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Suboptimal facial expression primes in textual media messages: Evidence for the affective congruency effect

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ABSTRACT

The effectiveness of suboptimal affective primes in real media applications has remained debatable. We investigated the effects of suboptimally (at 10-ms exposure) presented facial expression primes on emotional responses to, and cognitive evaluations of, textual (business news) messages ranging from slightly unpleasant to slightly pleasant among 33 participants. Facial expression primes were presented repeatedly on a simulated small screen of a mobile device during a news reading task. Facial electromyography (EMG) recordings were used as physiological indices of positive and negative emotions. Our results showed affective congruency effects between news messages and facial expression primes: joyful facial expressions, compared to angry primes or no priming, elicited higher positive affect evaluations and more positive facial EMG responses, as well as higher interest, when embedded in affectively more positive news. On the other hand, the mere presence of suboptimal primes was detrimental to the perceived trustworthiness of news. These results suggest that embedding suboptimal facial expression primes into textual media messages may exert an influence on affectively congruent messages; at the same time, our results highlight the potential hazards and difficulties of utilizing such primes.

1. Introduction

The possibility of presenting stimuli at suboptimal exposures to influence people's attitudes and behaviors without their informed consent has raised considerable public concern to the extent that several countries have decided to ban the presentation of such advertisements in mass media (cf. Federal Communications Commission., 1974). A notorious example is that of a private marketing researcher James Vicary, who claimed in the 1950s to have increased the sales of popcorn and beverages by flashing hidden verbal suggestions on a movie screen. These claims never received empirical support, however, and were revealed as a hoax several years later (Pratkanis, 1992). More recent commercial exploitations of similar phenomena, such as the genre of subliminal self-help audio tapes, have similarly failed to survive an empirical scrutiny (see Moore, 1992; Pratkanis, 1992). In a stark contrast, an accumulating wealth of research evidence has demonstrated that suboptimal exposure to affective stimuli can elicit cognitive and affective responses in the absence of self-reported awareness (Dimberg, Thunberg, & Elmehed, 2000; Draine & Greenwald, 1998; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Greenwald, Klinger, & Liu, 1989; Monahan, 1998; Monahan, Murphy, & Zajonc, 2000; Murphy, Monahan, & Zajonc, 1995; Murphy & Zajonc, 1993; Niedenthal, 1990; Rotteveel, de Groot, Geutskens, & Phaf, 2001; Stapel, Koomen, & Ruys, 2002). Although these findings do not qualify as evidence for the above exaggerated claims (in particular, see Moore, 1982; Pratkanis & Greenwald, 1988), they nevertheless beg the question of whether suboptimal affective stimuli could be used to exert more modest influences in different applied contexts when ethical issues are appropriately addressed. This question is particularly important for modern digital applications, where the presentation of such suboptimal primes would be technically easy. One potential example (among others) is news media, which is increasingly often consumed on computer displays and mobile devices. In the present investigation, we explored this topic by studying the effects of suboptimal exposure to affective facial expressions during textual news message reading.

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1.1. Suboptimal priming and affects

In the suboptimal affective priming paradigm, a participant is exposed to an affective prime stimulus so briefly that it is not fully accessible to subjective consciousness, but some of its features can nevertheless be processed automatically. Backward masks are typically presented immediately after the primes to interrupt the transfer of affective information from a sensory buffer to working memory (Greenwald, Draine, & Abrams, 1996). Typical affective primes used in previous studies have included single emotionally charged words (e.g., Fazio et al., 1986; Greenwald et al., 1989), affect-arousing images (e.g., Hermans, Spruyt, de Houwer, & Eelen, 2003), and facial expressions (e.g., Dimberg et al., 2000; Murphy & Zajonc, 1993; Stapel et al., 2002). Note that following some previous studies (Murphy & Zajonc, 1993; Rotteveel et al., 2001), we have here adopted the term suboptimal rather than subliminal to allow for the possibility that limited but objectively measurable conscious processing might take place even at extremely brief stimulus exposures (see Merikle, Smilek, & Eastwood, 2001).

Previous studies have demonstrated that the effects of affective primes on subsequent stimuli depend drastically on prime exposure times. In a series of experiments, Murphy and colleagues (Murphy & Zajonc, 1993; Murphy et al., 1995) compared the effects of suboptimal (4-ms; however, in reality closer to 10-ms, see Rotteveel et al., 2001) and optimal (1000-ms) presentations of facial stimuli on subsequent affectively neutral Chinese ideographs. Their results demonstrated that at suboptimal exposures, happy facial expressions increased and angry facial expressions decreased the participants' liking ratings for the ideographs—that is, the affective tone of the faces was assimilated into the affectively neutral stimuli. In contrast, only optimally presented male and female faces had congruent effects on the perceived femininity of ideographs. In a series of experiments, Stapel et al., 2002 investigated these findings further by presenting facial stimuli at suboptimal 30-ms and 100-ms exposure times. Their findings confirmed that at 30-ms exposure, affective features were extracted and became assimilated into the following stimuli; whereas extraction of gender information became possible only at 100-ms exposure times.

These findings suggest that rudimentary affective processing, such as identifying the hedonic tone of a facial expression, can take place before more detailed perceptual or cognitive processing—that is, they give support to the "affective primacy hypothesis" by Zajonc (1980). A plausible neural explanation for this phenomenon is that the evaluation of affective significance in subcortical brain circuits, amygdala in particular, takes place prior to and independent of later cortical processing that is associated with conscious awareness (LeDoux, 1989; see also Berridge, 2003). Consistently, brain imaging evidence has demonstrated haemodynamical responses to suboptimal presentations of emotional facial expressions (Whalen et al., 1998). When the extracted affective features cannot be attributed to consciously perceived objects, they may be displaced onto an unrelated but temporarily close stimulus instead. The affective primacy hypothesis entails that longer exposure times are needed for decoding more complex information. Consequently, this hypothesis may help explain why suboptimal verbal suggestions (e.g., "Choose this") are largely ineffective when embedded in other stimuli (e.g., Smith & Rogers, 1994).

Most affective priming studies have relied on single self-report items for measuring affective responses (e.g., subjective liking). More refined emotion evaluation scales could reveal more subtle effects due to suboptimal experimental manipulations, however. A circumplex model of emotion suggests that most emotions can be placed circularly in a space spanned by valence (unpleasant–pleasant or negative–positive) and arousal (e.g., calm–excited or relaxed–tense) dimensions (Posner, Russell, & Peterson, 2005; Russell, 1980). An alternative conceptualization has suggested that the two main orthogonal dimensions of affective experience are positive activation (e.g., elated vs. dull) and negative activation (e.g., fearful vs. calm), which correspond roughly to main axes in a valence–arousal space that has been rotated 45 degrees counter-clockwise (Watson & Tellegen, 1985; Watson, Wiese, Vaidya, & Tellegen, 1999). This model holds theoretical appeal particularly because the PA and NA dimensions can be seen as subjective components of the behaviorally fundamental approach and withdrawal systems (Watson et al., 1999). An additional benefit of treating positivity and negativity separately is that it allows simultaneous appetitive and aversive reactions to stimuli (cf. Cacioppo, Gardner, & Berntson, 1999).

In addition to subjective experiences, facial (and other) expressions constitute a major component of emotions (Scherer, 2005). Facial EMG measurements over specific muscle regions have been established as sensitive psychophysiological correlates of affect (P. J. Lang, Greenwald, & Bradley, 1993). Increased activities at the *zygomaticus major* (ZM; lip corner raiser) and *corrugator supercilii* (CS; brow furrower) muscle regions have been associated with positive and negative valences, respectively (P. J. Lang et al., 1993; Witvliet & Vrana, 1995). Activity in the outer region of orbicularis oculi (OO; cheek raiser) muscle has been associated with positively valenced high-arousal emotional states (Jäncke, 1994; Ravaja, 2004a), and visible changes in this region have also been suggested to differentiate genuine from casual smiling (Ekman, Davidson, & Friesen, 1990). Previous studies have demonstrated that activations in these muscle regions are associated with emotional valence also in the context of textual news media (Kätsyri, Ravaja, & Salminen, 2012; Ravaja & Kallinen, 2004; Ravaja, Saari, Kallinen, & Laarni, 2006).

An important advantage of facial EMG measurements over self-reports in suboptimal priming studies is that they are measured during, not after, the stimulus presentation. Facial activity measurements should hence be more appropriate for measuring immediate emotional reactions independently of other cognitive or social factors. The sensitivity of facial EMG for measuring involuntary responses to suboptimal stimuli has already been demonstrated. Dimberg et al. (2000) showed that, when participants were exposed to 30-ms presentations of facial expressions, happy and angry faces evoked the strongest responses in the ZM and CS regions, respectively. In another study, suboptimal (10-ms) presentations of happy and angry faces elicited similar congruent facial EMG responses in the ZM and CS regions; additionally, these responses were stronger to suboptimal than to optimal (1000-ms) presentations (Rotteveel et al., 2001).

1.2. Affective congruency and priming

Several previous studies have implied that when both the prime and consecutive target stimuli contain affective meaning (e.g., both represent either positive or negative valence), their affective congruency has a significant impact on the processing of target stimuli. In their seminal study, Fazio et al. (1986) showed that positive and negative target words that were preceded by affectively congruent suboptimal prime words were classified faster and with a better accuracy than similar words with incongruent primes. Later studies have demonstrated similar effects using words as primes and targets (Draine & Greenwald, 1998; Greenwald et al., 1989), affective pictures as primes and targets (Spruyt, Hermans, de Houwer, & Eelen, 2002), and facial expressions as primes and words as targets (Hsu, Hetrick, & Pessoa, 2008). Some evidence exists that the effects were based more on facilitation by affective congruency than interference by affective