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BRIEF ARTICLE

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A different kind of pain: affective valence of errors and incongruence*

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ABSTRACT
People hiss and swear when they make errors, frown and swear again when they encounter conflicting information. Such error- and conflict-related signs of negative affect are found even when there is no time pressure or external reward and the task itself is very simple. Previous studies, however, provide inconsistent evidence regarding the affective consequences of resolved conflicts, that is, conflicts that resulted in correct responses. We tested whether response accuracy in the Eriksen flanker task will moderate the effect of trial incongruence using affective priming to measure positive and negative affect. We found that responses to incongruent trials elicit positive affect irrespective of their accuracy. Errors, in turn, result in negative affect irrespective of trial congruence. The effects of conflicts and errors do not interact and affect different dimensions of affective priming. Conflicts change the speed of evaluative categorisation while errors are reflected in categorisation accuracy. We discuss the findings in light of the "reward value and prediction" model and the "affect as a feedback for predictions" framework and consider the possible mechanisms behind the divergent effects.

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Nobody likes to make mistakes. Surely, they can lead to new discoveries, but usually one would prefer a less painful road. Similarly, conflicting information, such as inconsistent results of two experiments, is something one would like to avoid. Neither errors nor conflicts have to be especially serious to result in an unpleasant experience. Previous studies have shown that even errors in simple cognitive tasks can lead to negative affect (Aarts, De Houwer, & Pourtois, 2012; Chetverikov, 2014; Chetverikov & Filippova, 2014; Chetverikov, Jóhannesson, & Kristjánsson, 2015). Negative affect also arises when observers deal with simple perceptual or motor incongruence, such as incompatible trials in the Eriksen flanker task, an incongruent Stroop stimulus, or negative priming in visual search (Brouillet, Ferrier, Grosselin, & Brouillet, 2011; Chetverikov & Kristjánsson, 2015; Dreisbach & Fischer, 2012; Fritz & Dreisbach, 2015; Schouppe et al., 2015). Here we looked into whether these two sources of negative affect work in a similar fashion and whether they interact with each other using affective priming to measure negative affect in the Eriksen flanker task.

Dreisbach and Fischer (2012) found empirical evidence for the aversive nature of conflict using the affective priming paradigm to measure affect. Observers viewed Stroop stimuli followed by pictures or words with positive and negative valence. They did not have to respond to the Stroop stimuli, but they had to categorise the pictures or words as positive or negative. Such categorisation tasks are often used to measure affect because activation of positive or negative affect leads to speeded responses to positive or negative targets, respectively, or to changes in the

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*The data and scripts for analyses reported in this paper are available at https://osf.io/pzxq6/.

categorisation accuracy. In other words, affect primes subsequent categorisation (Fazio, 2001). Dreisbach and Fischer (2012) reported that observers responded faster to positive stimuli and slower to negative ones following congruent compared to incongruent Stroop colour stimuli. Fritz and Dreisbach (2015) later demonstrated that incongruent Stroop stimuli also increase the chance that neutral targets will be categorised as negative though this effect could be reversed with longer presentation durations and stimuli onset asynchronies (SOA). Similar results were obtained with incompatible motor actions (Brouillet et al., 2011) and distractor-to-target role-reversals in visual search (Chetverikov & Kristjánsson, 2015). In addition, Braem et al. (2017) have recently demonstrated that negative pictures evoke less activation in the anterior cingulate cortex (ACC) after incongruent as compared to congruent trials, further supporting the idea that conflicts might be processed as aversive events.

Interestingly, Schouppe et al. (2015) found that negative affective priming in the Eriksen flanker task or in the Stroop task is reversed when observers have to make responses instead of passively observing primes. The authors explained this as a result of "conflict resolution" in line with the reward value and prediction model (RVPM; Silvetti, Seurinck, & Verguts, 2011). According to the RVPM, correct responses on incongruent trials elicit large positive prediction error because they are less frequent and thus less expected and consequently can be especially rewarding. Molapour and Morsella (2011) also measured affect evoked by responses to Stroop stimuli and in the flanker task. They did find a positive effect of incongruence on the affective ratings of nonsense shapes but only with Stroop stimuli and only when Stroop stimuli were shown simultaneously with the evaluated shapes. In contrast, in the study reported by Chetverikov and Kristjánsson (2015) observers also had to respond "resolving" the conflict (albeit in a visual search task) but the results showed that the conflict was associated with negative affect. In this study, the conflict was created by breaking observers' expectations, when stimuli that were distracting on trial N became targets on trial $N+1$. Such targets were liked less than the normal targets or the new stimuli. Finally, Chetverikov et al. (2017) assessed preferences for targets and distractors in the flanker task with facial stimuli and did not find any effect of trial congruence on preferences for correct responses. In sum, there is a strong evidence that observers experience negative affect when they passively view incongruent stimuli, but the results are contradictory when responses are needed.

A different line of research focused on the error-related negative affect. In a series of studies, Chetverikov and colleagues (Chetverikov, 2014; Chetverikov & Filippova, 2014; Chetverikov et al., 2015, 2017) found that errors in recognition, perceptual identification, and visual search lead to affective devaluation of stimuli, associated with errors. In a similar vein, Aarts et al. (2012) found that false alarms in a Go/NoGo task result in a negative affective priming. Crucially, this negative affect arises even though participants do not receive any feedback about their accuracy from the experimenter. For example, when observers failed to identify the category of a degraded and noisy image, they disliked this image regardless of its baseline affective valence (Chetverikov & Filippova, 2014).

Chetverikov and Kristjánsson (2016) explain error-related negative affect using the "affect as feedback for predictions" (AFP) framework. This framework suggests that affect is an integral part of the predictive activity of the brain (e.g. Clark, 2013). The AFP framework describes affect as feedback for predictions on a wide range of levels in the cognitive hierarchy. According to the model, sources of negative affect can be categorised under three broad categories: uncertainty (it is difficult to make accurate predictions), unexpectedness (violation of predictions), and conflict (different predictions contradict each other). Similar proposals have been made before, especially in the literature on aesthetic perception (e.g. Van de Cruys & Wagemans, 2011). However, the AFP is not limited to art perception and makes one further addition to the previous literature: not only negative affect results from inaccurate predictions (high prediction error) and positive affect from accurate ones (low prediction error), but it is also inversely weighted with a prior probability of prediction. That is, if prediction error is low, but the prediction itself was highly likely to be accurate, the experienced positive affect will be relatively weak.

The AFP predicts that errors will be associated with negative affect for three reasons: because errors are more probable when there is a strong conflict, because post-decisional accumulation of evidence might introduce new information (see Yu, Pleskac, & Zeigenfuse, 2015), and because a chosen response might itself serve as a source of information in evaluation of old and new predictions. So if post-decisional accumulation of information results in more evidence in favour of a correct response, this will be in conflict with the decision just made. This proposal suggests that negative affect resulting from errors and incongruence may be evoked by the same neural mechanisms (see also Daniel & Pollmann, 2014).

Furthermore, according to the AFP framework the stronger the evidence in favour of a correct decision, the stronger the negative affect following errors. This prediction follows from the idea that to make an error when the correct decision is strongly supported, observers need more evidence in favour of the incorrect decision as well (otherwise they would respond correctly). Moreover, even if they initially miss the information supporting the correct decision, it might become available during post-decisional accumulation of evidence. The inconsistency between predictions based on the evidence supporting correct and incorrect decisions will evoke stronger negative affect. Indeed, errors result in stronger negative affect when stimuli are exposed more often before a recognition task (Chetverikov, 2014), when observers are more confident in an identification task (Chetverikov & Filippova, 2014), and when observers gaze at the target longer before missing it in visual search (Chetverikov et al., 2015).

Presently, we are aware of only two studies that looked both at conflict- and error-related negative affect simultaneously (Schouppe et al., 2015; Chetverikov et al., 2017). As discussed above, Schouppe et al. (2015) found that correct responses in the Eriksen and Stroop tasks lead to a more positive evaluation of incongruent relative to congruent primes, as measured by changes in response times (RTs) (but not accuracy). However, after errors, observers were more likely to categorise the stimuli in evaluative categorisation task as negative, that is, there was an affective priming effect measured by changes in accuracy (but not RTs). Unfortunately, Schouppe et al. (2015) were not able to compare the priming after errors between incongruent and congruent trials due to a low number of errors. They only analysed errors in incongruent trials, because only in this condition there were sufficient number of erroneous trials for the analysis.

In sum, previous studies demonstrate that both conflict and errors might lead to negative affect. However, it is not clear whether conflict provides negative affect only when responses are incorrect or no responses are given (Schouppe et al., 2015) or is it generally negative (Chetverikov & Kristjánsson, 2016). Moreover, there could be a potential interaction between the effects of errors and conflict or a potential dissociation in the mechanisms of error- and conflict-related negative affect assessed with the affective priming paradigm. It is usually difficult to address this issue because errors are not frequent. Thus, we aimed to use the Eriksen flanker task combined with subsequent evaluative categorisation to test if we would obtain the same pattern of findings as reported by Schouppe et al. (2015) and to investigate the interactions between accuracy and congruence. We used a strict response deadline to obtain more errors for the analysis.

We derived predictions for our experiment from the two theories best suited to explain the effects of incongruence and errors: the RVPM and the AFP. The RVPM predictions regarding the Eriksen flanker task can be formulated in terms of the ACC activation and are presented by Silvetti et al. (2011, Simulation 3). The theory predicts that in correct trials, incongruent stimuli elicit higher ACC activation than congruent stimuli due to high positive prediction error, which is experienced as positive affect. In error trials, ACC activation is predicted to be higher for congruent trials than for incongruent ones due to negative prediction error, so congruent trials would lead to more negative affect. For the affective reactions following correct responses, this prediction was supported by Schouppe et al. (2015). Thus, regardless of the response accuracy, according to the RVPM we would observe relatively more negative affect following congruent trials in comparison with incongruent ones.

The AFP predicts that erroneous trials will elicit more conflict than correct trials. This should be true for both congruent and incongruent trials. In erroneous trials, the AFP further predicts more negative response in congruent trials than in incongruent ones, as the inconsistency between predictions involved in the decision is higher. In contrast, in case of correct trials, AFP predicts negative affect from incongruence only, that is, more negative response in incongruent trials than in congruent ones. This prediction is derived from the fact that conflict is one of the sources for negative affect in this framework.

Both theories predict more negative affect following errors, especially in congruent trials compared to incongruent ones. Thus, we expect a significant effect of response accuracy moderated by the congruence condition according to both theories. The RVPM, however, predicts that correct responses would lead to more negative affect following congruent trials compared to incongruent while the AFP makes the opposite prediction. In sum, the predictions for the RVPM and the AFP regarding affective consequences of errors in the flanker task are qualitatively the same, but their predictions regarding correct responses diverge. Previous studies of affective valence utilising the flanker task either did not empirically test for the interaction between congruence and accuracy due to the low number of errors (Schouppe et al., 2015) or used the average accuracy rather than trial-by-trial analyses (Chetverikov et al., 2017). We aim to fill this gap using the affective priming paradigm to estimate the effects of response accuracy and congruence in a flanker task.

Method

Procedure and stimuli

The experiment was run at Psychology Department of St. Petersburg State University using PsychoPy 1.84.2 (Peirce, 2007). Observers sat at approximately 55 cm distance from a 24-inch ViewSonic VG2401 LCD display with 1920 × 1080 resolution. Each trial consisted of a flanker task and an evaluative categorisation task.

In the flanker task, stimuli were composed of a target letter and four identical distractor letters, two on each side of the target. Participants were told to respond to the target letters and to ignore the flanking letters. The letters P, R, M, V, X, and W in Arial font with 1.3 degrees of visual angle (v.a.) height were used. The response keys for the flanker stimuli were "1", "2", and "3" on a standard numeric keypad, mapped with the stickers "P R", "M V", and "X W", respectively. Each letter was used as a target letter and was combined with a distractor letter that was either the same as the target (congruent stimuli) or required a different response (incongruent stimuli). In this way, 30 stimuli were constructed. Observers responded with the right hand (index finger for P or R, middle finger for M or V, ring finger for X or W). Stimuli were presented centrally for 850 ms. Flanker stimuli disappeared immediately after the response if the response was faster than 850 ms.

After each flanker trial, participants categorised the target stimuli as positive ("G" key labelled with a green sticker and signed "+") or negative ("B" key labelled with a red sticker and signed "−") using the left hand. 150 positive and 150 negative pictures equated for arousal were selected for this task from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008). The affective images size was 18.1° × 10.1° of v.a. Positive pictures had a mean valence of 6.72 ($SD = 0.4$) and a mean arousal of 5.17 ($SD = 0.37$); negative pictures had a mean valence of 2.84 ($SD = 0.4$) and a mean arousal of 5.16 ($SD = 0.52$). The difference in arousal was not significant, $t(268.5) = -0.203$, $p = 0.84$. The picture for categorisation was presented centrally immediately after the flanker response. Presentation and RT was limited to 10 s. One second fixation cross divided the affective categorisation response and the following flanker trial.

Overall there were 600 flanker trials and 300 pictures (each was presented twice: once after congruent and once after incongruent flanker trials) divided into 6 blocks with the self-paced breaks. There were 2 short training sessions before the main part of the experiment: flanker task training (until 75% of responses within 850 ms were correct in the last 16 trials) and flanker plus evaluation task (16 trials). The overall time of the experiment was about 40 minutes.

Participants

Thirty volunteers (18–31 years old; 27 women) took part in the experiment. They were paid 200 rubles for participation (approx. 3 USD at the time). Part of them were students of the Psychology Department at St. Petersburg State University, part of them were recruited through advertising outside the department. All participants gave an informed consent before participation. The experiment was approved by the ethics committee at St. Petersburg State University.

Results

Outliers

Trials with the RTs above 850 ms in the flanker task (8.7% of all trials), the first trial after every break, and the trials with RT in the evaluation task above 2000 ms or below 200 ms (7.2% of all trials) were excluded (the same criteria for the evaluation task were used by Schouppe et al., 2015).

Flanker task

We observed flanker effect in both RT and accuracy. Participants responded faster to congruent stimuli than to incongruent ones ($M = 581$, $SD = 27$ ms, vs.

$M = 600$, $SD = 31$ ms, respectively), $F(1, 29) = 95.34$, $p < .001$, $\eta_g^2 = .099$. For all accuracy analyses we used a logistic regression with the response accuracy as dependent variable. Congruent trials ($M = 90.3$% correct, $SD = 5.8$) were more accurate than incongruent ($M = 87.6$%, $SD = 6.4$), $B = -0.33$, $SE = 0.06$, $z = -5.12$, $p < .001$.

Affective reaction to (in)congruence

Only correct categorisation (positive vs. negative) responses after correct flanker trials were analysed. To control for the effect of RTs in the flanker task (congruent trials are systematically faster than incongruent), we followed the approach suggested by Schouppe et al. (2015) and added a binary variable for fast and slow responses in the flanker task (defined by median split) as a covariate to all models. We observed significant interaction between congruence and target valence in RTs, $F(1, 29) = 5.98$, $p = .021$, $\eta_g^2 = .002$. After congruent trials, positive targets were classified 48 ms slower than negative ones and the difference was smaller (21 ms) after incongruent trials. In the following text, we will refer to the difference between positive and negative targets categorisation RTs as negative priming. The results show that congruent trials elicit stronger negative priming in comparison with incongruent ones (Figure 1).

We then analysed the effect of flanker congruence on the affective categorisation accuracy (only the trials after correct responses in the flanker task were used). We did not find affective priming from flanker compatibility in accuracy data: accuracy of positive and negative targets classification after congruent ($M = 83.8$%, $SD = 10.1$, and $M = 92.7$%, $SD = 6.2$ accordingly) and incongruent ($M = 82.7$%, $SD = 11.4$, and $M = 92.5$%, $SD = 5.8$, accordingly) trials did not differ significantly, $B = 0.19$ ($SE = 0.16$), $z = 1.16$, $p = .245$.

Affective reaction on errors

Affective effects of erroneous and correct responses were analysed using linear mixed-effects regression due to the non-balanced design. A random intercept was added for every participant and every image in addition to a random slope for the flanker accuracy and the image valence for every participant.

The effect of errors on the affective priming RTs was not observed as indicated by a non-significant flanker accuracy and target valence interaction, $B = 0.02$ (SE = 0.02), $t = 1.07$. The difference between classification RTs of positive and negative targets (that is, the affective priming for RT, RT_{pos}–RT_{neg}) after the correct and erroneous responses in the flanker task was approximately the same (34 and 41 ms, respectively).

In contrast, we did find the effect of flanker accuracy in categorisation accuracy data. Negative targets were classified more accurately in general, but the difference in accuracy between positive and negative targets was higher after the errors in the flanker task (17.6%) in comparison to the correct flanker responses (8.4%). Flanker accuracy and target valence interaction was significant, $B = -0.58$ (SE = 0.24), $z = -2.41$, $p = .016$.

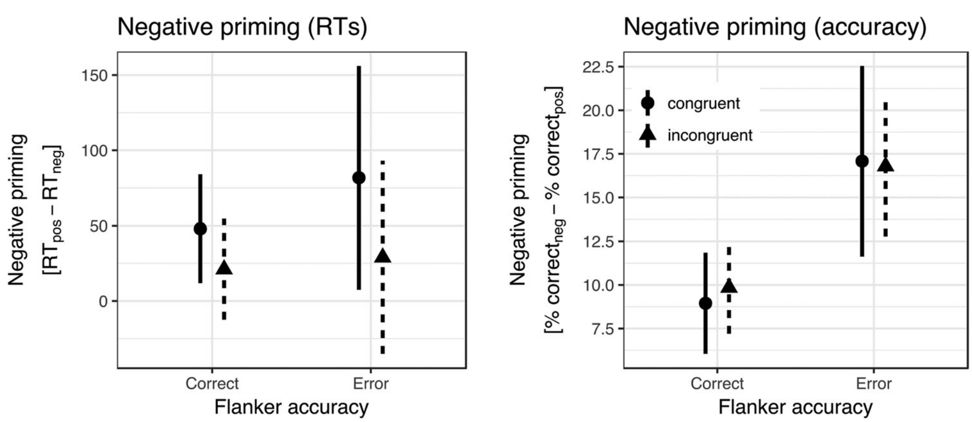

Figure 1. Negative priming by prime compatibility (circles vs. triangles) and prime response accuracy. Left panel presents negative priming in RTs of affective categorisation (mean RT for positive targets – mean RT for negative targets). Right panel presents negative priming in the accuracy of affective categorisation (mean accuracy of negative targets categorisation – mean accuracy of positive targets categorisation). Error bars represent 95% confidence intervals. In both cases, no significant congruency × accuracy interaction was found.

The interaction between flanker congruence and accuracy

The full mixed-effects regression model with flanker errors, flanker congruence, and target valence as predictors for the target classification RTs and accuracy revealed no significant three-way interactions, in both cases, $t < 1$ and $z < 1$. We additionally performed the Bayesian analysis to evaluate evidence for the null hypothesis. A JSZ Bayes factor ANOVA (Rouder, Morey, Speckman, & Province, 2012) with default prior scales revealed that the model without three-way interaction was preferred to the three-way interaction model by a Bayes factor of 9.36 (RT) and 16.16 (accuracy), which is substantial evidence for the null three-way interaction in both cases.

Discussion

Previous research indicated that conflict created by incongruent stimuli, such as the ones used in the Stroop task or the Eriksen flanker task, leads to negative affect (Chetverikov & Kristjánsson, 2015; Dreisbach & Fischer, 2012; Fritz & Dreisbach, 2015; Schouppe et al., 2015). Similarly, negative affect can be evoked by errors even when participants do not receive any feedback (Aarts et al., 2012; Chetverikov, 2014; Chetverikov & Filippova, 2014; Chetverikov et al., 2015, 2017). The affect as feedback for predictions (AFP) framework suggests that these effects result from the inconsistency of predictions involved in the task (Chetverikov & Kristjánsson, 2016). The RVPM explains affect based on negative/positive prediction error regarding the reward in a trial (Silvetti et al., 2011). However, previous studies show contradictory results when observers have to respond to conflicting stimuli rather than just look at them. While Chetverikov and Kristjánsson (2015) and Chetverikov et al. (2017) found that a “resolved” conflict elicits either negative or no affect, Schouppe et al. (2015) found positive affect, and Molapour and Morsella (2011) found positive affect only when the conflict occurred after the evaluated stimuli (but before the evaluation) and only with a Stroop but not a flanker task. We aimed to obtain additional evidence to resolve this contradiction. We also aimed to study the affective consequences of errors in their interaction with flanker congruence. We used a strict response deadline in our study to have more errors than usually present in the flanker studies.

We found that incongruent stimuli lead to a decrease in negative affect compared to congruent stimuli. After responses to congruent stimuli observers categorised negative pictures significantly faster than positive ones. However, this difference in categorisation speed decreased after responses to incongruent stimuli. Errors, on the other hand, increase negative affect compared to correct responses. In contrast to priming effects from congruency that were evident in the evaluation RTs, errors affected the accuracy of evaluative categorisation: observers more often categorised positive pictures as negative when they made errors in the flanker task. Negative pictures were categorised with equal accuracy regardless of a previous response in the flanker task. In sum, the results show negative affective priming by congruence in the analysis of evaluative categorisation RTs and negative affective priming by errors in the analysis of evaluative categorisation accuracy. This replicates the pattern observed by Schouppe et al. (2015) and complements it with the data on erroneous responses.

The AFP correctly predicted an increased negative affect after errors, and the RVPM correctly predicted an increased negative affect after the congruent trials. We did not observe any interaction between prime congruency and response accuracy. This contradicts the AFP, which predicted more negative affect for correct incongruent trials compared to correct congruent ones. The RVPM correctly predicted more negative response to congruent trials regardless of their accuracy. While this prediction was never tested on affective data before, Braem, Coenen, Bombeke, van Bochove, and Notebaert (2015) used pupil dilation as a marker of prediction error and found larger pupil size after erroneous responses in congruent trials rather than in incongruent ones. At the same time, positive prediction error (measured by pupil dilation in correct trials) was higher for incongruent trials rather than congruent ones. This is consistent with more negative affect elicited by any response in congruent trials in comparison with incongruent ones found in our study. The main contribution of our work is the empirical support for the RVPM predictions regarding affective effects of erroneous responses. Our study also shows that the difference between prediction errors in congruent and incongruent trials is of approximately the same size in case of correct (positive prediction error) and incorrect (negative prediction error) responses, as demonstrated by the absence of the interaction between prime congruency and accuracy.

Our work also replicates Schouppe et al. (2015) results using a different procedure. First, we used the letters-based flanker task instead of the arrows-based one. Second, we used the affective priming paradigm with pictures instead of words and a larger number of stimuli were used (150 images instead of 30 words per valence). While there are no a priori reasons why words would be different from pictures as targets for priming, perhaps, words fall more easily into discrete "positive" and "negative" categories. A partial support for this idea comes from the fact that mean categorisation times in our experiments were longer than in the experiments of Schouppe et al. (2015). Although such comparisons need to be taken with caution, images could provide more space for interpretation than words. Despite these differences, our study replicates main findings of Schouppe et al. (2015).

One of the motivations of our study were the contradictions in the conflict resolution data. We found that any response to an incongruent flanker stimulus leads to the decreased negative affect as compared to a response to a congruent stimulus. The effect of response to congruent vs. incongruent stimuli was not observed in several studies (Chetverikov & Kristjánsson, 2015; Chetverikov et al., 2017). At the moment, the most plausible explanation is related to the task or the measure of affect (see below). It seems that conflict resolution results in positive affect in the flanker task, but it is hard to observe the effect using a modified flanker task (Chetverikov et al., 2017) or a visual search task (Chetverikov & Kristjánsson, 2015). However, the exception from this conclusion is Molapour and Morsella (2011), who did not observe conflict resolution using the flanker task, and the results of Schouppe et al. (2015) with the Stroop task. It is also possible that the discrepancy in the results is explained by the specifics of the affective priming paradigm, as suggested by the dissociation between RT and accuracy analyses.

Another possible explanation of more negative response to congruent rather than incongruent trials is the prime-target SOA. In the Fritz and Dreisbach's study (2015) negative priming by incongruence was observed when the SOA was 200 or 400 ms, however it was absent or even reversed when the SOA was 800 ms. When participants have to respond to prime stimuli, prime-target SOAs are usually longer than 200–400 ms used in most of the affective priming studies (e.g. Herring et al., 2013). Considering this, one can suggest that reversed valence of the resolved conflict is not due to the conflict resolution per se, but instead, it is just a matter of timing. One of the limitations of our study is that we cannot rule out this possibility with our data as the range of RTs in our experiment was 483–817 ms. To test this hypothesis, one needs to have wider range of responses including very fast ones.

It is not clear why we observed the affective effects of incongruence in the RT data and the effects of errors in the accuracy data. While there is no general explanation of speed-accuracy dissociation, it is sometimes related to the distinction between "early" ("perceptual") and "late" ("response selection") stages of processing (Santee & Egeth, 1982). Interestingly, this distinction maps to the classical "encoding" and "response" explanations of the affective priming effects (Herring et al., 2013). The encoding perspective suggests that affective priming results from increased activation of prime-valence association in memory that helps to encode targets with similar valence, while the response perspective suggests that prime only increases activation of the relevant response. In a recent meta-analysis, Herring et al. (2013) demonstrated that neither of these classical accounts provides a complete explanation of affective priming as both encoding and response-related processes contribute towards it. It is then possible that errors and conflict result in different kinds of affective priming: the former affecting the encoding stage while the latter affecting the response selection. It is also possible that a more unequivocal measure, such as categorisation of neutral targets (Fritz & Dreisbach, 2015), might be better suited for the studies of affective influences in simple tasks, such as this. Further studies might help to provide a more conclusive explanation of this dissociation.

In sum, we found that response conflict and errors both lead to affective changes, positive in the former case, but negative in the latter. The RVPM approach seems to be more suited to explain such results in the Eriksen flanker task than the AFP. This finding adds to the growing literature on cognitive antecedents of affect and shows that it is not a stimulus *per se* that is liked or disliked but rather how observers are interacting with it. The results seem to suggest that the same stimulus could give rise to both positive (perhaps, due to a resolved conflict) and negative (due to an unresolved conflict) affect. Thus, just like in everyday life the same task can make people happy or sad – but in the flanker task, these feelings seem to be separated into different processing levels, affecting RTs or accuracy in subsequent evaluative categorisation.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Aarts, K., De Houwer, J., & Pourtois, G. (2012). Evidence for the automatic evaluation of self-generated actions. *Cognition*, *124*(2), 117–127. doi:10.1016/j.cognition.2012.05.009

Braem, S., Coenen, E., Bombeke, K., van Bochove, M. E., & Notebaert, W. (2015). Open your eyes for prediction errors. *Cognitive, Affective, & Behavioral Neuroscience*, *15*(2), 374–380. doi:10.3758/s13415-014-0333-4

Braem, S., King, J. A., Korb, F. M., Krebs, R. M., Notebaert, W., & Egner, T. (2017). The role of anterior cingulate cortex in the affective evaluation of conflict. *Journal of Cognitive Neuroscience*, *29*(1), 137–149. doi:10.1162/jocn_a_01023

Brouillet, T., Ferrier, L. P., Grosselin, A., & Brouillet, D. (2011). Action compatibility effects are hedonically marked and have incidental consequences on affective judgment. *Emotion*, *11*(5), 1202–1205. doi:10.1037/a0024742

Chetverikov, A. (2014). Warmth of familiarity and chill of error: Affective consequences of recognition decisions. *Cognition and Emotion*, *28*(3), 385–415. doi:10.1080/02699931.2013.833085

Chetverikov, A., & Filippova, M. (2014). How to tell a wife from a hat: Affective feedback in perceptual categorization. *Acta Psychologica*, *151*, 206–213. doi:10.1016/j.actpsy.2014.06.012

Chetverikov, A., Iamschinina, P., Begler, A., Ivanchei, I., Filippova, M., & Kuvaldina, M. (2017). Blame everyone: Error-related devaluation in Eriksen flanker task. *Acta Psychologica*, *180*, 155–159. doi:10.1016/j.actpsy.2017.09.008

Chetverikov, A., Jóhannesson, Ó. I., & Kristjánsson, Á. (2015). Blaming the victims of your own mistakes: How visual search accuracy influences evaluation of stimuli. *Cognition and Emotion*, *29*(6), 1091–1106. doi:10.1080/02699931.2014.968097

Chetverikov, A., & Kristjánsson, Á. (2015). History effects in visual search for monsters: Search times, choice biases, and liking*Attention, Perception, & Psychophysics*, *77*(2), 402–412. doi:10.3758/s13414-014-0782-4

Chetverikov, A., & Kristjánsson, Á. (2016). On the joys of perceiving: Affect as feedback for perceptual predictions. *Acta Psychologica*, *169*, 1–10. doi:10.1016/j.actpsy.2016.05.005

Clark, A. (2013). Are we predictive engines? Perils, prospects, and the puzzle of the porous perceiver. *Behavioral and Brain Sciences*, *36*(3), 233–253. doi:10.1017/S0140525X12000477

Daniel, R., & Pollmann, S. (2014). A universal role of the ventral striatum in reward-based learning: Evidence from human studies. *Neurobiology of Learning and Memory*, *114*, 90–100. doi:10.1016/j.nlm.2014.05.002

Dreisbach, G., & Fischer, R. (2012). Conflicts as aversive signals. *Brain and Cognition*, *78*(2), 94–98. doi:10.1016/j.bandc.2011.12.003

Fazio, R. H. (2001). On the automatic activation of associated evaluations: An overview. *Cognition & Emotion*, *15*(2), 115–141. doi:10.1080/0269993004200024

Fritz, J., & Dreisbach, G. (2015). The time course of the aversive conflict signal. *Experimental Psychology*, *62*(1), 30–39. doi:10.1027/1618-3169/a000271

Herring, D. R., White, K. R., Jabeen, L. N., Hinojos, M., Terrazas, G., Reyes, S. M., … Crites Jr, S. L. (2013). On the automatic activation of attitudes: A quarter century of evaluative priming research. *Psychological Bulletin*, *139*(5), 1062–1089. doi:10.1037/a0031309

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2008). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual* (Technical Report A-8). Gainesville, FL: University of Florida.

Molapour, T., & Morsella, E. (2011). Valence from conflict? Preliminary evidence from Stroop interference. In L. M. Warfelt (Ed.), *Language acquisition* (pp. 139–154). New York: Nova Science Publishers.

Peirce, J. W. (2007). Psychopy – psychophysics software in python. *Journal of Neuroscience Methods*, *162*(1), 8–13. doi:10.1016/j.jneumeth.2006.11.017

Rouder, J. N., Morey, R. D., Speckman, P. L., & Province, J. M. (2012). Default Bayes factors for ANOVA designs. *Journal of Mathematical Psychology*, *56*, 356–374.

Santee, J. L., & Egeth, H. E. (1982). Do reaction time and accuracy measure the same aspects of letter recognition? *Journal of Experimental Psychology: Human Perception and Performance*, *8*(4), 489–501. doi:10.1037//0096-1523.8.4.489

Schouppe, N., Braem, S., De Houwer, J., Silvetti, M., Verguts, T., Ridderinkhof, K. R., & Notebaert, W. (2015). No pain, no gain: The affective valence of congruency conditions changes following a successful response. *Cognitive, Affective, & Behavioral Neuroscience*, *15*(1), 251–261. doi:10.3758/s13415-014-0318-3

Silvetti, M., Seurinck, R., & Verguts, T. (2011). Value and prediction error in medial frontal cortex: Integrating the single-unit and systems levels of analysis. *Frontiers in Human Neuroscience*, *5*, 75. doi:10.3389/fnhum.2011.00075

Van de Cruys, S., & Wagemans, J. (2011). Putting reward in art: A tentative prediction error account of visual art. *i-Perception*, *2*(9), 1035–1062. doi:10.1068/i0466aap

Yu, S., Pleskac, T. J., & Zeigenfuse, M. D. (2015). Dynamics of post-decisional processing of confidence. *Journal of Experimental Psychology: General*, *144*(2), 489–510. doi:10.1037/xge0000062