Affective touch during the processing of angry facial expressions: an event-related potential study

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1. Introduction

The stress-buffer hypothesis of affective touch holds that being gently touched by another person can positively influence emotion regulation (Morrison, 2016a). This effect is evident across the lifespan. For example, affective touch by parents helps to reduce arousal and discomfort in children (Field, 2010). In adulthood, affective touch also alleviates subjective as well as somatic components of emotional distress and pain (Fidanza et al., 2021; Krahe et al., 2016; Liljencrantz et al., 2017; Pawling et al., 2017; von Mohr et al., 2017; Walker et al., 2022; for a review see Saarinen et al., 2021).

Soft, caress-like stroking of the skin at low velocities (1–10 cm/s) activates specific mechanoreceptors, so-called C-tactile (CT) afferents, which transmit this tactile information via the spinothalamic tract to the thalamus and the primary/secondary somatosensory cortex (Morrison, 2016b). Further, as demonstrated by studies using functional magnetic resonance imaging (fMRI), brain regions concerned with the processing of stimulus salience and meaning (such as the insula and the prefrontal cortex) are recruited during affective touch (see meta-analysis by Morrison, 2016b).

Only a few studies have used electroencephalography (EEG) to investigate neural correlates of affective touch. Von Mohr et al. (2018) found that soft brush stroking of participants’ forearms decreased their EEG theta activity (4–8 Hz) relative to nonaffective touch and a rest condition without tactile stimulation. The authors of that study reported similar findings of attenuated theta from studies on mindfulness and meditation practices involving emotion regulation, and suggest that, along those lines, the decreased theta accompanying affective touch may reflect the engagement of attentional-emotional regulatory mechanisms. Further, in a study by Portnova et al. (2020), affective touch (brush stroking of the forearm) was associated with lower peak alpha frequency values indicating decreased cortical arousal. In addition, Kraus et al. (2020) investigated whether frontal power band activity during aversive mental imagery could be modulated by affective touch from romantic partners or strangers. The lowest theta (and beta) activity was observed while participants were holding hands with their partners. Taken together, these studies emphasize the role of affective touch on neural indicators of emotion regulation.

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ABSTRACT

It has been shown that affective touch can have stress-buffering effects. The current event-related potential (ERP) study investigated whether affective touch can reduce emotional distress and associated late positivity while viewing angry facial expressions. A total of 122 females (mean age = 23 years) were randomly assigned to one of three groups to either receive slow/soft brushing of their forearm (affective touch), fast brushing (nonaffective touch), or no touch while viewing images depicting angry and neutral facial expressions. The participants rated their affective state (valence, arousal) before and after the experiment. They also rated the perceived intensity of the angry facial expressions and the pleasantness of touch during the experiment. Components of the Late Positive Potential (LPP) in response to the images that are associated with stimulus significance, attention allocation, and emotion regulation (early LPP: 400–1000 ms; late LPP: 1000–3000 ms) were extracted for a frontal and a centroparietal cluster. Affective touch was associated with reduced amplitudes of the late LPP in the frontal cluster but did not affect centroparietal LPPs (early, late). Affective touch was rated as more pleasant than nonaffective touch but did not change reported valence, arousal, and perceived anger intensity. In conclusion, affective touch modulated a neural indicator of stimulus significance but did not influence self-report measures. More naturalistic touch settings might enhance the effects.

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Other studies on the effects of affective touch using EEG have focused on event-related potentials (ERPs). Schirmer and Gunter (2017) explored whether affective touch could modulate the electrocortical responses to concurrently presented emotional voices (surprised and neutral) and nonvocal sounds. Affective touch of the forearm (CT- innervated skin) but not the palm (CT-free skin) was accompanied by elevated amplitudes of the centroparietal Late Positive Potential (LPP: 400–950 ms) to surprising relative to neutral voices. The authors concluded that affective touch appears to facilitate the allocation of processing resources for emotional stimuli. In another study (Schirmer & McGlone, 2019), affective touch was administered during the presentation of line drawings depicting dyadic interactions with and without affectionate touch. The LPP (400–1000 ms) in a centroparietal cluster was larger for images with touch information as compared to no touch. Taken together, these ERP studies emphasize the role of affective touch on neural indicators of attention allocation to emotional over neutral stimuli.

An ERP study by Spape and Harjumets (2017) used vibrotactile affective stimulation (to the palm) as a prime for emotional stimulation (viewing affective facial expressions). This tactile stimulation administered before the image viewing however did not influence the LPPs at the image viewing. Thus, simultaneous stimulation (affective cues + affective touch) seems to be necessary for the touch-associated modulation of neural responses to emotional stimuli (e.g., changes in LPP amplitudes).

The present study also investigated changes in LPP amplitudes. In general, LPP modulation due to affective stimulation starts around 400 ms after stimulus onset and is maximal over centroparietal areas (e.g., Hajcak & Olvet, 2008). Emotionally engaging stimuli (e.g., affective facial expressions) elicit larger LPPs compared to neutral (non-arousing) stimuli (Eimer & Holmes, 2007; Schwab et al., 2020). This modulation of the centroparietal LPP has been interpreted to reflect attention allocation to incoming (motivationally relevant) information (‘motivated attention’; Hajcak et al., 2009).

The increased positivity following emotional pictures compared to neutral ones can last up to several seconds (for a review see Hajcak et al., 2010). Because of its sustained nature, the LPP is well-suited for studying higher-order emotional processes (MacNamara et al., 2022). Some studies have identified LPP modulation due to (re)appraisal of emotional stimuli across frontal electrode sites (e.g., Foti & Hajcak, 2008; Grassini et al., 2020; Schienle et al., 2022). In a study by Foti and Hajcak (2008) verbal affective descriptions preceding arousing images changed the frontal LPP (400–3000 ms after picture onset). The descriptions either aimed at enhancing or reducing the negative impact of the pictures (e.g., for a picture of a car accident: ‘Two people died in this horrendous car crash.’ vs. ‘No one was seriously injured.’). In another study (Schienle et al., 2022), participants were presented with images depicting angry and neutral facial expressions. The administration of an open-label placebo to alter stimulus meaning (reduction of perceived anger intensity) was associated with lowered amplitudes in a late LPP window (1000–6000 ms) across a frontal cluster.

In sum, the LPP is characterized by specific temporal-spatial components (early/late; frontal/centroparietal) that most likely reflect different, albeit overlapping, emotional/motivational processes (Hajcak et al., 2012). This interpretation is in line with combined EEG/ fMRI studies demonstrating that the LPP is associated with activation in the visual cortex, and frontotemporal brain regions, such as the prefrontal cortex and the insula (Liu et al., 2012).

The present ERP study tested the stress-buffer hypothesis of affective touch in the context of affective face processing. Participants were randomly assigned to one of three groups to either receive slow/soft brushing of their forearm (affective touch), fast brushing (nonaffective touch), or no touch while viewing images depicting angry and neutral facial expressions. During the picture viewing, participants rated the perceived intensity of the angry facial expressions and the pleasantness of touch. Before and after the picture viewing, they evaluated their affective state concerning valence and arousal.

It was expected that affective touch would enhance centroparietal LPP amplitudes to angry facial expressions (an increase of the early component (400–1000 ms) reflecting increased attention allocation (e.g., Schirmer & Gunter, 2017). A second exploratory analysis focused on the frontal LPP in response to angry faces because of its role as a concomitant of emotion regulation (e.g., Foti & Hajcak, 2008). Moreover, it was hypothesized that affective touch compared to nonaffective touch should be associated with reduced emotional distress as reflected by self-reports (Morrison, 2016a).

2. Method

2.1. Participants

A total of 122 females (mean age = 22.58 years; SD = 3.26) participated in the current study. The majority of participants were university students (92%); the remaining participants were white-collar workers. The participants were randomly allocated to one of three groups to either receive slow brushing (Affective Touch; n = 41), fast brushing (Nonaffective Touch; n = 41), or no brushing to their forearms (No Touch; n = 40) during affective picture viewing. The three groups did not differ in mean age (p = .92). We focused on female participants because of sex differences in (affective) touch processing (Fisher et al., 1976). Exclusion criteria were reported disease (somatic/ mental disorders) and psychotropic medication.

An apriori power analysis (G*power, Faul et al., 2009) indicated that a sample size of n = 111 participants would be necessary to detect an effect size of .30 and achieve a power of .80 at an alpha level of .05. To account for possible loss of data (due to artifacts, and dropouts), we recruited a total of 122 females through (online) campus announcements and email distribution lists. All participants gave written informed consent before study participation.

2.2. Visual stimuli

Participants viewed a total of 60 pictures depicting women with angry facial expressions (30 pictures) and neutral facial expressions (30 pictures) from the Karolinska Directed Emotional Faces (Lundqvist et al., 1998). The pictures were shown in randomized order for 3000 ms each, preceded by a fixation cross (500–1000 ms). Images had a resolution of 562 × 762 pixels and were presented on a 48 × 30 cm LCD screen running at a 1920 × 1080 resolution with a refresh rate of 60 Hz. The images were shown in the center of a gray background (1920 × 1080 pixels). Participants’ distance to the screen was 60 cm. The participants were asked to look at the pictures as if they were watching TV.

2.3. Tactile stimuli

A trained female research assistant was sitting beside the participant and administered the brushing (with a soft bristle brush, Bipa essentials). A curtain separated the research assistant and the participant, who placed her left forearm on a board accessible to the research assistant (Fig. 1). The brushing was administered concurrently with the pictures presented and was guided via a metronome over headphones. Affective (CT-optimal) touch had a velocity of 3 cm/s and an approximate indentation force of 0.3 N on the left forearm (stroking in proximal to distal direction, 6 cm region), whereas non-affective touch had a velocity of 30 cm/s. The parameters for the tactile stimulation (affective vs. non-affective touch) were chosen based on meta-analytical findings (Tanega et al., 2021).

In the No-Touch condition, the research assistant was sitting beside the participant but did not administer brush strokes. In each of the three experimental conditions, the experimenter-participant distance was the same (shoulder to shoulder: 40 cm). A schematic view of the experimental setup is depicted in Fig. 1.
2.4. Questionnaires

1) Two subscales of the Touch Experiences and Attitudes Questionnaire (TEAQ; Trotter et al., 2018) were administered: ‘Childhood Touch’ (9 items; e.g., As a child, my parents would often hold my hand when I was walking along with them), and ‘Unfamiliar Touch’ (5 items; e.g., If someone I don’t know very well puts a friendly hand on my arm it makes me feel uncomfortable). The items are rated on 5-point scales (1 = “disagree strongly”, 5 = “agree strongly”). Cronbach’s alphas in the present sample were $\alpha = 0.79$ (unfamiliar touch) and $\alpha = 0.69$ (childhood touch).

2) The Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) assesses social anxiety with 20 items (e.g., I find myself worrying that I won’t know what to say in social situations, I am nervous mixing with people I don’t know; Cronbach’s $\alpha = 0.92$). The items are rated on 5-point scales (0 = “does not apply”, 4 = “applies”).

2.5. Procedure

The study was preregistered on the Open Science Framework (https://osf.io/8bqdv/) on December, 30th, 2021. It was approved by the local ethics committee of the university and followed the Declaration of Helsinki.

The participants were invited to an experiment on multisensory integration. The study started with an online survey that included questionnaires and asked for socio-demographic data and exclusion criteria.

Eligible participants were invited to the EEG lab. They were presented with 60 images (30 angry faces, 30 neutral faces) while the EEG was recorded. A selection of 10 images (5 angry faces, 5 neutral faces) had to be rated during the EEG recording according to the perceived intensity of anger (0 = low intensity; 100 = high intensity). The participants only rated a subset of the presented images to avoid boredom with the repetitive evaluation task. The pictures for the ratings had been randomly selected before the experiment. Each of the participants rated the same 10 pictures at different time points of the experiment as the randomly selected before the experiment. Each of the participants rated a subset of the presented images to avoid boredom.

During each picture evaluation, the participants were additionally asked to rate the pleasantness of the brushing (0 = not pleasant; 100 = very pleasant). After completion of the ratings, the picture presentation continued.

At the beginning and the end of the EEG experiment, the participants rated their affective state according to valence and arousal (0 = I feel negative, calm; 100 = I feel positive, aroused). The procedure is illustrated in Fig. 2.

2.6. Electrophysiological recording and data analyses

Continuous EEG activity was recorded using the actiChamp system (actiChamp, Brain Products GmbH, Gilching, Germany) with 63 active actiCAP snap electrodes (according to the 10–10 system) and the BrainVision Recorder (version 1.21). The reference electrode was placed on position FCz and the ground electrode on position FPz. An electrolyte gel was applied to each electrode to keep electrode impedances below 10 k$\Omega$. The EEG was recorded with a sampling rate of 2500 Hz and a passband of 0.016–1000 Hz. For raw data analysis, the BrainVision Analyzer (version 2.2.1) was used. The sampling rate was changed to 250 Hz. The data were re-referenced to linked mastoid electrodes (i.e., TP9, TP10). Artifacts due to eye movements were corrected via the implemented ICA ocular correction software; components corresponding to horizontal and vertical eye movements were selected based on the correspondence of their shape, timing, and topography. Additional artifact episodes (e.g., due to movement) were excluded after a visual inspection in each trial using a semiautomated procedure with artifacts identified by the following criteria: a voltage step of more than 50.0 $\mu$V between sample points, a voltage difference of 200 $\mu$V within a trial, and a maximum voltage difference of less than 0.50 $\mu$V within 100 ms intervals. Percentages of artifact-free trials were as follows: 94 % in the No-Touch Group, 93 % in the Nonaffective-Touch Group, and 95 % in the Affective-Touch Group. The percentages of artifact-free trials did not differ between groups ($F(2,2117) = 2.02, p = .14$).

Based on previous literature (e.g., Schirmer & Gunter, 2017) and the visual inspection of the grand average waveforms, we extracted the early LPP (400–1000 ms after picture onset). Exploratory analyses concerned the late LPP (1000–3000 ms) due to its role in emotion regulation. (No distinct P300 was detected). Mean amplitudes were aggregated across a frontal cluster (AF3, AFz, AF4, F5, F3, F1, Fz, F2, F4, F6) and a centroparietal cluster (CP5, CP3, CP1, CPz, CP2, CP4, CP6, P5, P3, P1, Pz, P2, P4, P6).

2.7. Data analysis

All statistical analyses were performed with SPSS (version 28). Mixed-effects analyses of variance (ANOVA) tested the effects of Group (Affective Touch, Nonaffective Touch, No Touch) as a between-subjects factor, and Face (Angry, Neutral) as a within-subjects factor on anger (intensity) ratings, experienced pleasantness of touch, and LPP amplitudes.

Another mixed-effects ANOVA tested the effects of Group and Time (before, and after the experiment) on the affective state of the participants (ratings for valence and arousal). Partial eta squared is reported as the effect size measure.

One-way ANOVAs were computed to compare questionnaire scores.
between the three groups.

3. Results

3.1. Questionnaires

The three groups did not differ in their scores for the SIAS (F(2119) = 0.14, p = .99), TEAQ unfamiliar touch (F(2119) = 0.65, p = .53), and TEAQ childhood touch (F(2119) = 0.61, p = .55) (see Table 1).

3.2. Image ratings

The ANOVA revealed a significant main effect for Face (F(1119) = 1352, p < .001, \( \eta^2 = .92 \)). The effect for Group (F(2119) = 1.08, p = .34, \( \eta^2 = .02 \)), and the interaction Face x Group were not significant (F(2119) = 1.55, p = .22, \( \eta^2 = .03 \)). Angry faces (M = 77.17, SD = 14.81) received higher ratings for displayed anger than neutral faces (M = 18.51, SD = 12.62, t(121) = 36.60, p < .001).

3.3. Pleasantness of touch

The ANOVA revealed a significant main effect for Group (F(1,80) = 25.33, p < .001, \( \eta^2 = .24 \)). The effects for Face (F(1,80) = 0.39, p = .54, \( \eta^2 = .01 \)) and the interaction Face x Group (F(1,80) = 1.06, p = .31, \( \eta^2 = .01 \)) were not significant. Affective touch (M = 70.70, SD = 20.58) was rated as more pleasant than nonaffective touch (M = 44.12, SD = 26.83; t(80) = 5.03, p < .001).

3.4. Affective state

The ANOVA revealed significant effects of Time (F(1119) = 43.72, p < .001, \( \eta^2 = .27 \)) and Group (F(2119) = 3.79, p = .03, \( \eta^2 = .06 \)) on valence ratings. Pleasantness decreased over time (before experiment: M = 76.20, SD = 18.77; after: M = 67.97, SD = 21.53), and the No-Touch group felt more pleasant (M = 76.80, SD = 18.30) than the Nonaffective-Touch group (M = 65.21, SD = 22.81, t(79) = 2.52, p = .01). The Affective-Touch group gave marginally higher pleasantness ratings (M = 72.79, SD = 16.06) than the Nonaffective-Touch group (t(80) = 1.74, p = .09). The Affective-Touch group and the No-Touch group did not differ from each other (t(79) = 1.05, p = .30).

For arousal ratings, none of the effects (main, interaction) reached statistical significance (all p > .17).

Table 1

Self-report data (means, standard deviations).

| Questionnaires | Affective touch M (SD) | Nonaffective touch M (SD) | No touch M (SD) |
|----------------|-----------------------|--------------------------|----------------|
| SIAS           | 22.83 (12.53)         | 22.37 (13.05)            | 22.50 (12.82)  |
| TEAQ unfamiliar touch | 2.48 (0.81)   | 2.58 (0.84)             | 2.69 (0.92)    |
| TEAQ childhood touch | 3.94 (0.70)   | 4.05 (0.65)             | 4.09 (0.59)    |
| Perceived anger intensity [0...100] | 76.63(16.78) | 78.34(13.22)           | 76.52(14.50)  |
| Angry faces    | 21.89(15.35)          | 18.29(10.88)            | 15.30(10.41)   |
| Neutral faces  | 70.45(20.26)          | 43.53(27.46)            | -              |
| Pleasantness of touch [0...100] | 47.92(26.77) | -                       | -              |
| Affective state: pleasure [0...100] | 76.07 (16.77) | 70.39 (22.14)           | 80.43 (18.17)  |
| Before picture viewing | 69.51 (17.56) | 60.02 (25.85)           | 73.18 (20.49)  |
| After picture viewing | 21.49 (21.63) | 19.39 (17.86)           | 21.05 (20.71)  |

Footnote: SIAS (Social Interaction Anxiety Scale), TEAQ (Touch Experiences and Attitudes Questionnaire).

3.5. Event-related potentials

3.5.1. Early LPP (400–1000 ms)

3.5.1.1. Centroparietal. The interaction between Group and Face (F(2, 117) = 0.27, p = .77, \( \eta^2 = .01 \)) and the main effect of Group (F(2, 117) = 1.26, p = .29, \( \eta^2 = .02 \)) were not statistically significant. The main effect of Face was significant (F(1, 117) = 38.17, p < .001, \( \eta^2 = .25 \)). Follow-up pairwise comparisons showed that angry faces were associated with higher amplitudes (M = 2.58, SE = .22) compared to neutral faces (M = 1.56, SE = .17).

3.5.1.2. Frontal. The interaction effect between Group and Face (F(2, 117) = 2.21, p = .12, \( \eta^2 = .04 \)) and the main effect of Group (F(2, 117) = 0.27, p = .77, \( \eta^2 = .01 \)) were not significant. The main effect of Face was statistically significant (F(1, 117) = 15.85, p < .001, \( \eta^2 = .12 \)). The amplitudes were higher for angry faces (M = –1.36, SE = .24) relative to neutral faces (M = –2.04, SE = .20).

3.6. Late LPP (1000 – 3000 ms)

3.6.1. Centroparietal

The interaction between Group and Face was statistically significant (F(2, 117) = 5.61, p = .005, \( \eta^2 = .09 \)) (see Fig. 3). Group differences concerning the amplitudes for angry faces were marginally significant (F(2, 117) = 2.44, p = .09, \( \eta^2 = .04 \)). The Affective-Touch group was characterized by the lowest amplitude (M = –0.53, SE = .29), followed by the No-Touch group (M = .014, SE = .22) and the Fast-Touch group (M = –0.25, SE = .30). No group differences were present for neutral faces (p = .28). The main effect of Face (F(1, 117) = 3.58, p = .05, \( \eta^2 = .03 \)) resulted from higher amplitudes for angry faces (M = –0.05, SE = .16) compared to neutral faces (M = –0.34, SE = .14). The effect of Group (F(2, 117) = 2.07, p = .58, \( \eta^2 = .01 \)) was not significant.

We additionally conducted a ‘complex simple effects analysis’ (Nieuwenhuis et al., 2011). We calculated the difference score between the amplitudes for angry faces and neutral faces (i.e., angry minus neutral) and then compared the groups in this difference. The analysis showed that the frontal late LPP amplitude difference was significantly lower in the Affective-Touch group (M = –0.43, SE = .22) relative to the No-Touch group (M = .078, SE = .24, p = .006) and the Nonaffective Touch group (M = .52, SE = .33, p = .04; see Fig. 4). The No-Touch and the Nonaffective-Touch group did not differ from each other (p = .99).

4. Discussion

The current ERP study investigated the stress-buffer hypothesis of affective touch in the context of affective face processing. The participants were randomly assigned to one of three groups to either receive affective touch, nonaffective touch, or no touch while viewing images depicting angry and neutral facial expressions. The angry facial expressions received high ratings for anger intensity (M = 77, on a scale ranging from 0 to 100). Moreover, affective and nonaffective touch differed in perceived pleasantness, replicating previous findings that slow touch is more pleasant than fast touch (Saarinen et al., 2021). We also replicated effects concerning valence-associated LPP modulation with higher amplitudes for expressions of anger compared to neutral
expressions (Eimer & Holmes, 2007).

Contrary to previous findings (Schirmer & Gunter, 2017; Schirmer & McGlone, 2019), the Affective-Touch group did not differ from the two other groups in early LPP amplitudes. The early LPP is an indicator of motivated attention (Hajcak et al., 2009). Those stimuli that capture visual attention because of their emotional relevance are associated with elevated amplitudes, particularly across centroparietal electrode sites (Hajcak et al., 2009). Thus, the touching of the participants did not change the allocation of attention to the anger cues. In our study, the visual information might have been prioritized. The participants were presented with visual cues of high intensity which required no further information to classify the stimulus. From an evolutionary perspective, a prioritization of visual information in situations with people signaling anger seems functional. If you are approached by an aggressive person, it makes more sense to pay attention to visual cues (facial expressions, gestures) than to tactile information because this enables protective behavior (e.g. withdrawal/flight). Once touched, it is too late for preventive actions.

Moreover, it has to be noted that previous experiments that detected an early LPP effect in the context of affective touch (Schirmer & Gunter, 2017; Schirmer & McGlone, 2019) differed in a central aspect from the current study: the experimental task. For example, Schirmer and Gunter (2017) used a one-back task in their study on the influence of affective touch on vocal emotion processing. The participants were instructed to press a button any time a sound was the same as the one heard before. Thus, this study included an explicit attention task. Similarly, in the study by Schirmer and McGlone (2019), participants’ task was to categorize the images into touch versus no touch. It has been shown that directed attention affects the processing of affective stimuli in the early LPP time window (400–600 ms). For example, Schupp et al. (2007) asked participants to count (or passively view) pleasant, unpleasant, and neutral pictures and found larger LPP amplitudes for counted targets relative to non-targets. The effect was larger for emotional relative to neutral stimuli.

Fig. 3. Grand averages at the frontal cluster for angry and neutral faces for the Affective-Touch [A], Non-Affective Touch [B], and No-Touch [C] groups. Headmaps for the difference angry minus neutral for the time-window 1000–3000 ms for each of the groups [D] for the frontal cluster (electrodes included marked). Grand averages at the frontal cluster for the three groups for the Angry faces [E], and Neutral faces [F].
Fig. 4. Mean amplitudes (standard errors) for the difference score (angry faces – neutral faces) at the frontal cluster for the late LPP (1000 – 3000 ms post-stimulus onset). * p < .01, ** p < .001.

Schirmer and Gunter (2017) speculated that affective touch facilitated the integration of emotional and vocal information and enhanced attentional engagement with emotional voices relative to neutral voices and nonvocal sounds. According to the authors, the participants perceived the sound as originating from a surprised human and therefore prioritized the sound. In the present experiment, it was clear to the participants that the visual and tactile information must have different sources. An angry person (as depicted in the images) cannot be the one who is initiating affective touch.

In the present investigation, affective touch did not change the early LPP (frontal, centroparietal) but the late LPP in the frontal cluster. The computed LPP difference score (angry minus neutral) differed significantly between the groups. The No-Affective Touch group and the No-Touch group showed emotion differentiation with higher amplitudes to angry vs. neutral stimuli. This effect was not present in the Affective-Touch group. This finding might be interpreted as an indicator of emotion regulation, the process by which responses to negative stimuli are down-regulated. Hajcak and Foti (2020) have suggested conceptualizing the LPP as an indicator of stimulus significance and associated activation of motivational circuits. According to the significance framework of the LPP, affective touch changed the meaning of angry facial expressions. In line with this interpretation, other ERP studies have revealed a role of the frontal late LPP in higher-order affective processes, such as (re)appraisal of emotional stimuli (Foti & Hajcak, 2008; Grassini et al., 2020). A recent study by Schienle et al. (2022) used the same stimulus material as the present investigation (angry/neutral facial expressions from the Karolinska Directed Faces; Lundquist et al., 1998). The participants received a placebo treatment to reduce their emotional reactions to viewing angry faces. The treatment was associated with lowered late LPP amplitudes (1000–6000 ms) in a frontal cluster. Moreover, the participants reported lowered arousal.

In the present investigation, slow/soft touching of the forearm did not change participants’ affective states (arousal, valence). This is in line with the findings by Schirmer and Gunter (2017) but not in line with the stress-buffer hypothesis of affective touch (Morrison, 2016a). However, it has to be noted that although the intensity of the anger cues was rated as high, the emotional state of the participants remained very positive throughout the experiment. Therefore, stress buffering was not needed. Nevertheless, the pictures with angry facial expressions (relative to neutral) elicited higher LPP amplitudes reflecting their negative emotional impact.

Finally, affective touch did not change the ratings for the facial expressions; neither for the angry nor neutral ones. Pawling et al. (2017) administered affective touch (and nonaffective touch) simultaneously during the presentation of neutral facial expressions. After the combined visual-tactile stimulation, the participants in the affective-touch group rated the faces as significantly more approachable than the nonaffective-touch group. The authors concluded that the positive affective value of the touch had been transferred to the (previously) neutral visual stimuli. A similar trend did not exist in our data. The groups did not differ in reported anger intensity.

The unexpected findings of the present study might be associated with the following factors. First, this study was conducted after the end of a lockdown period during times of the COVID pandemic requiring physical (social) distancing. Research has shown that the minimization of close distance from others has led to social touch deprivation and even touch craving (von Mohr et al., 2021). This however refers to ‘intimate/friendly touch’ (e.g., hugging by a friend) but not touch by strangers (as applied in the present study). In times of the pandemic, we have been instructed to reduce physical contact with unfamiliar persons to prevent negative health effects. In the present study, a female research assistant applied brush strokes to the forearms of the participants. Although this procedure met hygienic requirements, being touched by a stranger might still have been associated with health-related concerns. This would imply that the Touch groups (affective/nonaffective) should have felt more uneasy than the No-Touch group. This however was not the case. Participants of the Affective-Touch group and No-Touch group did not differ in their self-reported affective state.

Second, the tactile stimulation in the present investigation was characterized by features that are not typical for real-life interactions. The participants received affective touch by a stranger (and not a familiar person) in the form of brush strokes (and not touching/caressing hands). More naturalistic settings might enhance the emotion-regulation effect of affective touch both on the neural and subjective levels.

Third, further affective traits besides social anxiety (e.g., trait anxiety) that are known to modulate LPP amplitudes during emotional processing should be assessed in future studies (e.g., Bunford et al., 2016). Moreover, individuals with a diagnosis of social anxiety disorder could be recruited to enhance the stress-buffering effect of affective touch while viewing angry facial expressions.

In conclusion, this ERP study demonstrated that affective touch can modulate frontal LPP amplitudes (1000–3000 ms) to angry facial expressions. This can be considered an indicator of altered stimulus significance (Hajcak & Foti, 2020).

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Declarations

The authors have no competing interests.

Data availability

Data will be made available on request.

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