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Masked emotional priming: A double dissociation between direct and indirect effects reveals non-conscious processing of emotional information beyond valence

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ABSTRACT

We demonstrate non-conscious processing beyond valence by employing the masked emotional priming paradigm (Rohr, Degner, & Wentura, 2012) with a stimulus-onset asynchrony (SOA) variation. Emotional faces were briefly presented and directly masked, followed by the target face, using a SOA of either 43 ms or 143 ms. Targets were categorized as happy, angry, fearful, or sad. With short SOA, we replicated the differentiated priming effect within the negative domain (i.e., angry differentiate from fearful/sad). A direct test of prime awareness indicated that primes could not be discriminated consciously in this condition. With long SOA, however, we did not observe the priming effect whereas the direct test indicated some degree of conscious processing. Thus, indirect effects dissociated from direct effects in our study, an indication for non-conscious processing. Thereby, the present study provides evidence for non-conscious processing of emotional information beyond a simple positive-negative differentiation.

1. Introduction

There is a long and sometimes heated debate about how to demonstrate non-conscious processing of stimuli or stimulus features in sequential priming paradigms (e.g., Holender, 1986; Reingold & Merikle, 1988; Schmidt & Vorberg, 2006). A standard procedure to establish evidence for non-conscious processing is to combine an indirect test and a direct test of prime processing (for alternatives see Lähteenmäki, Hyönä, Koivisto, & Nummenmaa, 2015; Schmidt, 2015): In the indirect test, participants respond to clearly visible target stimuli, preceded by a sequence of a briefly presented prime and a masking stimulus. In the direct test, identical trials are presented but participants respond to the primes instead of the targets. Typically we infer non-conscious processing from observed priming effects in the indirect test with the absence of priming effects in the direct test (i.e., indicating no conscious prime awareness; e.g., Dehaene et al., 1998; Klauer, Eder, Greenwald, & Abrams, 2007). This route has, however, some caveats. For example, besides the notorious null hypothesis testing problem (here: for the direct test), the zero awareness criterion is often not perfectly met (e.g., Draine & Greenwald, 1998; Reingold & Merikle, 1988; Schmidt, 2007; Schmidt & Vorberg, 2006).

Greenwald, Klinger, and Schuh (1995) addressed this problem by suggesting a regression method, regressing the individual priming differences between incongruent and congruent conditions on the individual prime detection indices. They

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argue that a significant intercept might be interpreted as the existence of a priming effect in the absence of prime awareness (given the adequate regression procedure, Klauer, Draine, & Greenwald, 1998; Klauer, Greenwald, & Draine, 1998, and some boundary conditions, see Klauer & Greenwald, 2000). However, there is a considerable and challenging debate about the regression method (see, Dosher, 1998; Klauer et al., 1998; Klauer & Greenwald, 2000; Merikle & Reingold, 1998; Miller, 2000; Schmidt & Vorberg, 2006) that focuses on the question whether the intercept dominantly reflects error variance if no strong relationship between priming differences and prime detection indices is given (which is typically the case). Thus, alternative solutions are highly desirable.

As an alternative route, Schmidt and Vorberg (2006); see also Kouider & Dehaene, 2007; Schmidt, 2007, 2015) proposed demonstrating experimental dissociations: If a certain experimental manipulation (e.g., SOA, prime duration, variations of attention) influences direct and indirect tests in opposite directions, these can be more straightforwardly explained by different – that is, conscious versus non-conscious – underlying processes. The authors contrast a general model which assumes that conscious and non-conscious perceptual information both influence the direct and the indirect measure with a null model which denies the non-conscious influences. This null model is falsified (given some rather mild assumptions) by observing such a double dissociation. The prime example given by Schmidt and Vorberg (2006) is the variation of the prime-target stimulus-onset asynchrony (SOA): In their response priming paradigm with meta-contrast masking (see Vorberg, Mattler, Heinecke, Schmidt, & Schwarzbach, 2003) they observed (given specific conditions) *increasing* priming effects with increasing SOA, but *decreasing* performance in the direct measure. Consequently, the priming effects must result from non-conscious processes; otherwise, they should have increased with increasing awareness. The approach from Schmidt and Vorberg (2006) thus possess the advantage that alternative explanations (i.e., error variance, conscious processes) for the observed effects are more easily excluded.

In the present study, we applied this approach to the masked emotional priming paradigm, a variant of the evaluative priming paradigm (Rohr, Degner, & Wentura, 2012). In our earlier research, we presented happy, angry, fearful, and sad facial primes for brief durations. Primes were always masked, thereby precluding at least subjective awareness for most participants. Subsequent to the masks, emotional faces (Experiment 1 and 2) or emotional words (Experiment 3) were presented as targets, which had to be categorized with regard to emotion. In all experiments, we observed significant congruency effects, that is, on average responses to emotion-congruent prime-target pairings (i.e., the prime emotion matching the target emotion) were faster than average responses to incongruent pairings. Further analyses revealed that the priming effects were based on (a) a differentiation of valence (i.e., happy expressions being clearly differentiated from all negative emotions) and (b) on a differentiation within the negative emotion domain with anger being clearly differentiated from fear and sadness.

These results indicate that more than the distinction between happy versus negative expressions (i.e., mere valence) is extracted from briefly presented and masked prime faces. Specifically, the differentiation of anger vs. fear/sadness faces is expected from different theoretical perspectives: First, Adams and Kleck (2003) argue that happy and anger expressions are signals of approach for the perceiver, whereas fear and sadness are signals of avoidance (see also Paulus & Wentura, 2016). Therefore, approach- versus avoidance types of emotions may be discriminated automatically, potentially non-consciously. Second, appraisal theories (Moors, Ellsworth, Scherer, & Frijda, 2013; Scherer, 1984, 2013) assume that individuals first and immediately engage in appraisal checks of novelty, valence, and relevance when encountering a stimulus. In this regard, joy and anger can be seen as more relevant, given their direct implications for the social interaction. In a similar account, emotions can be classified as possessor- vs. other-relevant (Peeters, 1983).[1] Within the negative domain, angry faces are predominantly *other-relevant:* They unequivocally signal behavioral relevance for an observer (i.e., the anger is directed at him or her). Sad or fearful faces predominantly signal *possessor-relevance*: They are unequivocally negative for the person experiencing (and expressing) this emotional state; their implications for observers are, however, more ambiguous (i.e., an outgroup member signalling fear might be seen as relatively positive; Paulus & Wentura, 2014). We have repeatedly demonstrated evidence for automatic processing of this type of relevance for social attributes (i.e., adjectives; e.g., Degner & Wentura, 2011; Wentura & Degner, 2010; Wentura, Rothermund, & Bak, 2000; see also Prochnow, Brunheim, Steinhauser, & Seitz, 2014).

Our previous research revealed that this type of differentiation within negative emotions was even found under limited processing conditions (Rohr et al., 2012), a finding which is in line with the functional perspectives on emotions outlined above. Without taking a specific theoretical perspective, we refer to this priming effect as a *relevance priming effect*. Finally, we did not find evidence for category-specific processing of emotional faces, that is, the interaction contrast, which tested for the differentiation between fear and sadness was not significant throughout the experiments. This result indicates that the paradigm does not simply reflect a semantic categorization of all prime types.

With the current research we explore to what extent the differentiated priming effects observed in our previous research (Rohr et al., 2012) are based on non-conscious processing. We therefore use the dissociation approach suggested by Schmidt and Vorberg (2006): We manipulated SOA in the emotional priming paradigm, comparing a short SOA condition (i.e., 43 ms; replicating Experiment 2 in Rohr et al., 2012) with a long SOA condition (i.e., 143 ms).

Note, that any SOA manipulation in a masked priming experiment has an inevitable confound because the SOA is either extended by increasing the mask duration or by presenting a blank screen between mask and target. Thus short and long SOA conditions either additionally differ regarding the duration of mask presentation (which may differentially impact prime

[1] Originally, Peeters (1983) used the terms self- vs. other-profitable.