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Necker's smile: Immediate affective consequences of early perceptual processes

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ABSTRACT

Current theories assume that perception and affect are separate realms of the mind. In contrast, we argue that affect is a genuine online-component of perception instantaneously mirroring the success of different perceptual stages. Consequently, we predicted that the success (failure) of even very early and cognitively encapsulated basic visual processing steps would trigger immediate positive (negative) affective responses. To test this assumption, simple visual stimuli that either allowed or obstructed early visual processing stages without participants being aware of this were presented briefly. Across 5 experiments, we found more positive affective responses to stimuli that allowed rather than obstructed Gestalt completion at certain early visual stages (Experiments 1–3; briefest presentation 100 ms with post-mask), and visual disambiguation in possible vs. impossible Necker cubes (Experiments 4 and 5; briefest presentation 100 ms with post-mask). This effect was observed both on verbal preference ratings (Experiments 1, 2, and 4) and as facial muscle responses occurring within 2–4 s after stimulus onset (zygomaticus activity; Experiments 3 and 7). For instance, in participants unaware of spatial possibility we found affective discrimination between possible and impossible Necker cubes (the famous Freemish Crate) for 100 ms presentation timings, although a conscious discrimination took more than 2000 ms (Experiment 4).

Interaction with the environment requires fast assessment of threats and opportunities. Within an appraisal theory of emotion, Leventhal and Scherer (1987) proposed that input undergoes different stimulus evaluation checks, some of them at a very early stage of the perceptual process. One of these early evaluation checks consists in an assessment of the affective quality of the stimulus, that is, whether the stimulus is positive or negative. Demonstrating this, a bulk of research has shown how fast affective stimuli are evaluated (e.g., Bargh, Chaiken, Raymond, & Hymes, 1996; Handy, Smilek, Geiger, Liu, & Schooler, 2010; Kuhbandner, Spitzer, & Pekrun, 2011; LeDoux, 2000; Morris, Öhman, & Dolan, 1998).

The present article examines the possibility of such early evaluation checks for emotionally *neutral* stimuli. Basically, we propose that affect is a genuine online-component (cf., Barrett & Bar, 2009) of perception, instantaneously mirroring the success of different perceptual stages (for similar reasoning concerning affect and cognition, see Duncan & Barrett, 2007; Eder, Hommel, & De Houwer, 2007; Storbeck & Clore, 2007). Hence, we predict that obstructing early perceptual processes should elicit rapid and subtle affective responses.

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Evidence that partly supports this notion comes from research on *processing fluency*, which is the content-independent speed and efficiency with which mental operations are carried out (Reber, Schwarz, & Winkielman, 2004). In fluency research, dynamics of perceptual processing may trigger downstream affect if the perceptual process as a whole is rendered more or less efficient (Reber, Winkielman, & Schwarz, 1998; Winkielman & Cacioppo, 2001; Winkielman, Halberstadt, Fazendeiro, & Catty, 2006). For instance, Reber et al. (1998) increased the perceptual fluency of visually degraded black-and-white drawings of everyday objects by briefly presenting the contour of the drawings before the actual target drawing was shown. They found that drawings preceded by their own contour were preferred over drawings preceded by an unrelated visual contour (Experiment 1). Obviously, the visual prime rendered the subsequent visual processing of the target drawing more efficient and thereby evoked positive affect (see also Winkielman & Cacioppo, 2001; for further judgmental effects beyond mere preference, see, for instance, Reber, Brun, & Mitterndorfer, 2008; Reber & Schwarz, 1999; Rhodes & Castel, 2008; Topolinski, 2014).

Such fluency manipulations alter the speed and efficiency of a perceptual process that will be successful eventually, regardless how easy or hard it was to execute (e.g., Reber & Schwarz, 1999; Reber et al., 1998, 2008; Unkelbach, 2007; Winkielman & Cacioppo, 2001). Thus, fluency research targets the *quantitative* aspect of processing dynamics, i.e., how efficient a certain information processing step can be rendered. Going beyond this, the present approach targets the *qualitative* aspect of whether a certain perceptual processing step can be rendered at all. On a coarse level, this may still affect overall processing fluency, but to the present authors' knowledge, no previous experimental manipulation realized such a selective inhibition of certain visual processes.

Moreover, in fluency research the presentation timing of target stimuli is usually long enough to allow identification of the source of fluency or disfluency (e.g., Reber et al., 1998). Although some priming presentations or manipulations of visual fluency were subliminal, such as in the famous 1-ms exposure by Kunst-Wilson and Zajonc (1980), the later target stimulus that was to be rated was often presented until participants rendered their rating (e.g., Reber et al., 1998, p. 46) or was presented for more than 500 ms (Kunst-Wilson & Zajonc, 1980, 1000 ms, p. 557; Winkielman & Cacioppo, 2001, 600 ms, p. 993). In the shortest target presentation we are aware of, Bar and Neta (2006) showed their stimuli for 84 ms. They manipulated the contour (curved vs. sharp angles) and found that people liked curved angles better. However, they did not mask the stimuli, and the manipulation of course was clearly visible.

Because we attempt to show immediate affective responses as online part of perception, the present experiments went beyond those earlier presentation conditions in two ways. First, we shortened the duration of stimulus presentation to 100 ms (and even 25 ms in some experiments). This duration is not subliminal but clearly shorter than in extant research. Second, we provide affect measures such as physiological responses that allow mapping very immediate stimulus evaluation at an early stage of the perceptual process. Note that this is unlike existing research on perceptual fluency, where stimuli have been shown for longer durations (e.g., Winkielman & Cacioppo, 2001) and no measure of the speed of affective activation has been employed.

In the following experiments, we chose two exemplary cases of early perceptual processes, namely Gestalt completion (Wertheimer, 1923; see also Bowers, Regehr, Balthazard, & Parker, 1990) and visual disambiguation (Long & Toppino, 2004) in the famous Necker cube (Necker, 1832), without the assertion that these two phenomena are completely distinct from each other. For both phenomena, experimental manipulations enabled or obstructed these early perceptual processes without participants becoming aware of this intervention. As dependent measures, we probed affective responses both with (1) verbal reports of stimulus liking as the most established measure in previous research (e.g., Reber et al., 2004) and (2) facial electromyography as a more indirect physiological measure (cf., Winkielman & Cacioppo, 2001). While alternative explanations might be derived for a single manipulation and single dependent measure, a consistent pattern across stimuli and manipulations should bolster our claim of affective consequences of success and failure in perceptual processing in general.

1. Data analysis

We determined minimal sample sizes with a priori power analyses (*G* ∗ *Power* 3, Faul, Erdfelder, Lang, & Buchner, 2007) attempting a power of 0.80 using the effect sizes of either related effects in the literature (namely Reber et al., 1998, for explicit ratings; and Winkielman & Cacioppo, 2001, for electromyography; see Fritz, Morris, & Richler, 2012, for this procedure) or the actually obtained effect sizes in the current string of experiments to guide the next experiment, respectively. For the convenience of integrating studies in other experiments, actual sample sizes often highly exceeded required sample size. All exclusion criteria and preparatory steps prior to the main analyses are described in the text.

2. Experiment 1

As a first demonstration that basic perceptual processes evoke immediate affective responses without higher cognitive elaboration we chose *Gestalt completion* (Wertheimer, 1923; see also Bowers et al., 1990; Ekstrom, French, Harman, & Dermen, 1976), which is an early visual capacity running fast and efficiently. Working with visual occlusion paradigms, researchers observed that it takes about 150 ms to complete the Gestalt of simple objects once the occlusion is removed (Sekuler & Palmer, 1992).

An experimental set-up evoking Gestalt completion is the *Waterloo Gestalt Closure Task* (Bowers et al., 1990), in which the stimuli are images of everyday objects that are visually degraded to such a degree that the depicted objects themselves are barely identifiable, yet their visual Gestalts are still subtly implied (Fig. 1 shows an example