Evidence that dissonance arousal is initially undifferentiated and only later labeled as negative

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HIGHLIGHTS
• We investigated when this negative affect related to dissonance appears.
• We recorded facial EMG.
• The negative affect does not appear immediately in the dissonance process.
• Attitude change is related to the intensity of the negative affect.

ABSTRACT
Although the existence of a negative affect related to dissonance has been largely documented, there is still much debate about exactly when this negative affect appears. The present study tested two hypotheses, the first being that it emerges immediately after individuals have committed to the counterattitudinal behavior (Elliot & Devine, 1994), and the second that it arises somewhat later, after an undifferentiated arousal state (Cooper & Fazio, 1984). The facial electromyograms (EMGs) of participants in no-dissonance and dissonance conditions were analyzed during the production of a counterattitudinal advocacy. As expected, only in the dissonance condition did participants’ facial EMGs indicate the presence of a negative affect. Instead of appearing just after they had committed to the counterattitudinal behavior, this affect emerged further on in the dissonance process, after participants had embarked on the counterattitudinal advocacy. In addition, the intensity of the negative affect was correlated with attitude change. Taken together, our findings suggest that dissonance arousal is initially undifferentiated and is only later labeled as negative. Furthermore, this negative affect motivates attitude change.

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negative (Losch & Cacioppo, 1990; Zanna & Cooper, 1974, 1976) and positive stimuli (Drachman & Worochel, 1976). Moreover, Rhodewalt and Comer (1979) observed that participants who interpreted their arousal as positive because electrodes had been placed on their face to stimulate a positive state did not attempt to reduce the dissonance. However, when participants interpreted their arousal as negative, because the electrodes on their face stimulated a negative state, they changed their attitude. Cooper and Fazio (1984) integrated these findings into the New Look model, in which dissonance gives rise to an initially undifferentiated and malleable state of physiological arousal that can be labeled later as either negative or positive. If a person labels this dissonance arousal as negative and attributes it to the counterattitudinal advocacy, it becomes the motivation for reducing the uncomfortable tension.

The first and always negative view was first advanced by Elliot and Devine (1994), who analyzed participants’ self-reports of their affect. Participants in dissonance who reported their affect before a counterattitudinal essay identified their psychological discomfort as negative. This negative affect fell to a baseline level once they changed their attitude after completing the essay. This suggests that dissonance arousal is rapidly labeled as negative, and that “the phenomenological experience of cognitive dissonance appears to be a distinct, aversive feeling, not an undifferentiated arousal state” (Elliot & Devine, 1994, p. 391).

The present experiment tested these two hypotheses by determining when the arousal related to dissonance is labeled as negative. Participants produced a counterattitudinal essay either of their own free will (dissonance) or because they had no choice (no-dissonance). We recorded the electromyographic (EMG) activity of the participants’ zygomaticus major and corrugator supercilii muscles, the activity of the former signaling a positive affect, the activity of the latter indicating negative affect (Cacioppo, Petty, Losch, & Kim, 1986; Larsen, Norris, & Cacioppo, 2003). We recorded facial EMGs before the dissonance manipulation to measure baseline muscle activity, and then throughout the advocacy. According to the initially undifferentiated, then negative view, in the dissonance condition, the activity of the corrugator supercilii should remain unchanged between the baseline measure and the start of the counterattitudinal advocacy, only increasing during the subsequent phases of the advocacy. Nor should there be any interaction between the conditions and the early EMG recording during the advocacy (compared with the baseline). By contrast, the first and always negative view suggests that the activity of the corrugator supercilii should be present from the start of the advocacy. Accordingly, we would expect to see an interaction between the conditions (dissonance, no-dissonance) and EMG recordings (baseline vs. beginning of the advocacy). Finally, given that attitude change indicates a reduction in psychological discomfort, we expected the intensity of the negative affect to predict attitude change in the dissonance group.

Method

Participants, design, and procedure

Thirty-two female psychology students from the University of Poitiers (France) volunteered to take part in this experiment. Two participants refused to freely produce the advocacy. Thus, thirty volunteers participated. Half of them composed a counterattitudinal essay about an increase in tuition fees for French universities (i.e., no-dissonance group), whereas the other half was given a choice to write or not the essay (i.e., dissonance group). Once the equipment had been installed, the participants were told to clear their minds for 5 min and the baseline recording of the facial EMG began. Next, participants wrote the essay for 10 min, during which time their facial EMGs were recorded. Participants had to inform the experimenter if they finished their text in less than 10 min in order to stop the EMG recording. Immediately after the essay, they rated their attitude toward an increase in tuition fees on a scale ranging from 1 (Totally against) to 9 (Totally in favor). At the end of the experiment, the participants were debriefed about the true purpose of the experiment.

Material

The left-sided electromyographic activity of the corrugator supercilii and the zygomaticus major was recorded following the standards for facial electromyographic recording (Fridlund & Cacioppo, 1986). electromyographic activity was recorded using silver/silver chloride surface electrodes with an electrode size, contact area and housing of 3, 5, and 13 mm in diameter, respectively. A ground electrode in the form of an anti-static bracelet was placed around the participants’ nondominant ankle and four facial receptors were attached to their skin (two in the area of the corrugator supercilii, two on the zygomaticus), with a distance of 15 mm between centers. Following the procedure used in a previous study (Capa, Audiffren, & Ragot, 2008), the EMG signal was continuously monitored (gain = 1000), filtered (10 Hz–1 kHz), digitized online (A/D rate = 2 kHz) (Model P511K, Grass Instruments, Quincy, MA, USA), and recorded using the BIOPAC acquisition system (Model MP150, Santa Barbara, CA). Artifacts such as coughing, yawning, stretching, and any other major movements detected by the experimenter were excluded from the analysis. Mean rectified EMG amplitudes were calculated and are provided here in microvolts.

Results

Post-essay attitude

The standard induced-compliance effect was observed. The participants in the dissonance group were more favorable (M = 3.00, SD = 1.31) to an increase in tuition fees than the participants in the no-dissonance group (M = 1.60, SD = .83), t(28) = 3.50, p < .01, Cohen’s d = 1.28.

Baseline facial activity

No difference was observed between the dissonance and no-dissonance conditions in the activity of the zygomaticus (dissonance: M = .004, SD = .002; no-dissonance: M = .004, SD = .002), r(28) < 1, or the corrugator (dissonance: M = .031, SD = .012; no-dissonance: M = .027, SD = .013), t(28) < 1.

Facial activity during the counterattitudinal advocacy

For each participant, we divided the total writing time (M = 4 min 42 s, SD = 41 s) into four equal phases, and calculated the mean EMG activity for the corrugator supercilii and zygomaticus major during each one. To verify the presence of a negative affect in the dissonance group, we first conducted a 2 (Group: dissonance, no-dissonance) × 5 (Phase: baseline, phases 1, 2, 3, 4) ANOVA on the corrugator and zygomaticus activities, with Group as the between-participants factor and Phase as the within-participants factor. Second, to test the hypotheses, we conducted a 2 (Group: dissonance, no-dissonance) × 2 (Phase: baseline, Phase 1) ANOVA with Group as the between-participants factor and Phase as the within-participants factor. This analysis was carried out for the corrugator supercilii only.

Zygomaticus major activity

The 2 × 5 ANOVA revealed a Phase effect, F(4, 112) = 3.03, p = .02, PRE = .09, but no Group effect, F(1, 28) < 1, and no interaction, F(4, 112) < 1. More specifically, the activity of the zygomaticus diminished during the writing session (baseline: M = .004, SD = .002; Phase 1: M = .031, SD = .094; Phase 2: M = .005, SD = .087; Phase 3: M = .001, SD = .071; Phase 4: M = .004, SD = .068).
Accordingly, no dissonance-specific positive affect was observed during the counterattitudinal advocacy.

**Corrugator supercilii activity**

The $2 \times 5$ ANOVA did not reveal a Group effect, $F(1, 28) = 2.69$, ns, but there was a significant increase in corrugator activity across phases, $F(4, 112) = 3.67$, $p = .008$, PRE = .11, and a significant interaction, $F(4, 112) = 4.54$, $p = .002$, PRE = .13 (see Fig. 1). More specifically, the activity of the corrugator increased during the composition of the counterattitudinal essay, but only in the dissonance condition. This interaction indicated the presence of a negative affect during dissonance.

The ANOVA carried out on the EMG scores to compare the corrugator’s baseline activity with its activity during the first writing phase failed to reveal any reliable effects of the Group factor, $F(1, 28)<1$. There was no Phase effect, $F(1, 28)<1$, and no interaction $F(1, 28)<1$. In sum, the participants in the dissonance condition did not experience any negative affect when they began the counterattitudinal advocacy. This result supports the initially undifferentiated, then negative view.

To pinpoint exactly when the corrugator’s activity began to increase in the participants with dissonance, we conducted a trend analysis of the corrugator’s activity by analyzing the linear contrast between Phases 1 and 4. This contrast was significant, $F(1, 28) = 20.64$, $p < .001$, PRE = .48, indicating that the corrugator’s activity increased linearly across the writing task. This linear trend was not significant in the no-dissonance group, $F(1, 28)<1$. Thus, a negative affect appeared and developed during writing, but only in the dissonance group.1

**Relationship between the intensity of the negative affect and attitude change**

We further analyzed the relationship between the intensity of the negative affect that participants experienced and their attitude change. We calculated this intensity by subtracting the corrugator’s reactivity score (i.e., weighted by the baseline activity; Sloan, Bradley, Dimoulas, & Lang, 2002) for Phase 1 from the score for Phase 4. We regressed the post experimental attitude score on Group (dissonance coded 1 and no-dissonance −1), on Intensity of the negative affect (continuous, centered), and on their interaction. This analysis revealed a significant interaction ($B = 2.11$, $SE = .87$, $t(26) = 2.41$, $p = .024$): the greater the intensity of the negative affect in the dissonance group, the more favorable the participants’ attitude toward the counterattitudinal essay ($B = 1.71$, $SE = .74$, $t(13) = 2.31$, $p = .04$). This was not observed in the no-dissonance group ($B = −2.51$, $SE = 1.27$, $t(13) = −1.97$, $p = .08$).

**Discussion**

We examined the valence, intensity, and time course of the affect that arises with dissonance by analyzing participants’ facial EMGs. In the dissonance condition, the activity of the participants’ corrugator supercilii muscle increased, indicating the presence of a negative affect, as already observed and postulated by the cognitive dissonance theories (Elliot & Devine, 1994; Harmon-Jones, 2000). Because emotional responses indexed with facial EMG occur within 500 ms after the stimulus onset (Achaibou, Pourtois, Schwartz, & Vuilleumier, 2008; Dimberg & Thunberg, 1998), the absence of the corrugator’s activity at the beginning of the advocacy demonstrated an absence of negative emotional response. One could argue that the increased activity of the corrugator actually reflected an increase in the participants’ mental effort related to composing the essay. The corrugator’s activity does indeed increase with mental effort (De Morree & Marcara, 2010). However, Martinie, Olive, and Milland (2010) have demonstrated that individuals who compose a counterattitudinal essay in a dissonance condition do not mobilize greater cognitive effort.

The negative affect associated with dissonance did not appear as soon as participants agreed to write the counterattitudinal essay, as there was no difference between corrugator activity during the first phase of the advocacy and the baseline facial EMG. Instead, the corrugator’s activity increased gradually and linearly between the first and final phases of the advocacy, indicating that the intensity of the negative affect increased throughout the composition of the essay. In sum, the participants in dissonance did not experience any negative affect immediately after commitment, but did do so later, during the composition of the essay. This confirms the initially undifferentiated, then negative view put forward in the New Look model (Cooper & Fazio, 1984), which argues that dissonance arousal is initially undifferentiated and only later labeled as negative.

This finding may appear difficult to integrate with results of studies showing that attitude change can be observed even without actually performing the counterattitudinal behaviour. This was the case, for example, in Eisenstadt, Leippe, Rivers, and Stambusch’s (2003) study. A careful look at its protocol, however, shows that at least 1 min elapsed between the participants’ agreement to write the counterattitudinal essay and the measurement of their attitude. This is in line with our finding that the negative affect only appeared during the second phase after commitment, which corresponded to the second minute of the counterattitudinal behavior. Nevertheless, we acknowledge that performing a counterattitudinal behavior is not a prerequisite for observing attitude change. What is important for the emergence of the negative affect is that participants are given time to access plausible counterattitudinal arguments, as proposed by Elliot and Devine (1994). However, in situations where individuals in dissonance are asked to

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1 Increasing the number of intervals did not change the results. For instance, with ten equal phases, we observed a Group × Phase interaction ($F(10, 280) = 5.34$, $p < .001$), with an increase in activity of the corrugator supercilii in the dissonance condition only. Furthermore, there was no difference between the corrugator’s baseline activity and the first phase ($p < .30$). The trend analysis of the corrugator’s activity between Phases 1 and 10 also indicated a linear increase across the advocacy, $F(1, 28) = 23.82$, $p < .0001$.
perform a counterattitudinal essay, composing this essay contributes to an increase in their negative affect.

A final finding of the present study is the positive relationship between the intensity of the affect and the extent of the attitude change in the dissonance group. This is not surprising, since attitude change is considered to indicate a reduction in the individual's psychological discomfort, and to be a consequence of dissonance. This confirms the important role of negative affect in reducing dissonance and again supports the idea that when dissonance arousal is labeled as negative, it turns into dissonance motivation for reducing the aversive psychological state (Cooper & Fazio, 1984). Future research should investigate whether these findings can be generalized to other paradigms of dissonance (e.g., free choice, hypocrisy).

To conclude, the use of facial EMGs allowed us to better understand the affective component of dissonance, just as Croyle and Cooper’s (1983) and Elkin and Leippe’s (1986) results with galvanic responses contributed to the understanding of the drive-like properties of dissonance. As mentioned above, the main interest of facial EMG lies in its ability to provide direct, objective, and continuous measurements of the time course of emotional states of participants in dissonance.

References


