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The influence of visual context on the evaluation of facial trustworthiness☆

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ABSTRACT

Evaluation of facial trustworthiness is often thought to be based on facial features and relatively immune to visual context. However, we rarely encounter an isolated facial expression in the real world. In 3 Experiments using a mouse-tracking paradigm, participants were asked to categorize the trustworthiness of faces that were shown against either threatening, negative but unthreatening, or neutral scenes. Results showed that visual scenes systematically altered the categorization of facial trustworthiness. The trajectory of hand movements reflected the compatibility of facial trustworthiness and contextual threat cues of the scene. Trajectories were facilitated when facial cues and contextual cues were compatible (e.g., untrustworthy face in a threatening scene), and were partially attracted to the context-associated response when incompatible (e.g., trustworthy face in a threatening scene). Thus, the evaluation of facial trustworthiness involves dynamic updates of gradual integration of the face and the level of threat posed by the visual context.

1. Introduction

Our impressions of others are often based on limited information that is spontaneously and automatically extracted from their appearance—in particular their faces (Zebrowitz, 1997; Zebrowitz & Montepare, 2008). Indeed, a growing body of research has shown that people make personality inferences from faces after minimal time exposure (Bar, Neta, & Linz, 2006; Todorov, Pakrashi, & Oosterhof, 2009; Todorov & Uleman, 2003; Willis & Todorov, 2006) and that these evaluations predict important social outcomes. For instance, inferences of dominance predict military rank attainment (Mazur, Mazur, & Keating, 1984; Mueller & Mazur, 1996), while inferences of competence predict the results of political elections (Ballew & Todorov, 2007; Todorov, Mandisodza, Goren, & Hall, 2005). In addition, facial dominance and competence together predict salaries of CEOs (Rule & Ambady, 2008).

An important class of inferences concerns judgments of trustworthiness (Todorov, Olivola, Dotsch, & Mende-Siedlecki, 2015). Studies on economic games have shown that players are less willing to trust other players who have untrustworthy-looking faces (Chang, Doll, van't Wout, Frank, & Sanfey, 2010; Rezlescu, Duchaine, Olivola, & Chater, 2012; Stirrat & Perrett, 2010) while recent experimental work reveals that defendants who have untrustworthy-looking faces are more likely to receive guilty verdicts (Porter, ten Brinke, & Gustaw, 2010; Wilson & Rule, 2015). Importantly, it has been shown that people start discriminating trustworthiness after 33 ms of exposure to a face and that the detection of trustworthiness in faces is faster than the detection of a variety of other characteristics, including competence, likeability, and dominance (Todorov et al., 2009; Willis & Todorov, 2006). In a similar vein, people show a memory advantage for faces varying on trustworthiness compared with those varying on likeability, friendliness, and dominance (Rule, Slepian, & Ambady, 2012) and facial trustworthiness predicts basic approach/avoidance responses (Slepian, Young, Rule, Weisbuch, & Ambady, 2012).

Such a preferential processing of facial trustworthiness has often been explained through a functionalist perspective. Indeed, our judgments of another person's trustworthiness are highly related to the essential decision we must make about whether they represent an opportunity or a threat (Ames, Fiske, & Todorov, 2011; Brambilla & Leach, 2014; Cosmides & Tooby, 1992). In line with this reasoning, it has been shown that perceived trustworthiness and threat are inherently linked. As such, behavioral studies have shown that the more a social target is perceived as untrustworthy, the more such a target is believed to pose a threat to the stability and integrity of the whole community. By contrast, highly trustworthy social targets are perceived as beneficial for the group survival and cohesion (Brambilla & Leach, 2014). At the group level, untrustworthy ingroup members are perceived as threatening to the image of their group (Brambilla, Sacchi,

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Pagliaro, & Ellemers, 2013; Leach, Ellemers, & Barreto, 2007; van der Toorn, Ellemers, & Doosje, 2015), while untrustworthy outgroup members are perceived as posing a real and a concrete danger to the ingroup's survival possibilities and represent a threat to the group's safety (Brambilla et al., 2013; Brambilla, Sacchi, Rusconi, Cherubini, & Yzerbyt, 2012; Leidner & Castano, 2012). In line with these findings, functional neuroimaging studies show that detection of trustworthiness in a face is a spontaneous, automatic process linked to activity in the amygdala (Winston, Strange, O'Doherty, & Dolan, 2002), a subcortical brain structure that tends to be implicated in the detection of potentially dangerous and threatening stimuli (Engell, Haxby, & Todorov, 2007; Freeman, Stolier, Ingbretsen, & Hehman, 2014; Todorov, Mende-Siedlecki, & Dotsch, 2013; Todorov, Said, Oosterhof, & Engell, 2011; Phelps & LeDoux, 2005).

In the vast majority of studies examining facial trustworthiness, faces are flashed on the computer screen, and categorization of trustworthiness quickly ensues (for a review, Todorov et al., 2015). However, faces are rarely encountered in isolation in the real world. Instead, they are typically embedded in rich contexts. For instance, we might catch sight of another person walking in a park or waiting at the subway station. Recent studies have found that context influences the perception of facial emotions; such studies reveal facilitated response times when the emotional context of the scene and face are congruent (Aviezer et al., 2008; Barrett & Kensinger, 2010; Righart & De Gelder, 2008). Thus, disgust, fear, and happiness are more easily recognized when faces are shown against backgrounds of natural scenes with congruent emotional significance (Righart & De Gelder, 2008). Beyond emotion recognition, contextual effects have been examined with respect to static category dimensions as well, such as ethnicity (e.g., Freeman et al., 2015; Freeman, Ma, Han, & Ambady, 2013). For instance, Asian categorization is more likely when an Asian face appears in a Chinese-typed rather than an American-typed scene context.

The present research sought to extend prior work by investigating whether visual context may impact the perception of trustworthiness. Indeed, while prior research has examined contextual effects with respect to emotion recognition and race categorization, hardly any experimental work has examined whether visual context influences the perception of traits, such as trustworthiness. One study found that faces were judged more trustworthy when surrounded by wealthy backgrounds (Keres & Chartier, 2016). In that study, the contextual information conveyed social status. Moreover, that study employed explicit ratings that did not permit an understanding of how facial and contextual cues were integrated during the judgment process. Here, we aimed to examine dynamics underlying the integration of facial trustworthiness and contextual cues, specifically contextual cues that convey threat. In doing so, our research is useful to broaden our understanding of the factors promoting or disrupting the processing of facial trustworthiness. Considering that prior research has shown that facial trustworthiness and the perception of threat are inherently linked (for reviews, Brambilla & Leach, 2014; Todorov et al., 2015), there is good reason to expect that visual scenes associated with threat could alter the processing of a face's trustworthiness.

To test this prediction we went beyond response times and considered a more process-sensitive methodology. Thus, we employed a mouse-tracking technique that records and analyzes hand movements during categorization tasks (Freeman & Ambady, 2010; Freeman & Johnson, 2016). Previous studies examining contextual effects suggest in some cases outcome-based measures (e.g., ratings or reaction times) may have limited sensitivity while more process-based measures such as mouse-tracking overcome this (Freeman et al., 2013; Freeman & Johnson, 2016). As such, there are many cases where a participant's ultimate perception is not predicted to be altered by context even if the process leading up to that response would be altered considerably. In line with this reasoning, the computer mouse-tracking procedure records the position of the mouse on the x and y coordinate space, providing an online measure of the spontaneous changes across a decision process. In a typical trial, participants are required to click on a "Start" button located at the bottom-center of the screen, which is replaced by a target. Participants then must click an appropriate response button located either at the top-left or top-right of the screen. Because the mouse is moving while a categorization response is still evolving, it is able to provide a "read-out" of how categorization unfolds over time (Freeman & Ambady, 2011; Freeman & Johnson, 2016). In other words, this paradigm can track how various cues drive categorization in real time and therefore reveal potentially subtle influences of context, even when an ultimate response may not be affected.

If the visual context influences the categorization of facial trustworthiness, one would expect that perceivers partially integrate the response associated with the context with that associated with the face. This would be evidenced by a partial attraction in participants' mouse trajectories toward the opposite category response before clicking their final response when the facial and context information do not match. In other words, trajectories would be facilitated when facial cues and contextual cues are compatible (e.g., untrustworthy face in a threatening scene), and would be partially attracted to the context-associated response when incompatible (e.g., trustworthy face in a threatening scene). We conducted three experiments to test these hypotheses.

2. Experiment 1

Experiment 1 was designed as a first test of our hypothesis that categorization responses of facial trustworthiness are influenced by the threatening nature of the visual context. To do so, we asked participants to categorize the trustworthiness of faces that were shown against either threatening or neutral backgrounds. We predicted a more direct mouse-trajectory toward the untrustworthy response button when untrustworthy faces are embedded in threatening contexts rather than in a neutral context. By contrast, we expected a more curved mouse-trajectory toward the trustworthy response button when trustworthy faces are embedded in threatening contexts rather than in a neutral context.

2.1. Method

2.1.1. Participants

Sample size was determined before the data collection. Specifically, an a priori power analysis was conducted for sample size estimation (using G Power 3.1; Faul, Erdfelder, Lang, & Buchner, 2007). The projected sample size needed to detect a small-to-medium effect size (Cohen, 1988) with 80% power is $N = 36$ for a within-subject ANOVA. We advertised the study on campus and all the students who responded within 4 weeks were involved in the study. Overall, we recruited 51 Italian students (36 female) aged between 19 and 75 ($M_{age} = 28.72$, $SD = 12.83$), with normal or corrected-to-normal vision. The sample size was comparable to those employed by previous published works on categorization of faces (Carraro, Castelli, & Negri, 2016; Freeman, 2014; Freeman et al., 2013; Righart & De Gelder, 2008). In this and the subsequent studies, we report all measures, manipulations, and exclusions.

2.1.2. Stimuli

We employed 24 computer-generated identities (12 trustworthy, 12 untrustworthy) borrowed from a set of photos previously validated for facial trustworthiness (Todorov, Dotsch, Porter, Oosterhof, & Falvello, 2013). Specifically, trustworthy and untrustworthy faces had the highest and the lowest levels of trustworthiness, respectively. Scene context stimuli (4 neutral, 4 threatening) were obtained from public-domain websites. A pretest confirmed that the scenes were perceived as intended. In particular, independent raters ($N = 26$; $M_{age} = 23.80$; $SD = 2.77$) were asked to indicate the extent to which each scene context was threatening using a scale ranging from 1 (*not at all*) to 7 (*extremely*). Pre-test results revealed that threatening scenes were perceived as more threatening ($M = 5.53$, $SD = 1.31$) than neutral scenes