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# Trial-by-trial effects in the affective priming paradigm

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ABSTRACT

In this paper, we yield evidence for the dependence of affective priming on the congruency of the previous trial. Affective priming refers to the finding that valence categorizations of targets are facilitated when the preceding prime is of the same valence. In two experiments, affective priming was diminished after incongruent trials (i.e., prime and target were of different valence), whereas, significant affective priming was observed after congruent trials (i.e., prime and target were of same valence). We compare this pattern to the known sequential dependencies in Stroop- and Eriksen-type tasks. Furthermore, our results can help to improve the statistical power of studies in which the affective priming task is used as a measure for automatic evaluations of attitude-objects.



## 0. Introduction

The affective priming paradigm was introduced by Fazio, Sanbonmatsu, Powell, and Kardes (1986). In this paradigm, each target stimulus (e.g., a valent word) is preceded by a single prime (e.g., a valent word) and participants' task is to categorize the target valence as positive or negative. Affective priming refers to the finding that target categorizations are facilitated if the preceding prime has the same valence as the target (for reviews see Fazio, 2001; Klauer & Musch, 2003; see also Wentura & Rothermund, 2003a; Wentura & Rothermund, 2003b). Usually, the affective priming effect is explained in analogy to a Stroop- or Flanker-task: the task-irrelevant feature of prime valence either helps or hinders in terms of quickly generating a target response, depending on congruency with target valence (see Klauer, Rossnagel, & Musch, 1997; Wentura, 1999).[1]

Although there has been a lot of basic research on affective priming, there remain open questions about the intricacies of the effect. Some of these questions are stimulated by research on paradigms that are near neighbors of the affective priming paradigm. For example, we already pointed out that the task is often seen in analogy to the Stroop- or Flanker-task. For these tasks, it is known that if the incongruent stimulus of trial $n-1$ is presented as the target of trial $n$, responses are slowed down (a phenomenon known as negative priming, Darlymple-Alford & Budayr, 1966). Transferred to the affective priming paradigm, Wentura (1999) found that if the prime's valence was incongruent in trial $n-1$, responses to targets in trial n that were non-identical to the preceding prime but congruent in valence were slowed down (negative affective priming; see also Frings, Wentura, & Holtz, 2007). A second example is the relatedness proportion of congruent vs. incongruent trials that is known to affect Stroop effects. Proceeding from a Stroop analogy of the affective priming task, Klauer and colleagues (1997) and Klauer, Mierke, and Musch (2003) varied the proportion of congruent prime-target pairs in the affective priming paradigm and found the affective priming effect to be greater with a higher proportion of congruent pairs, even for short stimulus-onset asynchronies of prime and target.

In this tradition, we want to draw an analogy with respect to sequential dependencies known from other Stroop-, Simon-, Flanker-, and response priming studies. In a nutshell, this analogy will lead to the hypothesis that affective priming processes in a given trial (leading to the incongruency effect) depend on the congruency of the preceding trial. That is, affective priming will be found after congruent trials, but will be significantly reduced up to non-existence after incongruent trials. There are a large number of studies analyzing sequential modulation of Flanker effects (e.g., Botvinick, Nystrom, Fissell, Carter, & Cohen, 1999; Gratton, Coles, & Donchin, 1992), Simon effects (Stürmer, Leuthold, Soetens, Schröter, & Sommer, 2002), Stroop-like tasks (Greenwald & Rosenberg, 1978), or response-priming effects (e.g., Kunde, 2003; Kunde & Wühr, 2006). These studies demonstrate that after an incongruent trial, that is a trial in which the distractor/prime and the target evoke different responses, the Flanker or priming effects were diminished compared to trials following a congruent trial.

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[1] In this article, we solely focus on affective priming in the evaluation task, which is structurally a version of response priming tasks. Affective priming using other tasks (e.g., lexical decision, e.g., Wentura, 2000, or naming, e.g., De Houwer, Hermans, & Spruyt, 2001) are structurally versions of semantic priming tasks and should be discussed separately.

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Several mechanisms have been purposed to explain this pattern. For example, the gating or suppression account (cf. Kornblum, Hasbroucq, & Osman, 1990; Kunde, 2003; Mordkoff, 1998) assumes that responses are generated by an automatic S-R route (i.e., the process initiated by the distractor/prime) and a controlled S-R route (i.e., processing the target). In incongruent trials, however, the automatic route causes interference and hence becomes blocked in the following trial. This in turn leads to smaller interference in incongruent trials following incongruent trials and smaller benefits in congruent trials following incongruent trials. Alternatively, work by Hommel (2000), Hommel, Proctor, and Vu (2004) suggests that sequential modulations are due to complete versus partial matches/mismatches of the features in the current trial and in the previous one. In the case of complete matches the previous response could directly be repeated and in the case of complete mismatches a new response could directly be computed. When prime and target, however, share some features while mismatching on others, this partial match slows the response time down due to the ambiguity of repeating the previous response or generating a new one. There is evidence for both mechanisms at least in the Simon task (see Wühr, 2004; Wühr, 2005), and the present study is not concerned with deciding between these accounts.

Would affective priming also show a sequential modulation by congruency of the previous trial? On the one hand, given that affective priming is usually explained as a variant of a Stroop or Flanker task, one could also expect trial-by-trial modulations of affective priming in the dependence of the congruency of the previous trial. However, on the other hand, it is also possible to think of the contrary. In fact, when valent material is used as in affective priming, one could assume that the cognitive system handles such 'hot' information in a special way; that is even after an incongruent trial, it would not be possible to ignore the irrelevant valent information (the prime) and hence affective priming would not be modulated by the congruency of the previous trial. There is a lot of evidence that valent information is processed in a special way. For example, negative irrelevant stimuli seem to interfere with color pronunciation (the emotional Stroop task, see Williams, MacLeod, & Mathews, 1996, for a review), and participants' own names cannot be ignored in selection tasks (e.g., Frings, 2006; Shapiro, Caldwell, & Sorensen, 1997).

In fact, when scanning the relevant literature there is tentative evidence for sequential modulations in affective priming. However, the finding of a trial-by-trial modulation was never targeted in a study; instead it was reported as a by-product in two studies (Greenwald, Draine, & Abrams, 1996; Musch, 2000). Greenwald et al. (1996) had a focus on masked ("subliminal") priming effects. They reported that their masked priming effect did not depend on sequence, whereas a supraliminal control effect did. Using a 50 ms presentation of primes and a SOA of 150 ms, they found robust priming effects for trials following congruent as well as incongruent trials, however, with a clearly perceptible difference in magnitude in favour of those trials with congruent predecessors.[2] They discussed the higher order interaction as evidence for the dissociation between subliminal and supraliminal effects, but did not elaborate on the sequential effects themselves. Musch (2000); see also Musch, Klauer, & Mierke, 2008) focussed on the relatedness proportion effect (i.e., larger effects with a higher proportion of congruent trials). Knowing the result of Greenwald et al. (1996), however, Musch argued that an effect of relatedness proportion might be a covered effect of local sequences because an overall higher proportion of congruent trials leads automatically to a higher rate of trials that *follow* a congruent trial. In several experiments, he took different means to experimentally control for that alternative explanation (see below). In his Experiment 1 (using a 57 ms prime presentation of primes and a SOA of 71 ms), however, he analyzed his data *post hoc* with regard to local sequences and reported a significant sequence effect (i.e., larger priming following a congruent trial).

So far, we can with some caution affirmatively answer the question as to whether sequential effects can be found for the affective priming task. However, for some reasons it seems worthwhile to directly analyze the sequence effect. First, a detail of both the Greenwald et al. (1996) and the Musch (2000) experiments make the evaluation a bit difficult. Both conducted experiments using a gender classification task as a control and report some essential statistics (with regard to the sequence effect) only for the combined data sets of affective and gender classifications. In the gender classification task, participants categorize common first names with regard to gender. In structural equivalence to the affective priming task, other first names that are either congruent or incongruent to the target with regard to gender are presented as primes. For the Greenwald et al. data, only means of combined data were reported. Thus, we cannot disentangle results for the two tasks. Musch reports an overall sequential effect (i.e., the difference between priming after a congruent vs. incongruent trial) of app. $d = 0.40$.[3] Although it is not significantly moderated by task, the difference in means is about twice for the gender classification task compared to the evaluation task. Thus, we cannot evaluate the robustness of the finding. Moreover, in his Experiment 2, he analyzed the relatedness proportion effect (i.e., whether affective priming increases from a 25% over a 50–75% rate of congruent trials) in two different ways: To control for local sequences, his dominant analysis focuses on sequences that were balanced with regard to the preceding trial for all three relatedness conditions. To establish the different relatedness proportions, however, these experimental trials were embedded into filler trial sequences that were completely incongruent for the 25% condition and completely congruent for the 75% condition (and balanced for the 50% condition). Interestingly, analyses suggested no significant differences for the relatedness proportion effect if calculated on the basis of all trials or the experimental trials only. The existence of strong sequence effects would have predicted a difference between the experimental trials and all trials: when all trials were analyzed sequence effects should have diminished affective priming in the 25% condition additionally to the proportion effect and should have enhanced affective priming in the 75% condition additionally to the proportion effect.

Thus, it seems worthwhile to analyze trial-by-trial effects in the standard affective priming setting without proportion manipulations and furthermore with SOA variations usually used in affective priming studies. In addition, we solely focus on the evaluation task (i.e., we do our experiments without the gender classification task). Although there is nothing against the hypothesis that effects in the two tasks are based on essentially comparable processes, the affective priming version takes on a special position in the literature. Seen as reflecting the unintentional automatic activation of prime valence, it is often used as an indirect measure for attitudes (with attitude-related stimuli as primes; e.g., Fazio, Jackson, Dunton, & Williams, 1995; see also Fazio & Olson, 2003). Any process characteristics that might be of help to foster our understanding of such a measure is surely welcome. Moreover, finding a sequential modulation of affective priming would suggest that at least for this property information processing for *hot* and *cold* stimuli is alike.

## 1. Experiment 1

In this experiment a standard affective priming task was used. We varied the SOA between 63 ms and 188 ms to cover a typical

[2] The inferential statistics for the comparison is missing (due to the brevity of a *Science* report), but it can be easily inferred from their Fig. 3 that the difference must be significant.

[3] The value was calculated by using the reported *F*-value.