



Long-lasting effects of subliminal affective priming from facial expressions

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ABSTRACT

Unconscious processing of stimuli with emotional content can bias affective judgments. Is this subliminal affective priming merely a transient phenomenon manifested in fleeting perceptual changes, or are long-lasting effects also induced? To address this question, we investigated memory for surprise faces 24 h after they had been shown with 30-ms fearful, happy, or neutral faces. Surprise faces subliminally primed by happy faces were initially rated as more positive, and were later remembered better, than those primed by fearful or neutral faces. Participants likely to have processed primes supraliminally did not respond differentially as a function of expression. These results converge with findings showing memory advantages with happy expressions, though here the expressions were displayed on the face of a different person, perceived subliminally, and not present at test. We conclude that behavioral biases induced by masked emotional expressions are not ephemeral, but rather can last at least 24 h.

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1. Introduction

The influence of affective information on behavior is notable because it can sometimes occur without conscious awareness of the affective input (e.g., Whalen et al., 1998; Zajonc, 1980, 1984). Demonstrations that subliminal processing of sensory input can influence how we immediately evaluate consciously perceived stimuli (e.g., Higgins, 1996; Li, Zinbarg, Boehm, & Paller, 2008; Murphy & Zajonc, 1993; Stapel, Koomen, & Ruys, 2002) are particularly intriguing because such findings highlight the remarkable extent to which human behavior is not necessarily in agreement with subjective intentions and experiences.

Given the immense amount of information in typical environments that people process without awareness, it is critical to understand the extent to which such processing influences conscious experience and behavior. In particular, if affective priming remains operative for many hours, such influences on people's preferences and social behavior may be much more pervasive than commonly assumed. The goal of the present investigation was thus to determine if unconscious emotional processing has long-lasting effects in addition to previously described short-term effects.

Investigations of unconscious processing often include procedures that allow experimenters to assess the degree to which aspects of an unseen *prime* stimulus are incorporated into a judgment regarding a consciously perceived *target* stimulus (Higgins, 1996). This subliminal assimilation is particularly effective with emotional stimuli such as facial expressions. Presumably, the affect from a subliminal stimulus is diffuse in the sense that it can spill-over onto a temporally adjacent stimulus. For example, subliminally presented smiling and scowling faces positively and negatively shift evaluative judgments of subsequently presented, affectively neutral Chinese ideographs (Murphy & Zajonc, 1993). In some paradigms, this spill-over appears to require a lack of awareness of quickly flashed primes, because primes presented for longer durations produce

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contrast effects in which ambiguous target stimuli are judged as opposite in valence from the primes (Murphy & Zajonc, 1993; Stapel et al., 2002), analogous to effects observed during recognition testing (Jacoby & Whitehouse, 1989).

Emotionally ambiguous facial expressions, such as surprise, derive their affective valence primarily through context. For example, a face with a surprise expression can appear positive in the context of a surprise birthday party or negative in the context of a grisly murder in a horror film. This emotional ambiguity makes surprise expressions especially susceptible to modulations of affective judgment (Kim et al., 2004), and thus suitable for use as targets in subliminal priming paradigms. In a recent study from our lab, for example, emotionally ambiguous surprise faces preceded by subliminally presented happy faces were judged to be more positive than those preceded by subliminally presented fearful faces (Li et al., 2008).

Although subliminal affective priming in these cases may be regarded as a transient phenomenon manifested only in fleeting perceptual changes, here we question the tacit assumption that such phenomena are short-lived. Might unconscious affective processing also have long-lasting effects? Memory for emotional faces is a natural avenue through which to study potential long-lasting effects of subliminal affective priming.

Unconscious affective processing is often thought to be mediated by a subcortical neural system that does not necessarily produce conscious affective sensations (Damasio, 1994; Winkielman, Zajonc, & Schwartz, 1997). This neural system has been described as implementing a “quick and dirty” analysis of visual threat through visual pathways from the thalamus to the amygdala, bypassing visual cortex (LeDoux, 1996). Several studies have demonstrated that subliminally presented fearful faces elicit greater amygdala activation than neutral faces, suggesting that the amygdala is involved in unconscious processing of threat (Breiter et al., 1996; Whalen, 1998; Williams et al., 2006). In addition to its role in coarsely-tuned threat detection (Anderson, Christoff, Panitz, De Rosa, & Gabrieli, 2003; Vuilleumier, Armony, Driver, & Dolan, 2003), the amygdala can function to narrow attention toward facial features critical for emotion recognition (Adolphs et al., 2005) and to enhance memory for emotional details (Adolphs, Tranel, & Denburg, 2000). One prediction might thus be that memory would be superior for surprise faces subliminally primed by fearful faces.

Alternatively, other findings have documented superior memory storage associated with processing happy faces. For example, after viewing happy and sad faces in an expression-classification procedure, participants were more accurate at recognizing faces with happy expressions than sad expressions when presented with the same images 5 min later (Ridout, Astell, Reid, Glen, & O’Carroll, 2003). Similarly, participants were more accurate at recognizing faces that had earlier been encoded showing happy rather than angry expressions, even though only faces with neutral expressions were used for memory testing (D’Argembeau & Van der Linden, 2007; D’Argembeau, Van der Linden, Comblain, & Etienne, 2003). In addition, when recall of the original facial affect was tested, also using neutral versions of the same faces, memory was superior for faces originally seen with happy expressions (D’Argembeau et al., 2003; Shimamura, Ross, & Bennett, 2006). When participants learned faces with neutral instead of emotional expressions, those learned in the context of a happy story were subsequently remembered better, when tested with the same facial images as shown during learning, than neutral faces learned in the context of a sad story (Bridge, Chiao, & Paller, accepted for publication). Similar results have also been demonstrated with non-face stimuli, such that neutral words encoded with a positive context are recalled better than neutral words encoded with a neutral or negative context (Erk et al., 2003). These results foster the prediction that faces subliminally primed by happy expressions might be remembered best.

In the present study, we examined the short- and long-lasting effects of unconscious affective processing by: (1) assessing the degree to which exposure to subliminal primes influenced immediate affective evaluations of surprise faces, and (2) assessing the degree to which both this unconscious processing and the affective evaluation influenced memory for the same surprise faces after a 1-day delay. Subliminal primes portrayed either a fearful, happy, or neutral expression. Our predictions were that assimilation of primes into perceptual processing of the surprise faces would, in accord with the affective valence of prime expressions, influence affective evaluations of surprise faces and subsequent memory for those same faces.

2. Method

2.1. Participants

Forty-three undergraduate students at Northwestern University gave informed consent to participate for course credit. All had normal or corrected-to-normal visual acuity, and all were enrolled in an introductory psychology course. Participants were tested individually in a dimly lit room on two consecutive days (Day 1 and Day 2).

2.2. Stimuli

We selected four categories of faces from the Karolinska Directed Emotion Face Set (Lundqvist, Flykt, & Öhman, 1998) according to their emotional expressions: 70 surprise faces (48 of which were used in the priming phase and 22 as foils in the memory test), as well as 8 fearful faces, 8 happy faces, and 8 neutral faces used as primes. Due to the limited size of the face set, the identities of the primes also appeared in surprise faces during the priming phase (20 matching identities) and as foils during the memory test (four matching identities). However, no surprise face was ever paired with a prime of the same identity. All faces were color photographs (half women and half men).

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