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ORIGINAL ARTICLE

Person information facilitates memory for face identity

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Abstract

We tested whether episodic information about people facilitates memory for their faces (Experiment 1) and whether this effect is specific for face identity (Experiment 2). Participants were presented with faces paired with behavioral descriptions (positive, neutral, or negative) and faces displayed alone. In both experiments, participants were more likely to recognize faces paired with behavioral descriptions, and after 1-week delay, their memory was better for faces paired with descriptions of salient behavior (i.e., with positive and negative valence) than faces paired with neutral behaviors or faces presented without information. To examine whether these effects are about memory for face identity rather than face image memory, in Experiment 2, we presented different facial images (varying in facial angle) of the same people at the encoding and at the recognition test. Although this manipulation decreased the overall recognition, the findings of Experiment 1 were fully replicated. The findings suggest that minimal affective information is sufficient to facilitate memory for face identity.

Introduction

The face is typically the most important factor in identifying familiar people. Most of the research on face recognition has exclusively focused on the contribution of visual features (e.g., distinctiveness and race) to the strength of memory representation (Valentine, 1991; Hancock, Bruce, & Burtun, 2000; Johnston & Edmonds, 2009; Wang, 2013; Wiese, Altmann, & Schweingerger, 2014). As a result, surprisingly little is known about the contribution of verbally derived semantic information (i.e., person knowledge) to face memory. The few available studies suggest that face recognition is enhanced when specific person-related information (e.g., occupation, name, or personality traits) is provided (Kerr & Winograd, 1982; Klantzky, Marti, & Kane, 1982). Whether face memory is also enhanced by the availability of episodic information, such as behavioral descriptions, is unknown. At the same time, studies reveal that such information has large effects on social judgments of faces (Carlston, Skowronski, & Sparks, 1995; Todorov & Uleman, 2002, 2003, 2004), even after a long delay (Buchner, Bell, Mehl, & Musch, 2009). A recent study showed that people can extract and associate the affective gist of behaviors with unknown faces after seeing as many as 500 faces paired with single behavioral descriptions (Falvello, Vinson, Ferrari, & Todorov 2015). Specifically, in the first stage of the experiments, participants were presented with faces paired with positive (e.g., "he helped push someone's car out of a snowbank"), neutral (e.g., "he took a nap one afternoon"), or negative behaviors (e.g., "he intentionally swerved his car to hit a squirrel"). In the second stage, they were presented with the faces alone and asked to judge their trustworthiness. Despite the large number of faces and behaviors, participants judged faces associated with negative behaviors as less trustworthy and faces associated with positive behaviors as more trustworthy than faces associated with neutral behaviors. In fact, the strength of this effect did not seem to decrease as the number of faces and behaviors increased. Given these results, it is likely that behavioral information, particularly salient information about negative or positive behaviors, may also facilitate face memory.

The primary goal of the present study was to test the hypothesis that immediate and long-term face recognition is facilitated by learning behavioral information about the person. We expected that providing episodic information about a face promotes a deeper processing of the face and,

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consequently, facilitates a subsequent recognition. As Craik and coworkers (1972, 1975) have posited, the strength of a memory trace is dependent on the depth of encoding (i.e., a greater degree of semantic involvement). Accordingly, the memory traces of faces associated with episodic information would persist overtime and the faces would be more easily recognized after a long delay. In addition, we expected that the recognition advantage for faces associated with episodic information would depend on the kind of episodic information (i.e., the affective value of the behavioral description). The previous studies have shown that, compared to emotionally neutral items, emotionally evocative verbal items presented at encoding result in better subsequent memory performance (Craik & Blankstein, 1975; Bradley, Greenwald, Petry, & Lang, 1992; Mather, 2007; Kensinger, 2009).

We conducted two experiments, in which participants were presented with faces alone and faces paired with behavioral information, varying in affective valence (i.e., morally positive, neutral, and negative actions). We expected that faces associated with positive and negative information would be easier to recognize than faces associated with neutral information. In Experiment 1, we used the same face images at both encoding and recognition. Given the importance of image variation in recognition of relatively unfamiliar faces (Burton & Jenkins, 2011; Jenkins, White, Van Montfort, & Burton, 2011), it is possible that the effects observed in Experiment 1 can be attributed to memory for specific face images (e.g., image matching) rather than to memory for face identity (e.g., person recognition). To ascertain that these effects are about memory for face identity rather than memory about face images, in Experiment 2, we presented different facial images of the same people at encoding and recognition.

Experiment 1

In light of the facilitating role of trait encoding and affective evaluation on face memory (Burton, Bruce, & Hancock, 1999), we were also interested in testing the potential effect of the type of encoding on face memory. Thus, participants were randomly assigned to an intentional ("… try to memorize as many as you can ...") or incidental ("… try to form an impression ...") face memory task. Because impression-formation goals lead to better memory than memory goals (Fiedler et al., 2009), we expected participants to be better at face recognition in the incidental than in the intentional memory condition.

Materials and methods

Participants

Eighty undergraduate students (49 women; mean age 20.15 ± 1.11) from Bologna University participated voluntarily for partial course credit. All participants gave written informed consent. The experimental procedures were approved by the institutional review board (IRB) of the University of Bologna, Italy.

To test our hypotheses that (a) episodic information about people facilitates memory for their faces and (b) this effect depends on the emotional valence of the information, we determined sample size a priori, using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007) and assuming a medium size effect. Our actual sample size ($N=80$) is larger than the required one to achieve a statistical power of 0.95 for alpha = 0.05, assuming a correlation of 0.50 between repeated measures ($N=54$ for the effects of episodic information vs. no episodic information and $N=44$ for affectively charged information vs. neutral information).

Materials

Three hundred and sixty black and white, forward-facing, photographs of Caucasian individuals (180 women), were selected from the FERET Grayscale Database (Phillips, Wechsler, Huang, & Rauss, 1998). One hundred and twenty faces were used as study items, 120 as fillers for the 5-min break recognition task, and 120 as fillers for the 1-week recognition task.

We selected an equal number of photographs of young and middle-age individuals, with long or short hair or bald, with or without beards or mustaches, and other features: face size, winter/summer cloths, and hairstyle. To avoid possible effect of these specific stimulus characteristics on face memory performance, the fillers were matched for gender and all these specific features. Similarly, gender and facial features were fully counterbalanced across participants for the conditions of having or not having behavioral information about the face, as well as the three types of behavioral information. Six additional faces were used for practice trials.

Sixty behavioral descriptions were taken from Fuhrman, Bodenhausen, and Lichtenstein (1989). We selected the 20 most positive (mean ± SD: 8.23 ± 0.33), 20 neutral (mean ± SD: 5.56 ± 0.49), and the 20 most negative (mean ± SD: 1.43 ± 0.18) behavioral statements; these were based on 11-point "goodness" ratings (extremely good–extremely bad behavior) by a prior sample of participants. Here are examples of typical positive, neutral, and negative statements, respectively: "He volunteered to stay late to help a coworker", "He watched an old western on the late show", and "She insulted a stranger by making a racial slur". The selected positive descriptions were on average 57.35 ± 15.13 characters long, the neutral ones were on average 52.00 ± 9.75 characters, and the negative ones were 54.60 ± 12.47 characters (there were no significant differences between character lengths of the three types of descriptions, $F(2,57)=0.89$, $p>0.05$, $\eta_p^2=0.03$), see Fig. 1 for examples of stimuli.

Procedure

The experiment consisted of a study phase followed by two memory tests administered after 5-min break (during which participants performed a working memory task, i.e., count backwards from 500 to 0 in steps of 3), and 1 week after the encoding session. Participants were told that they would be viewing photographs of faces that could be paired (or not) with a behavioral description. In each task session, stimuli (256 × 384 pixels bitmap) were centrally presented at a 65-cm viewing distance from the center of a 15.6-inch computer monitor, subtending a visual angle of approximately 4.64 × 6.95.

Encoding session Participants were randomly assigned to an intentional ($n=38$; "… try to memorize as many as you can ...") or incidental ($n=42$; "… try to form an impression ...") face memory task. One hundred and twenty face photographs were presented for 8 s each. On half of the trials, faces were simultaneously presented with a statement describing an action performed by the person depicted; on the other half, faces were presented alone (see Fig. 1). The order of the face presentation was pseudorandomized with the restriction that any face associated with a behavioral description (or a description with the same valence) could not occur on more then two consecutive trials. The presentation of picture-statement pairing (description vs. no-description as well as the type of description) was counterbalanced across participants. Each trial was preceded by a fixation cross for 1 s. The task started with two practice trials to familiarize participants with the task.

Memory tests After 5-min break and after 1 week, participants were asked to look at faces presented alone and to decide whether they had seen the face during the first phase of the experiment (5 min before or last week). Two hundred and forty faces (120 study faces and 120 new faces) were shown serially. The sequence of faces was pseudo-randomly intermixed, so that no more than 3 old or new items were shown successively.

Each face image, preceded by a fixation cross for 1 s, stayed visible until a decision (yes/no) was made. Each memory task started with two practice trials to familiarize participants with the task.

Results and discussion

For the hit rates, a 2 × 2 × 2 mixed-model ANOVA, with description (within-subject factor: face with description vs. face alone), recognition interval (within-subject factor: immediate vs. delayed), and type of encoding (between-subject factor: intentional vs. incidental), showed a large effect of recognition interval, $F(1,78)=60.49$, $p<0.001$, $\eta_p^2=0.44$, indicating that recognition accuracy was lower after the 1-week interval (see Fig. 2). More importantly, the effect of description was also significant, $F(1,78)=33.05$, $p<0.001$, $\eta_p^2=0.30$. As predicted, accuracy was higher for faces presented with behavioral description than for faces presented alone. Neither the main effect of the type of encoding, $F(1,78)=0.75$, $p>0.05$, $\eta_p^2=0.01$, nor the two, $F_s(1,78)<3.61$, $p_s>0.05$, $\eta_{ps}^2<0.04$, and three-way interactions, $F(1,78)=0.27$, $p>0.05$, $\eta_p^2=0.003$, were statistically significant.

The above analysis was consistent with an analysis of the sensitivity of recognition memory responses (i.e., how well a participant distinguishes a new stimulus from an old one). For this analysis, a P_r index (Snodograss & Corwin, 1988) was calculated. The P_r index was calculated by subtracting the false alarm rate from the hit rate. False alarm rates could not be calculated separately for the condition of behavioral description, because the foils did not appear in any encoding context; thus, we used the overall false alarm rates for each condition of recognition interval and type of encoding. We report P_r as a sensitive measure,

Fig. 1 Examples of stimulus display in the two conditions of face presented with behavioral description and face presented alone

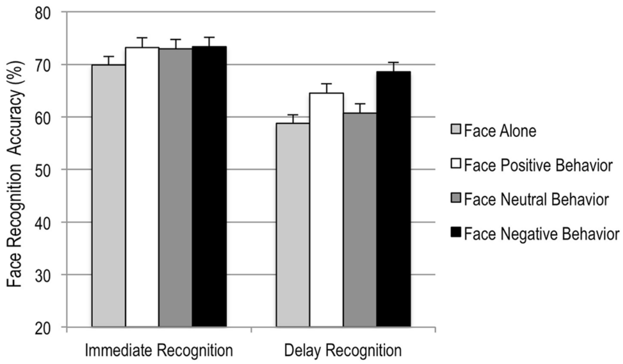

Fig. 2 Proportion of face recognition accuracy as a function of recognition interval and behavioral description; bars represent standard error of the mean

because it was favorably evaluated in validation studies (Snodograss & Corwin, 1988) and avoids the problem of undefined values that comes with using *d'*. The P_r index was then entered into a 2 × 2 mixed-model ANOVA with recognition interval as a within-subject factor (immediate recognition vs. delay recognition) and type of encoding as a between-subject factor (intentional vs. uncidental). The old-new discrimination (P_r) was better 5 min (0.60 ± 0.15) after the encoding session than 1 week later (0.51 ± 0.23), $F(1,78) = 18.48$; $p < 0.001$, $\eta_p^2 = 0.19$. Neither the main effect of the type of encoding, $F(1,78) = 1.85$; $p > 0.05$, $\eta_p^2 = 0.02$, nor the two-way interaction, $F(1,78) = 0.34$; $p > 0.05$, $\eta_p^2 = 0.004$, were statistically significant.

To return to the most important hypothesis whether the valence of the behavioral descriptions differentially affect the correct recognition of the study faces, and whether this effect changes over time, we submitted the hit rate to a 2 (recognition interval) × 3 (valence of the behavioral description: positive vs. neutral vs. negative) repeated measures ANOVA. Both the main effects of recognition interval, $F(1,79) = 48.52$, $p < 0.001$, $\eta_p^2 = 0.38$, and valence, $F(2,154) = 9.51$, $p < 0.001$, $\eta_p^2 = 0.11$, were significant and qualified by a significant interaction, $F(2,158) = 4.69$; $p = 0.01$, $\eta_p^2 = 0.06$. Separate follow-up analyses showed that the main effect of valence of the behavior was not significant in the immediate recall, $F(2,78) = 1.39$, $p > 0.05$, $\eta_p^2 = 0.03$. However, after 1 week, face memory significantly differed across the three types of behavioral descriptions, $F(2,156) = 14.52$; $p < 0.001$, $\eta_p^2 = 0.16$. As shown in Fig. 2, pairwise comparisons, with Bonferroni adjustment of p value, indicated that participants were more likely to recognize faces associated with negative ($p < 0.001$) and positive ($p = 0.04$) behavior, than faces associated with neutral behavior. Moreover, faces associated with negative behavior were more likely to be recognized than faces associated with positive behavior ($p = 0.02$).

Interestingly, an additional independent analysis revealed that the recognition accuracy for faces associated with neutral behavior (60.69 ± 17.66) did not differ from the accuracy for faces presented without (58.81 ± 18.22) behavioral information ($t = 1.53$; $df = 79$; $p > 0.05$).

These findings indicate that memory for faces is improved by episodic information about the person and that affectively salient episodic information provides an additional memory advantage in the long-term.

Experiment 2

In Experiment 1, we used the same photographs at both encoding and recognition. In everyday life, however, identity recognition relies on the ability to recognize facial identity regardless of surface appearance variations, such as hairstyle or head pose. As a consequence, it is unclear whether the effect of episodic information on recognition is due to memory for pictorial aspects of the photographs (e.g., image matching) or to specific memory for face identity (e.g., person recognition). To address this issue, in Experiment 2, we also included different photos of the same people (e.g., front headshot vs. ¾ view) at the encoding and at the recognition test. If the effect is due to specific memory for face identity, we should expect an effect of behavioral information on face memory, regardless of whether the face image was the same or different across encoding and recognition. The procedures of this experiment followed closely those of Experiment 1, except that we did not manipulate the encoding instructions and only included a recognition test after a week delay. These choices were dictated by the fact that the type of encoding did not have any effects in Experiment 1 and that the effect of the valence of behavior was only evident after a week delay. Moreover, this 1-week delay test (rather than an immediate recognition test) is a more stringent test of the hypothesis that the effects of episodic information are about memory for face identity.

Materials and methods

Participants

The study involved a convenience sample of 40 speech pathology and nurse undergraduate students recruited from the University of Bologna. By chance, they were all women (mean age 20.10 ± 1.86). They participated voluntarily for partial course credit. The experimental procedures were approved by the University of Bologna' IRB, and all participants gave written informed consent.

To test our hypotheses that episodic information about people (face presented alone vs. face presented with positive vs. neutral vs. negative information) facilitates memory for their face identity, we determined sample size a priori, using the G*Power software (Faul et al., 2007) and assuming a medium size effect. Our actual sample size ($N=40$) is larger than the required one (i.e., $N=36$) to achieve a statistical power of 0.95 for alpha = 0.05 and assuming a correlation of 0.50 between repeated measures.

Materials

Ninety-eight black and white images of Caucasian individuals (49 women) were selected from the FERET Database (Phillips et al., 1998). Forty-eight images were used as study faces, forty-eight as fillers for the 1-week recognition task, and two served for the practice trials. Non-facial cues (i.e., clothing and necklaces) were removed and the possible additional cues to recognition (i.e., gender, hairstyle, and hair color) were fully counterbalanced across conditions. For half of the study faces, we selected only frontal view photographs ($n=24$); for the remaining study faces, we selected both frontal view and ¾-turned face photographs, either to the right or to the left (Fig. 3).

As in Experiment 1, the behavioral descriptions (12 positive, 12 neutral and 12 negative) were taken from Fuhrman, Bodenhausen, and Lichtenstein (1989).

Procedure

The experiment consisted of a study phase (i.e., encoding) followed by the memory test administered after a 1-week delay.

Encoding phase Out of the 48 study faces, 12 faces were presented alone, while 36 faces were simultaneously presented with a statement (12 positive, 12 neutral, and 12 negative) describing an action performed by the person depicted. Participants were instructed to carefully view and memorize as many faces as possible. The faces were presented one after the other for 8 s each. Each trial was preceded by a fixation cross for 1 s.

Memory test One week after the encoding session, all faces were presented without behavioral information and the participants were asked to indicate whether they had seen the person during the first phase of the experiment.

Participants viewed a random sequence of 96 faces (48 study faces and 48 fillers). Half of the study faces were presented in the same pose presented during the encoding phase (i.e., face in a frontal view); the other half were presented in a new pose: either ¾-turned to the left ($n=12$) or right ($n=12$) (see Fig. 3). Likewise, half of the fillers ($n=24$) were presented in a frontal position and half of them were presented ¾-turned to the left ($n=12$) or right ($n=12$).

Results and discussion

A 4 × 2 ANOVA, computed on hit rates, with description (face alone vs. face with positive description vs. face with neutral description vs. face with negative description) and face image (same vs. different) treated as within-subject factors confirmed a significant main effect of behavioral description, $F(3,114)=7.01$, $p=0.001$, $\eta_p^2=0.16$. Specifically (see Fig. 4), pairwise comparisons, with Bonferroni adjustment of p value, indicated that participants were more likely to recognize faces associated with negative ($p_s<0.02$) and positive ($p_s<0.02$) behavior than faces associated with neutral behavior or faces presented alone. There were no significant differences between faces associated with negative and faces associated with positive information ($p>0.05$). In addition, recognition accuracy for faces associated with neutral behavior was not significantly different from the recognition accuracy for faces presented without behavioral information ($p>0.05$).

Not surprisingly, recognition accuracy for faces presented in the same pose across encoding and memory test was significantly higher than recognition accuracy

Fig. 3 Examples of stimulus display in the encoding session and in the recognition test

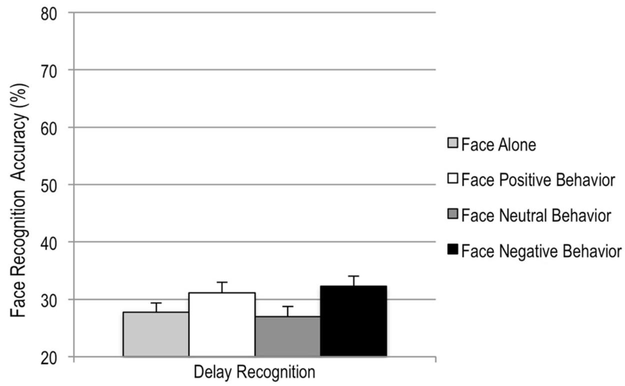

Fig. 4 Proportion of 1-week delay face recognition accuracy as a function of behavioral description. Error bars represent standard error of the mean

for faces presented using different poses, $F(1,38) = 59.37$, $p < 0.001$, $\eta_p^2 = 0.61$ (mean ± standard error: 4.30 ± 0.12 vs. 2.80 ± 0.19). Of note, the two-way interaction of description x face image was not statistically significant, $F(3,114) = 0.78$, $p = 0.491$, $\eta_p^2 = 0.02$, which suggests that the observed memory effects of behavioral description are about face identity rather than about image matching. Nevertheless, we conducted an additional analysis limited to trials, where the images at encoding and recognition were different. This analysis confirmed the significant effect of behavioral description, $F(3,97) = 5.46$, $p = 0.003$, $\eta_p^2 = 0.13$.

Different from Experiment 1, the P_r index was not included in any control analyses to examine in depth the influence of the two conditions on face memory correcting for guessing, because the foils did not appear in any of the two conditions of encoding (i.e., description and face image). The mean P_r (± SD) value for face recognition, regardless of the encoding condition, was 0.43 ± 0.16.

General discussion and conclusions

Having behavioral information about a briefly seen person has a large effect on person judgments (Todorov & Uleman, 2002, 2003, Buchner et al., 2009). The previous research has also indicated that the automatic trait inferences triggered by this behavioral information are encoded as a part of the person's representation (Todorov and Uleman, 2004). In the studies reported here, we extend these findings by showing that such information also facilitates memory for face identity. This was the case despite the fact that the perceptual load was lowest when faces were presented alone than when they were presented with behavioral descriptions. Although participants had more time to encode the faces in the faces alone condition, their memory for the faces was worse in this condition than when they had to encode both faces and behavioral information. Consistent with prior research on face memory (Kerr and Winograd, 1982; Klantzky et al., 1982; Bruce and Young, 1986; Hills, Lewis, & Honey, 2008; Herzmann and Sommer, 2010; Marzi and Viggiano, 2010; Burton et al., 2011; Neumann et al., 2013), having person-related information may induce a more complex memory representation (based on a semantic memory code) of the person's face that facilitates face identity recognition. While the previous studies (Kerr and Winograd, 1982; Klantzky et al., 1982) have demonstrated the effect of specific semantic person-related information (e.g., occupation, name, or personality traits) on short-term face recognition, the present findings indicate that the memory advantage for faces associated with affectively charged episodic information persists overtime.

The memory advantage for faces paired with behavioral information was detectable shortly after the encoding of the faces and after 1 week. Consistent with the previous studies using different paradigms (Mogg & Bradley, 1999; Schupp et al., 2004; Buchner et al., 2009; Rule, Slepian, & Ambady, 2012), after 1 week, the face memory advantage was limited to faces paired with affectively relevant information. As in recent studies (Maratos & Rugg, 2001; Erk, Martin, & Walter, 2005; Bell et al., 2012a; 2012b; Mattarozzi, Todorov, & Codispoti, 2015), our findings suggest that, in the short-term, faces associated with an emotional context seem not to acquire a memory advantage relative to faces associated with irrelevant neutral information. However, this advantage emerges in the long term. The long-term memory advantage for faces associated with positive and negative episodic information, rather than with neutral statements, suggests that changes of arousal levels during the encoding phases would facilitate long-term face memory. This is in line with the previous studies indicating that long-term memory for natural scenes is mainly affected by arousal (Bradley, Bell, Mehl, & Musch, 1992; Kensinger & Corkin, 2004).

Our findings are consistent with a functional memory perspective, which posits that the long-term retention of faces is a function of the face's functional value (Nairne, Panderiada, & Thompson, 2008; Rule et al., 2012). Thus, it is plausible that faces associated with neutral information (or without behavioral information) do not receive a selective memory advantage in the long term, because most likely, these faces do not carry sufficient information to guide future social interactions. Hence, they have a weak memory representation. By contrast, the long-term retention of faces associated with positive and negative information is relevant to future social interactions. Specifically, the memory advantage for faces of people associated with positive behavior is functional, because such memories can activate approach responses in the service of cooperative and affiliate behaviors with these people. Likewise, the memory advantage for faces associated with negative information is functional, because such memories activate avoidance responses to prevent potentially disadvantageous interactions. The relevance of negative information is also highlighted by studies, showing that negative behavioral information enhances memory for face identity and for the associated context (Bell & Buchner, 2010, Bell et al., 2012a; and Buchner et al. 2009). Of note, faces with negative associations are more memorable (Schupp et al., 2004; Rule et al., 2012; Mattarozzi et al., 2015), suggesting that negativity effects are stronger than positivity effects. For example, Rule et al. (2012) found that untrustworthy-looking faces were remembered better than trustworthy-looking faces. Similarly, we found a memory advantage for faces associated with negative than faces associated with positive behaviors in Experiment 1. However, this effect was not replicated in Experiment 2, suggesting that differential effects of positive and negative valence on memory may be subtle and dependent on the specific context. Given that Experiment 1 included two memory tests (immediate vs. delayed), it is possible that retrieving negative information about a person in the first test may have enhanced face recognition in the long term.

The specific perceptual and memory mechanisms (e.g., depth of encoding, consolidation, and encoding–retrieval interactions) that could explain memory advantage for affectively charged information warrant future investigation. Though the present studies do not identify the processes underlying the memory advantage for faces associated with affectively charged episodic information, it is plausible to argue that this information may have provided an attentional boost for these faces because of their higher motivational significance (relative to faces with no information or with neutral information, Schupp et al., 2007) and that this boost facilitated face perception and ultimately memory encoding. Of note, we cannot rule out that the simple presentation of any additional information along the face (e.g., pseudowords which have corresponding phonological but not semantic representation) would impact face memory performance in the short term. However, our findings do show that in the long term, the kind of information presented with the face determines the memory advantage. To the extent that this advantage is due to selective attentional processing during encoding, it would be worth including psychophysiological measures (e.g., late positive potential, or EEG oscillations) of attention during encoding.

In contrast to Fiedler et al. (2009), the results of Experiment 1 indicate that forming an impression of a face does not necessarily lead to a memory advantage relative to an explicit memory task. This discrepancy may reflect methodological differences (e.g., task and stimuli used). For example, the previous research indicates that affectively charged behavioral information triggers impression inferences, independent of the task instructions to participants (Todorov & Uleman, 2003; 2004). In line with classical studies (Postman, 1964; Tulving & Thomson, 1973; Craik & Tulving, 1975), the likelihood of face recognition depends not on the intention to learn the face, but on the motivational significance of the face and the kinds of operations carried out in the learning situation (e.g., attentional engagement and depth of encoding).

In sum, our findings suggest that a single behavioral description with emotionally relevant content is sufficient to enrich the encoding process, making the face more distinguishable from others encoded without information or with non-emotional information. That is, different evaluative inferences about the face extracted from semantic information affect not only face evaluation but also memory for face identity.

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Compliance with Ethical Standards

Conflict of interest All co-authors declare no conflict of interest to report.

Ethical approval All procedures performed in studies were in accordance with the ethical standards of the institutional research committee (University of Bologna Ethical Committee) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All participants were fully informed about the procedure of the study and gave their formal consent to participate.

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