encoding context was presented with very similar images and participants had to recognize the scene details to correctly identify the scene associated with the face at encoding. To sum up, our experiment is aimed to investigate recognition memory for faces and contexts with different emotional valence (happy and fear) in order to assess the congruency effect.

2. Method

2.1. Participants

Thirty participants volunteered for the experiment (11 male, mean (SD) age = 24.77 (3.41)). None of the participants had a neurologic or psychiatric history and all had normal or corrected to normal vision. Informed consent was obtained according to the Declaration of Helsinki.

2.2. Stimulus materials

A pilot validation study was performed to select and validate the stimulus materials employed in the experimental study. This pilot study used different participants with respect to the experimental procedure. The pilot procedures used to select faces, scenes and face-scene compounds are described in the corresponding paragraphs.

2.2.1. Faces

Pictures of facial expressions (facing forward) were taken from the Karolinska Directed Emotional Faces set (Lundqvist, Flykt, & Öhman, 1998) and from NimStim (Tottenham et al., 2009). Faces were cropped to remove background and were equated in terms of size, central alignment of the face within the image, luminance and contrast by using Adobe Photoshop® 2.0.

15 participants [8 females, mean (SD) age: 23.4 (3.11)] volunteered for the valuation of faces during the pilot study. 108 face identities were randomly presented one by one on a screen with 3 expressions: fearful, neutral and happy (Tot = 324 pictures) and participants were instructed to categorize the valence expressed in the face on a 5 point scale (1 = very fearful, 2 = slightly fearful, 3 = neutral, 4 = slightly happy, 5 = very happy). Based on these results, pictures of 64 face identities (32 males) were selected so that fearful pictures were categorized as 2 (=slightly fearful) and happy pictures were categorized as 4 (=slightly happy) at least 85% of the participants. A t-test confirmed