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RUNNING HEAD: TOUCH PROCESSING AND CULTURAL CONTEXT

Is cultural context the crucial touch? Neurophysiological and self-reported responses to affective touch in women in South Africa and the United Kingdom

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Abstract

Affective touch, involving touch-sensitive C-tactile (CT) afferent nerve fibres, is integral to human development and wellbeing. Despite presumed cultural differences, affective touch research typically includes 'Western', minority-world contexts, with findings extrapolated cross-culturally. We report the first cross-cultural study to experimentally investigate subjective and neurophysiological correlates of affective touch in women in South Africa (SA) and the United Kingdom (UK) using (1) touch ratings, and (2) cortical oscillations for slow CT-optimal (vs. faster CT-suboptimal) touch on two body regions (arm, palm). We also controlled for individual differences in touch experiences and attitudes and attachment style. Cultural context modulated affective touch: SA (vs. UK) participants rated touch as more positive and less intense, with enhanced differentiation in sensorimotor beta band oscillations, especially during palm touch. UK participants differentiated between stroking speeds, with opposite directions of effects at arm and palm for frontal theta oscillations. Alpha band power showed consistent effects across countries. Results highlight the importance of cultural context in subjective experience and neural processing of affective touch. Findings suggest that palm touch may hold greater social or emotional significance in SA than the UK. Future research should further explore potential cultural influences on the meaning and function of touch across contexts.

Key words: affective touch; cross-cultural research; electroencephalography; neural oscillations; attachment style

Our sense of touch is essential for physical and social interaction. Discriminative touch identifies object properties and guides motor behaviour (McGlone *et al.*, 2014), whereas affective touch – typically gentle, dynamic touch – fulfils affiliative (Morrison *et al.*, 2010) and communicative (Kirsch *et al.*, 2018; McIntyre *et al.*, 2022; Krahé *et al.*, 2024) social functions. Affective touch is typically associated with pleasant feelings (Löken *et al.*, 2009; although see e.g., Strauss, 2019) and is linked to approach tendencies (Pawling *et al.*, 2017). Research has charted the importance of affective touch, and more broadly prosocial/affectionate touch, in human social development (Bendas and Croy, 2021), emotion regulation (Fotopoulou *et al.*, 2022), and psychological and physical wellbeing (Field, 2010; Jakubiak and Feeney, 2017). However, empirical studies on the perception and functions of affective touch have overwhelmingly been carried out in 'Western' contexts (sometimes termed minority-world settings, differentiating these from majority-world contexts, where most of the world's population resides; Draper *et al.*, 2023), limiting our understanding of cross-cultural variations in touch perception and processing.

Affective touch perception integrates 'bottom-up' peripheral afferent pathways and top-down psychological and contextual factors. Tactile stimulation activates cutaneous low-threshold mechanoreceptors via myelinated Aβ afferent fibres, resulting in rapid central processing through the somatosensory system (Abraira and Ginty, 2013). Additionally, gentle stroking of hairy skin at velocities of 1–10cms^{-1}, optimally at 3cms^{-1}, preferentially activates unmyelinated C-tactile (CT) afferents (Löken *et al.*, 2009), with such activation positively correlated with perceived pleasantness (Löken *et al.*, 2009; Perini *et al.*, 2015). Experimentally, this type of touch is commonly contrasted with faster, CT-suboptimal touch to the hairy skin (Löken *et al.*, 2009) or non-hairy (glabrous) body regions such as the palm (where CT fibres are not – or only sparsely – present) to isolate the contribution of CT-fibre activation and bottom-up from top-down effects on touch perception.

Neuroimaging studies have highlighted a distributed network of brain regions involved in touch processing, including somatosensory, insular, posterior parietal, and orbitofrontal cortices (Morrison, 2016a). Meta-analytic evidence from fMRI studies suggests a functional dissociation between discriminative and affective aspects of touch (McGlone *et al.*, 2012). While discriminative touch is associated with greater activation of primary somatosensory cortices, affective touch is linked to stronger activation of the dorsal posterior insula, a key region for interoception (Craig, 2002, 2009; Feldman *et al.*, 2024) and emotional processing (Duerden *et al.*, 2013). However, fMRI measures neural activity indirectly via hemodynamic responses and lacks the temporal resolution necessary to capture the rapid neural processing of tactile stimulation. By contrast, EEG provides a direct measure of neural activity with millisecond-level temporal precision, making it ideally suited to track the real-time cortical processing of dynamic touch.

EEG detects fluctuations in cortical oscillatory activity linked to sensory and affective processing. Event-related desynchronisation (ERD) and synchronisation (ERS) in alpha (8–13 Hz) and beta bands (16–24 Hz) are linked with cortical activation (ERD) or active inhibition (ERS) in the sensorimotor system (Pfurtscheller, 1977; Pfurtscheller and Aranibar, 1977). Tactile brushing stimulation of glabrous and hairy skin elicits ERD in alpha and beta bands over bilateral sensorimotor cortices, suggesting their involvement in bottom-up sensory processing and motor preparation (Gaetz and Cheyne, 2006). By contrast, midfrontal theta (4–7 Hz) oscillations are implicated in top-down functions of cognitive control (Cavanagh and Frank, 2014) and emotion regulation (Ertl *et al.*, 2013), with increased theta power associated with more cognitively demanding or emotionally arousing stimuli. However, this is most often the case under uncertainty, anxiety, or negative emotional stimuli (Cavanagh and Shackman, 2015). Conversely, CT-optimal touch has been hypothesised to promote soothing, affiliative states, with considerable evidence that it reduces stress and arousal (Walker *et al.*, 2022; Kidd *et al.*, 2023) and serves as a buffer in stressful situations (Morrison, 2016b; von Mohr *et al.*, 2017). This aligns with the concept that social touch regulates affect through homeostatic and allostatic mechanisms (Fotopoulou *et al.*, 2022). Notably, CT-optimal touch (to hairy skin of the forearm) has been shown to attenuate widespread theta and parietal beta oscillations compared to CT-suboptimal touch to the same region (von Mohr *et al.*, 2018a), potentially reflecting a soothing, regulatory response. Individual differences further shape these dynamics: for example, hand-holding after negative affect induction attenuates theta activity, but only in people with a secure attachment style (Kraus *et al.*, 2020), underscoring the role of social-emotional context in shaping neural responses to touch.

Psychological factors and individual differences influence the perception and meaning (Sailer and Leknes, 2022), as well as the neurophysiological correlates, of affective touch (Haggarty *et al.*, 2020; Kraus *et al.*, 2020). Touch exposure (Sailer and Ackerley, 2019) and attitudes (e.g., as part of attachment styles; Krahé *et al.*, 2018) modulate perceived affective touch pleasantness. Moreover, sex and gender effects are apparent, with females rating affective touch more positively (Russo *et al.*, 2020) and women ascribing different meaning to touch (Krahé *et al.*, 2024) compared to males/men. At a cultural level, individuals from collectivist cultures report higher acceptability of affectionate touch (Burleson *et al.*, 2019; Sorokowska *et al.*, 2021) but the few studies investigating the role of culture in affective touch (Burleson *et al.*, 2019; Suvilehto *et al.*, 2019; Sorokowska *et al.*, 2021; Schirmer *et al.*, 2023) have primarily focused on self-reported outcomes, with no studies on the neurophysiological correlates of affective touch in different cultural contexts. In the present study, we focused on comparing the UK and SA. SA shares features associated with more positive touch norms and greater touch frequency, such as stronger collectivist tendencies and a warmer climate (Sorokowska *et al.*, 2021). Cultural variations in touch norms (Burleson *et al.*, 2019) and early touch experiences (e.g., baby wearing and co-sleeping; Schön and Silvén, 2007), together with the influence of 'top-down' factors on touch perception and evaluation (Sailer and Leknes, 2022), suggest that the neural processing of affective touch may differ in SA vs. UK cultural contexts, but this has not yet been explored.

Accordingly, this pre-registered experimental study, conducted in the UK and SA, explored how cultural context shapes touch evaluations and neural oscillations (captured using electroencephalography; EEG) during affective touch. Using a within-subjects design, we varied touch velocity (affective i.e., slow, CT-optimal, vs. faster, CT-suboptimal) and body region (arm vs. palm) to tease apart the influence of bottom-up vs. top-down effects, whilst controlling for individual differences in touch experiences and attitudes, and attachment styles. As noted in our pre-registration, hypotheses were exploratory in nature. We tentatively hypothesised that SA participants would evaluate affective touch more positively and, given potentially greater touch exposure in the SA context (e.g., Sailer and Ackerley, 2019), that SA participants would show enhanced differentiation (to slow vs. faster touch) in neural oscillations compared to UK participants. More broadly across cultural contexts, we hypothesised that slower-velocity, affective touch would be evaluated more positively than faster-velocity touch (Löken *et al.*, 2009), and would be associated with decreased theta band activity (specifically, increased ERD) in response to CT-optimal touch (cf. von Mohr *et al.*, 2018a). We also examined effects of affective touch on alpha and beta band activity to capture sensorimotor processes. Given greater innervation of Aβ fibres and relevance of the hand for reach-to-grasp movements, we explored whether increased alpha and beta ERD would be evident for the palm vs. arm.

Methods

The study was pre-registered on the Open Science Framework: https://osf.io/fcqnk. Ethical approval was obtained from the Institute of Population Health Research Ethics Committee, University of Liverpool, and the Human Research Ethics Committee (Medical) at the University of the Witwatersrand. Data collection ran in the summer in each respective country: from June – August 2022 in the UK and November 2023 – January 2024 in SA. Data was not analysed until all participants had been tested.

Design

The study employed a 2 (country: UK, SA; between-subjects) × 2 (touch velocity: slow, CT-optimal 3cms^{-1} vs. faster CT-suboptimal 18cms^{-1}; within-subjects) × 2 (body region: CT-innervated forearm vs. non-CT-innervated palm; within-subjects) mixed design. All participants received slower and faster velocity touch to the arm and palm of the hand (one block per condition), with order counterbalanced across participants, while EEG was recorded. Outcome measures were: (1) self-reported pleasantness, comfort, intensity, liking and wanting ratings of touch; and (2) theta, alpha, and beta neural oscillations. We also measured self-reported experiences and attitudes to touch (Trotter *et al.*, 2018) and adult attachment style (Fraley *et al.*, 2000).

Participants

N = 36 female participants (given biological sex differences in touch perception; Russo *et al.*, 2020) were recruited in two different countries: *N* = 15 in Liverpool, UK, and *N* = 21 in Johannesburg, SA. The sample size was based on previous research (*N* = 28 in the similar EEG study by von Mohr *et al.*, 2018a); though we included the exploratory country variable, we exceeded our target of *N* = 30 indicated in the OSF pre-registration. EEG data from two SA participants was excluded prior to data analysis: one due to poor electrode impedances and missing behavioural data, and one due to a technical issue resulting in missing event markers. This resulted in a final EEG sample of 19 SA participants.

Participants were all aged 18 or over (*M* = 23.14 years, *SD* = 7.32 in SA, and *M* = 25.93 years, *SD* = 6.39 in UK), with no significant differences in age between countries (see Table 1 for full demographic characteristics and difference tests). All participants were right-handed, as touch was administered to the non-dominant left arm and palm. Exclusion criteria were: a history of psychiatric, neurological, or medical conditions affecting touch perception (e.g., chronic pain) and wounds, scars, tattoos or skin conditions on the forearm or palm.

[TABLE 1 HERE]

Materials and Measures

Touch protocol

Touch was administered by a trained experimenter, unknown to participants, using a cosmetic make-up brush (Natural Hair Blush Brush, No. 7, The Boots Company). Four 9cm × 4cm areas were marked on the participant's skin: two contiguously along participants' left volar forearm between wrist and elbow, and two side-by-side on the surface of the palm. Touch was administered in a block design across four conditions (order counterbalanced, with one block per condition): CT-innervated arm at $3cms^{-1}$, CT-innervated arm at $18cms^{-1}$, non-CT-innervated palm at $3cms^{-1}$, and non-CT-innervated palm at $18cms^{-1}$, as in previous research contrasting CT-optimal and non-CT-optimal touch (e.g., Krahé *et al.*, 2016; von Mohr *et al.*, 2018b; Meijer *et al.*, 2024). For the $3cms^{-1}$ condition, a single brush stroke was delivered manually from proximal to distal within the marked area. For the $18cms^{-1}$ condition, six proximal-to-distal strokes were delivered in the same region. CT afferents show an inverted U-shaped response to dynamic stimuli, with firing rates broadly tuned to stimuli between 1-$10cms^{-1}$, and maximal firing at 3 cms^{-1}. Microneurography studies have shown that stroking at higher speeds elicits very few CT responses (Löken *et al.*, 2009; Ackerley *et al.*, 2014b). Therefore, minor variations in brushing speed are highly unlikely to impact neural responses if they are in the correct CT-optimal or non-CT-optimal ranges, as was the case here.

Each block included 5 practice trials (not included in analyses) and 40 3s trials, separated by 8s of no touch. Adjacent skin areas were alternated between strokes to prevent habituation. Touch onsets were synchronised with a 4s auditory countdown, audible only to the experimenter through headphones. The use of audio or visual cues to trigger manual brushing is well established in affective touch research (e.g., Björnsdotter *et al.*, 2009; Morrison *et al.*, 2011; Lucas *et al.*, 2014; Haggarty *et al.*, 2020).

To ensure consistency in touch administration, each experimenter was trained using a standardised video and followed a protocol aligned across sites. Only one experimenter administered touch in each site. A virtual pilot session was conducted with each site to observe and verify adherence to the touch and EEG protocol. Brushing speed and duration were maintained through internal pacing and extensive training, while consistent pressure was ensured by maintaining full brush contact across the entire marked region throughout strokes. Participants provided single ratings for pleasantness, comfort, intensity, liking and wanting ratings of touch after each block on visual analogue scales with the anchors 0 (*not at all*) to 100 (*extremely*).

Electroencephalography

EEG data was recorded from 64 active silver-silver chloride electrodes using a BrainProducts actiCap snap system (BrainProducts GmbH, Munich, Germany) in the UK, and a g.tec g.Hlamp (g.tec medical engineering GmbH, Schiedlberg, Austria) in SA. Electrodes were embedded in a cap, positioned in line with anatomical landmarks according to the International 10-20 system. The BrainProducts actiCap system utilised Fz as the reference electrode and FPz as the ground electrode (63 active recording electrodes). The g.tec system utilised linked earlobe references A1 and A2 and AFz as the ground electrode (62 active recording electrodes). Electrode-to-skin impedances were kept below 5kΩ for g.tec and 25kΩ for BrainProducts. Signals were digitised at 1kHz using an actiChamp (UK) or g.Hlamp (SA) DC amplifier and stored for offline analysis.

EEG Data Processing

EEG data were processed using EEGLab Delorme and Makeig, 2004. Continuous data were split into 8s epochs (-2.5 to 5.5s around touch onset) and combined into one datafile for each participant. Data were re-referenced to the common average. Original reference channels were not regenerated to maintain consistency across sites, as different reference channels were used for UK and SA datasets. Data were filtered using 1Hz high pass and 70Hz low pass filters. A notch filter from 48–52Hz was applied to remove mains line noise before downsampling to 256Hz.

Artefacts were removed using a semi-automated method in EEGLab (see Supplementary Materials for details). Power spectra were computed in FieldTrip (http://fieldtriptoolbox.org) using a discrete Fourier time-frequency transformation. Power spectral densities were computed in the 8 s epochs (-2.5 to 5.5s around touch onset) using Welch's method from 1s overlapping segments. Data were smoothed using a 4Hz Slepian sequence prior to Fourier transformation. The spectral window was shifted in 0.1s intervals to yield a power time series of 80 points. Spectral power was estimated in the range 1–70Hz with a frequency resolution of 1Hz. Relative power was evaluated using the classical ERD transformation (Pfurtscheller and Aranibar, 1977): $D\% = \left(100 * \frac{A-R}{R}\right)$ where D represents the percentage power change during epochs following stimulus onset (A, 0 to 5.5s) relative to baseline (R, -2 to –1 s). Positive D values correspond to relative power decreases (event-related desynchronisation, ERD), while negative D values correspond to power increases (event-related synchronisation, ERS (Pfurtscheller, 1977; Pfurtscheller and Aranibar, 1977).

Questionnaires

Experiences in Close Relationships Revised Questionnaire (ECR-R; Fraley *et al.*, 2000): The ECR-R assesses individual differences in attachment anxiety and avoidance in adult romantic relationships. It consists of 36 items rated on a 7-point Likert scale, where 1 = 'strongly disagree' and 7 = 'strongly agree', and produces separate scores for attachment anxiety and attachment avoidance, with higher scores denoting greater anxiety/avoidance. Cronbach's alphas were α = .93 for both anxiety and avoidance in the current sample (across countries).

Touch Experiences and Attitudes Questionnaire (TEAQ; Trotter *et al.*, 2018): The TEAQ includes 57 items scored on a five-point Likert-type scale (1 = strongly disagree to 5 = strongly agree), with a mean score calculated for each of six subscales: Friends and family touch (FFT), Current intimate touch (CIT), Childhood touch (ChT), Attitude to self-care (ASC), Attitude to intimate touch (AIT), and Attitude to unfamiliar touch (AUT). Higher scores denote more positive attitudes and experiences. The TEAQ has recently been validated in a SA sample (Puckle, 2021). Cronbach's alphas were α = .84 for FFT, α = .88 for CIT, α = .92 for ChT, α = .77 for ASC, α = .89 for AIT, and α = .74 for AUT.

Procedure

Participants attended one laboratory visit (see Figure 1 for set-up). After obtaining informed consent, the EEG cap was fitted by a female researcher while participants completed the questionnaires. Thereafter, touch blocks were administered while EEG data was recorded. During these blocks, a screen was placed to prevent participants from seeing the experimenter and tactile stimulation. After all blocks were completed, the EEG cap was removed by the researcher, and participants were fully debriefed and compensated for their time.

[FIGURE 1 HERE]

Statistical Analyses

The analysis plan was pre-registered, with deviations noted below as they appear.

Amplitude changes of cortical oscillations were examined by exporting relative power (ERD/S) in theta (4–7 Hz), alpha (8–13 Hz), beta (16–24 Hz) frequency bands from bilateral electrode sites associated with touch processing: frontal (F1, F2, F3, F4), central (C1, C2, C3, C4, Cz) and parietal (P1, P2, P3, P4, Pz) regions for alpha and beta band power, and frontal and central clusters for theta band power, based on previous literature showing maximal changes in these bands at the respective sites for tactile stimulation (Gaetz and Cheyne, 2006; Henderson *et al.*, 2023; Hewitt *et al.*, 2023). Bilateral clusters were pre-registered based on a previous EEG study on affective touch (von Mohr *et al.*, 2018a) and well-documented prior evidence that somatosensory stimulation is followed by bilateral 10 Hz and 20 Hz ERD over sensorimotor cortices (reviewed in Stančák, 2006; also Fallon *et al.*, 2013). Restricting analyses to contralateral alpha power would therefore capture only part of the neural response to affective touch, whereas bilateral analysis offers a more complete representation. The window for ERD analysis was the sustained brushing period between 0.5s to 3s to avoid contamination of transient, non-stationary artifacts at the onset of brushing, motivated by the delayed central processing associated with slow-conducting CT afferents (Vallbo *et al.*, 1993; Löken *et al.*, 2009) and prior research showing that affective touch responses are more evident in later neurophysiological responses (e.g., ultralate potentials) rather than early, transient responses (Ackerley *et al.*, 2013; Haggarty *et al.*, 2020). Moreover, sustained theta dynamics have been documented in various studies investigating cognitive or emotional processing, including emotion regulation (Zouaoui *et al.*, 2023), working memory (Raghavachari *et al.*, 2001), and emotional memory retrieval (Zheng *et al.*, 2019), illustrating the appropriateness of this analysis window for continuous, dynamic touch. This window also allowed us to minimise any potential variation in manually applied brushing. Post-stimulus changes (3 to 5.5 s) were not analysed in the current study to avoid dilution of the effects from the active touch stimulus.

Deviations from preregistration based on an updated review of this literature included: amended frequency bands in theta (4–7 Hz; 4–8 Hz in preregistration) and beta bands (16–24 Hz; 13–30 Hz in preregistration); relative power was not exported from delta or gamma bands, the former being primarily associated with slow-wave sleep (e.g., reviewed in Long *et al.*, 2021), while the latter is frequently produced by microsaccades and muscle activity (Yuval-Greenberg *et al.*, 2008); prefrontal, temporal and occipital regions were not included to restrict the number of comparisons; and ERPs are not reported to focus rather on sustained cortical oscillations during dynamic touch. Following EEG data cleaning, blocks with <30 trials were removed from further analysis, based on previous work (Pfurtscheller, 1977). A total of eight blocks were removed across six participants (four with one excluded block, and two with two excluded blocks each: full details in Supplementary Materials). The remaining valid blocks for these participants were retained in statistical analyses.

Hypothesis testing: Multivariate linear mixed models (MLMMs) in Stata 18 (StataCorp, 2023) were used to test hypotheses. Outcomes were self-report ratings and spectral power. All data provided by participants was included for touch ratings. MLMMs can handle missing data under the assumption that data is missing at random. Where EEG data was missing entirely (in two participants, due to technical issues or persistent noise in the recording), self-report data was still included. In each analysis, we included ECR-R and TEAQ subscale scores as fixed-effect covariates. Fixed effects of interest were touch velocity (3cms^{-1} vs.

18cms^{-1}; categorical predictor), and region (arm vs. palm; categorical predictor)[1]. All interaction terms were included, and significant interactions were followed up with planned contrasts (Bonferroni corrected). The intercept of the participant ID was a random effect. We originally planned to include frequency band and region in analyses as fixed effects of interest. However, contrary to our preregistered analysis plan, we instead ran analyses separately for each frequency band and region, as directly comparing frequency bands or regions was not deemed useful. To account for the increase in number of analyses, we additionally applied Benjamini-Hochberg corrections to the results (false discovery rate set to 5%) and report in the text only those effects that survived correction; full results are in the tables. We calculated marginal R^2 (representing the variance explained only by fixed effects) and conditional R^2 (including fixed and random effects) for each model. Given the presence of significant interactions, we did not try to isolate R^2 values for individual predictors.

Exploratory analyses: The above confirmatory MLMMs were re-run adding country (UK, SA) as a between-subjects categorical predictor and examining its interactions with touch velocity and body region on outcome ratings. The country comparisons, while labelled exploratory here and in our preregistration due to the novel and multifactorial nature of the data, were central to the study's aims and thus are presented prominently in the Results.

Results

The data showed a strong modulatory effect of cultural context, such that the effects of touch velocity and location differed significantly between UK and SA participants. Given this and the centrality of cultural context to our study aims, we focus here on analyses including country (UK vs. SA) as a between-subjects factor. Confirmatory within-subject effects of touch velocity and location, derived from the affective touch literature, are reported in the Supplementary Materials.

Descriptive statistics

[1] Including random slopes for velocity and location did not change any of the results, so these were not included in final models.

Self-reported touch ratings are presented by country in Table 2 (see Supplementary Table 2 for ratings across countries). There were no differences between SA and UK regarding attachment styles and experiences and attitudes to touch, except that UK participants had significantly more positive attitudes to unfamiliar touch than did SA participants.

[TABLE 2 HERE]

Touch ratings

The four evaluative ratings (liking, wanting, comfort, pleasantness) formed a highly internally consistent scale (see Supplementary Materials). Therefore, our outcomes were 'touch evaluation' (four ratings entered concurrently into MLMMs) and touch intensity (single rating).

Model results are presented in Table 3 (marginal R^2 = .26 and conditional R^2 = .56 for the full touch evaluation model and marginal R^2 = .35 and conditional R^2 = .81 for the full intensity model). There was an effect of velocity on evaluative touch ratings that was not qualified by country or body region: participants in SA and UK evaluated affective, slow touch (M = 73.47, SE = 2.48) significantly more positively than faster touch (M = 67.34, SE = 2.47), in line with our hypothesis, though the faster touch was still evaluated moderately positively. Ratings did not differ by body region. Examining effects of country, participants in SA evaluated touch significantly more positively (M = 76.78, SE = 3.37) and significantly less intense (M = 23.63, SE = 5.00) than did UK participants (evaluative rating: M = 61.54, SE = 4.08; intensity rating: M = 56.02, SE = 6.06) across stroking velocities and body regions (see Table 3), in line with our hypothesis.

[TABLE 3 HERE]

Electroencephalography (ERD/S)

Grand-averaged ERD/S in alpha, beta and theta bands in each of the four conditions, averaged over participants within the UK and SA, are presented in Figure 2. Cortical activation changes during dynamic touch as a function of velocity, body region, and country were evaluated using MLMMs.

[FIGURE 2 HERE]

Alpha band: No effects of country (alone or in interaction with velocity and/or body region) survived Benjamini-Hochberg corrections (see Table 4). However, there was an effect of velocity across countries at central sites (marginal R^2 = .31 and conditional R^2 = .69 for the full model involving central electrodes and alpha band oscillations). Alpha-band ERS was significantly greater for slow-velocity touch (*M* = -.32, *SE* = 3.43) compared to ERD for faster-velocity touch (*M* = 5.41, *SE* = 3.42) across body regions. There was also an effect of body region at both central and parietal alpha sites (marginal R^2 = .22 and conditional R^2 = .43 for model involving parietal electrodes). Alpha-band ERS was significantly larger for the arm vs. greater ERD at palm at central (*M* = -.58, *SE* = 3.43 for arm; *M* = 5.81, *SE* = 3.43 for palm) and parietal sites (*M* = -8.99, *SE* = 1.72 for arm; *M* = -5.33, *SE* = 1.72 for palm) across stroking speeds. Therefore, alpha band oscillations were not influenced by cultural context but were modulated by stroking speed and body region.

[TABLE 4 HERE]

Beta band: For both central and parietal electrode sites, the effects of body region were shaped by cultural context (Figure 3b, e; marginal R^2 = .19 and conditional R^2 = .53 for model involving central electrodes; marginal R^2 = .23 and conditional R^2 = .57 for model involving parietal electrodes). The difference in the strength of beta-band ERD between palm and arm in bilateral central electrodes was significant in SA but not UK participants. SA participants showed larger ERD in central electrodes touch to the palm vs. ERS during touch to the arm (see planned contrast statistics in Figure 3a, b). Planned contrasts were not significant for beta-band ERD in parietal electrodes, though the trend was in the same direction as the central site (Figure 3c, d). The effect in parietal electrodes was further qualified by a three-way interaction of country, velocity, and body region (see Table 4). Breaking this interaction down by country, the velocity by body region interaction for beta-band ERD/S in central electrodes was significant in SA (b = -8.27, SE = 2.24, p = .005) and UK participants (b = 3.44, SE = 1.68, p = .041); there was stronger ERS for slow vs. fast touch at the palm but not arm in SA participants, whilst none of the planned contrasts were significant in the UK sample (Figure 3c, d). These results are in line with our hypothesis that SA (vs. UK) participants would show enhanced differentiation in their neural activation patterns.

[INSERT FIGURE 3 HERE]

Theta band: There was a country by body region interaction in theta-band ERD/S in both frontal and central electrode sites (Table 4; Figure 3e-h; marginal R^2 = .31 and conditional R^2 = .64 for model involving frontal electrodes; marginal R^2 = .27 and conditional R^2 = .52 for model involving central electrodes). At both sites, as for beta-band oscillations, theta-band ERD was reduced for the arm compared to palm region in SA participants (Figure 3e, g) but not UK participants (Figure 3f, h), pointing to greater differentiation between body regions but not stroking speeds in SA participants. However, the 3-way interaction of country by velocity by body region was also significant for theta-band in frontal electrodes. Here, the velocity by body region interaction was significant in the UK (b = 10.67, SE = 2.48, p < .001) but not SA sample (b = .60, SE = 2.66, p = .820). In the UK sample, the slow vs. fast contrast was significant at both palm and arm body regions (Figure 3f), but in opposite directions, with larger ERD for slow vs. fast touch at the palm, and lower ERD for slow vs. fast touch at the arm. While SA participants differentiated between body regions, UK participants additionally differentiated between stroking speeds, with opposite directions of effects at arm and palm.

Discussion

This is the first study to experimentally investigate the influence of cultural context on self-reported and neurophysiological responses to affective touch, accounting for individual differences in touch experiences and attitudes. Comparing women living in SA and the UK, we found that cultural context modulated both affective (how pleasant, comfortable, liked, and wanted the touch was rated) and intensity evaluations of dynamic stroking touch, as well as cortical oscillatory patterns (ERD/S) in beta and theta bands. ERD/S in the alpha band did not differ between countries.

SA participants rated all touch more positively and less intense than UK participants, aligning with our hypotheses based on touch norms and exposure. Across countries, slow-velocity touch was also evaluated more positively than faster touch (replicating a robust main effect in the literature (Essick *et al.*, 1999; Löken *et al.*, 2009). This effect was evident across both body regions (cf. Cruciani *et al.*, 2021), supporting findings that top-down modulatory factors beyond activation of CT-afferents contribute to the sensation and evaluation of affective touch (Morrison, 2023). While general attitudes towards touch from intimate others, current levels of intimate touch, friends and family touch, levels of positive childhood touch, and adult attachment styles did not differ between countries, attitudes to unfamiliar touch were less positive in SA (vs. UK) participants. The discrepancy between touch ratings and self-reported attitudes may be explained by the study environment, in which touch was delivered in a controlled, arguably safe way, by a trained experimenter of the same gender as participants. By contrast, attitudes to unfamiliar touch may be more generally influenced by high rates of interpersonal violence in SA (Richter *et al.*, 2018).

Cortical oscillations in response to touch were modulated by cultural context in beta and theta bands. Participants in SA but not UK showed enhanced differentiation between touch to body regions in the beta band, with larger central ERD during touch to the palm (vs. ERS to the arm), and stronger parietal ERS for slow vs. fast touch at the palm (but not the arm), a contrast that was not significant in the UK sample. Sensorimotor beta oscillations play an active role in endogenous top-down processing and sensorimotor integration by linking sensory input with contextual knowledge (Barone and Rossiter, 2021). Pre-stimulus beta oscillations in the primary somatosensory cortex are influenced by tactile expectations, with this effect enhanced by attention (van Ede *et al.*, 2010). Moreover, beta oscillations correspond to somatosensory decision outcomes, responding selectively to stimulus features only when they are task-relevant (Herding *et al.*, 2016). Taken together, enhanced desynchronisation of central beta oscillations during fast touch and touch to the palm in participants in SA may represent context-specific endogenous modulation of neural sensory processing, potentially shaped by cultural differences in touch experiences and expectations, as we explore further below.

Theta oscillations were also modulated by cultural context, possibly reflecting differences in the social or emotional importance of touch. UK participants showed lower frontal ERD for slow (vs. fast) touch at the arm. This finding is opposite to prior research pointing towards a potentially soothing effect of pleasant and prosocial touch, denoted by lower absolute theta power across the scalp in response to slow, CT-optimal touch (compared to faster CT-suboptimal touch, von Mohr *et al.*, 2018a), and in frontal sites in response to static, supportive hand-holding (Kraus *et al.*, 2020); from a partner, compared to no touch or hand-holding from a stranger). This discrepancy may stem from methodological differences between absolute band power changes (von Mohr *et al.*, 2018a; Kraus *et al.*, 2020) and power change relative to baseline in the current study. Our findings may reflect heightened theta power during the preceding baseline period, which diminished during touch. This relative increase aligns with studies linking theta synchronisation to emotion regulation (Ertl *et al.*, 2013), suggesting greater regulatory engagement during slow (vs. fast) arm touch in UK participants. Additionally, UK participants also showed lower ERD for fast (vs. slow) touch to the palm. As frontal theta ERS is linked with somatosensory orienting (Dietl *et al.*, 1999), attention, and cognitive control (Cavanagh and Frank, 2014), lower ERD for fast (vs. slow) palm stroking in UK participants suggests enhanced engagement of top-down attentional processes. This aligns with evidence that faster stroking touch is associated with communicating intentions of warning (Kirsch *et al.*, 2018), potentially eliciting heightened attention. However, as the oscillatory changes that we observed were during continuous brushing rather than at brushing onset (see Supplementary Materials Figure 4), changes in relative theta power in UK participants are unlikely to reflect differences in early sensory or orienting responses, typically reflected by phasic theta ERS. Furthermore, as theta research has largely focused on ERS, the underlying mechanisms of theta ERD during affective touch have yet to be determined. Given the lack of prior studies examining cortical oscillations in response to dynamic palm touch, future research is needed to clarify its functional significance.

In contrast to UK participants, SA participants exhibited reduced frontal and central theta-band ERD (less theta suppression) for arm versus palm touch across speeds. When considered alongside beta-band results, this suggests greater significance of palm touch in SA participants compared to those in the UK. The relevance of touch to the palm in SA participants may extend beyond sensory attributes to social and cultural dimensions. Previous research has found differences in touch permissibility to different body sites as a function of emotional closeness; for example, stranger touch is more acceptable to the hand than the forearm (Suvilehto *et al.*, 2015), and cultural differences in terms of the strength of this association for arm vs. hand in British vs. Japanese cultural contexts (Suvilehto *et al.*, 2019). Moreover, Chinese participants preferred touch to the hands more than German participants (Schirmer *et al.*, 2023). The arm and hand may therefore hold different significance in different cultural contexts, and further research is needed to investigate our effect of heightened cortical engagement in relation to palm vs. arm touch in participants living in SA. In SA, palm touch may hold augmented social significance, but this remains to be fully explored.

Alpha band power showed consistent effects across countries. Faster touch induced stronger central alpha ERD, and touch applied to the palm was associated with greater central alpha ERD and reduced parietal alpha ERS compared to the arm. 10Hz and 20Hz ERD in somatosensory regions have been associated with cortical excitability and readiness for sensory processing (Stančák, 2006), as well as attentional resource allocation and arousal (Neuper and Pfurtscheller, 2001). Thus, augmented cortical oscillations may be driven more by bottom-up stimulus properties. Heightened cortical activation signified by stronger ERD for palm touch might be linked to the palm's greater innervation density and smaller receptive fields (Vallbo *et al.*, 1995) and greater tactile acuity (Ackerley *et al.*, 2014a) compared to the forearm. These features facilitate precise sensory processing, especially during tasks requiring detailed mapping of stimulus characteristics, such as object manipulation and grasping (Johansson and Vallbo, 1983). The hands have larger cortical somatotopic representations compared to the forearms and much of the rest of the body, further emphasising their importance in detailed sensory processing (Penfield and Rasmussen, 1950). Sensory-driven processes are further shaped by social factors, with increased alpha power over frontal and parietal regions found when participants were at rest with somebody else present vs. at rest alone (Verbeke *et al.*, 2014). In sum, alpha-band oscillations were not modulated by cultural context, indicating that while potentially shaped by individual differences, these attentional processes may not be culturally specific.

A strength of our study was investigating not only cross-cultural differences but also measuring individual differences relating to touch attitudes and experiences and controlling for inter-individual variance in analyses. Thus, our findings are not due to e.g., differences in individual attachment styles or current intimate touch levels between participants in the two countries. Moreover, we asked participants to rate touch in relation to five aspects (pleasantness, comfort, intensity, liking, and wanting) and found that the four affective terms formed an internally consistent scale. In future, researchers may choose to include one or more of these aspects that seem to relate to similar evaluative constructs, at least at the self-report level.

Several limitations regarding the broad use of 'culture' and sample representativeness should be noted. Our samples are not representative of entire populations living in SA and the UK, nor were all our participants South African or British nationals. Both SA and the UK are home to individuals from various countries and ethnic backgrounds, which likely influence their touch norms and experiences. Moreover, early touch experiences might be different for people who moved to SA or UK in adulthood. Future studies should explore specific cultural groups within these countries to investigate more nuanced cross-cultural differences in affective touch experiences. The influence of sociodemographic factors such as religiosity (e.g., as in

Sorokowska *et al.*, 2021) on affective touch perception (both within and between cultural contexts) also warrants further investigation. Measures such as attachment style, rooted in Western constructs (Keller, 2018), may also not be the most appropriate way of assessing mental representations of social relationships across cultural contexts. Nevertheless, experimental studies that draw on neuroimaging methods within cognitive neuroscience are rare and challenging to conduct in contexts such as SA (see Besharati and Akinyemi, 2023; Cockcroft, 2024), resulting in further underrepresentation of African populations in EEG and experimental neuroscience research (Kwasa, 2024). Thus, the current study is a critical step in adding to the diversity and representation of majority-world participants in cognitive neuroscience generally and in affective touch research more specifically.

Although we hypothesised that cultural context may underlie cortical oscillatory changes during affective touch, we acknowledge that methodological differences between sites, including differences in EEG systems and laboratory environments, may have also contributed to the observed findings. Therefore, while we suggest cultural factors were important, the impact of these methodological variations should also be considered when interpreting the findings. However, previous work suggests that individual participant differences account for substantially more variance in EEG data compared to hardware differences. For instance, Melnik *et al.* (2017) reported that between-subject variability explained 32% of the variance in event-related potentials, while different EEG systems accounted for only 9%. These findings support the robustness of cross-system comparisons when appropriate harmonisation procedures are in place. Standardised analysis pipelines as in the current study have also been found to reduce variability in multi-lab EEG studies (Farzan *et al.*, 2017). We also acknowledge that environmental differences between laboratories—such as lighting conditions, ambient noise, and other contextual factors—may have influenced participant arousal or comfort. However, such variation is inherent and widely recognised as a challenge in both multi-site and cross-cultural research, where the use of different labs is not only unavoidable but essential (see Pavlov *et al.*, 2021). This issue is similarly present in wider neuroimaging research, where data are frequently acquired (and compared) on different MRI systems across sites (Warrington *et al.*, 2025).

Methodological limitations should also be considered. Although our sample size aligns with prior EEG studies of affective touch (Ackerley *et al.*, 2013; von Mohr *et al.*, 2018a; Haggarty *et al.*, 2020), it remains relatively modest. A formal power analysis was not conducted due to the multidimensional nature of the data and practical constraints associated with multi-site EEG research conducted in resource-limited settings. Moreover, as this study included only women participants, the findings may not generalise to other genders. While the current findings provide a valuable foundation, future studies should aim to replicate and extend these results in larger, more representative samples across both UK and SA contexts. Finally, while care was taken to standardise touch delivery across sites using training and auditory cues, manual brushing introduces minor variability in brush speed and pressure. This method aligns with validated procedures in affective touch research, and small variations are unlikely to significantly impact outcomes due to the broad tuning of CT afferents (Löken *et al.*, 2009). Future studies could consider using robotic tactile stimulators to further enhance precision, though such methods may reduce the naturalistic qualities of human social touch.

In conclusion, our study provides the first experimental and neuroimaging evidence showing that cultural context modulates both subjective and neurophysiological responses to affective touch. We observed effects of cultural context on touch evaluation across body region and velocity. The neural data paints a more nuanced picture, suggesting there may be a disconnect between cortical representations and subjective touch evaluations. Taken together, extrapolating findings from a given study to populations in a different cultural context is unlikely to be appropriate. Given the increasing use of touch in therapeutic contexts (McGlone *et al.*, 2024), indications of cross-cultural differences in health benefits as a function of affective touch (Packheiser *et al.*, 2024), and the cultural diversity within and between countries in an increasingly globalised world, we strongly recommend that researchers developing and implementing touch-based interventions (cf. Packheiser *et al.*, 2024) consider such country-level factors as well as individual differences in their design and in the interpretation of their findings.

Data availability

Source data and code are available on the Open Science Framework: https://osf.io/fcqnk.

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Ethics declarations

To conduct this study and collect data, consent was obtained from the Institute of Population Health Ethics Committee, University of Liverpool, and the Human Research Ethics Committee (non-medical) from the University of the Witwatersrand.

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Figure legends

FIGURE 1. THE SCHEMA DEPICTS THE EXPERIMENTAL SET-UP IN SOUTH AFRICA AND IN THE UNITED KINGDOM. SLIGHT ALTERATIONS IN THE ROOM SET-UP WERE MADE DUE TO CONSTRAINTS TO THE PHYSICAL LABORATORY SPACE BUT THE MAIN LAYOUT AND MATERIALS USED WERE STANDARDISED AND CONSISTENT ACROSS BOTH STUDY SITES.

FIGURE 2. GRAND-AVERAGED EVENT-RELATED DESYNCHRONISATION/SYNCHRONISATION (ERD/S) DURING TOUCH (0-3 S) BY COUNTRY IN ALPHA (A, D), BETA (B, E) AND THETA (C, F) BANDS IN EACH OF THE FOUR CONDITIONS, FOR SA AND UK PARTICIPANTS. ONLY PARTICIPANTS WITH DATA FOR ALL CONDITIONS ARE SHOWN IN THE TOPOGRAPHIC PLOTS (AS MATRICES NEED TO BE EQUAL), RESULTING IN A SLIGHTLY SMALLER N HERE THAN THE NUMBER INCLUDED IN STATISTICAL ANALYSES (UK N=15, SA N=19 PARTICIPANTS). TOPOGRAPHIC PLOTS SHOW ONLY ELECTRODES WHICH WERE COMMON ACROSS COUNTRIES.

FIGURE 3. EFFECTS OF COUNTRY PLOTTED BY BODY REGION (X AXIS) AND VELOCITY (SEPARATE LINES; FAST = DOTTED LINES. UK N=15, SA N=19 PARTICIPANTS). ERROR BARS DENOTE ±1 STANDARD ERROR OF THE MEAN. FOR CENTRAL BETA, THE DIFFERENCE BETWEEN PALM AND ARM (ACROSS VELOCITIES) WAS SIGNIFICANT IN THE SA (A; PLANNED CONTRAST PALM VS. ARM = 6.19, SE = 1.0, P < .001) BUT NOT THE UK SAMPLE (B; CONTRAST = 2.27, SE = 1.05, P = .060). FOR PARIETAL BETA ERD/S IN SA PARTICIPANTS (C), THE SLOW VS. FAST CONTRAST WAS SIGNIFICANT ONLY AT THE PALM (CONTRAST SLOW VS. FAST = -5.92, SE = 1.57, P < .001) AND NOT THE ARM (CONTRAST SLOW VS. FAST = .34, SE = 1.56, P = .999) BODY REGION, WHILE IN THE UK (D), NEITHER OF THESE BONFERRONI-CORRECTED CONTRASTS WERE SIGNIFICANT (PALM SLOW VS. FAST CONTRAST = 1.50, SE = 1.19,

P = .417; ARM CONTRAST = -1.94, SE = 1.19, P = .204). FOR FRONTAL THETA, ERD WAS REDUCED FOR THE ARM COMPARED TO PALM BODY REGIONS IN SA PARTICIPANTS (E; FRONTAL THETA CONTRAST = 6.64, SE = 1.24, P < .001) BUT NOT UK PARTICIPANTS (F; FRONTAL THETA CONTRAST = .30, SE = 1.31, P = .999). HOWEVER, IN THE UK SAMPLE (F), THE SLOW VS. FAST CONTRAST WAS SIGNIFICANT AT BOTH PALM (CONTRAST = 5.52, SE = 1.75, P = .003) AND ARM (CONTRAST = -5.15, SE = 1.75, P = .007) BODY REGIONS, BUT IN OPPOSITE DIRECTIONS, WITH GREATER ERD FOR SLOW VS. FAST TOUCH AT THE PALM, AND LOWER ERD FOR SLOW VS. FAST TOUCH AT THE ARM BODY REGION. FOR CENTRAL THETA, ERD WAS REDUCED FOR THE ARM COMPARED TO PALM BODY REGIONS IN SA PARTICIPANTS (PANEL G; CENTRAL THETA CONTRAST = 4.64, SE = 1.40, P = .002) BUT NOT UK PARTICIPANTS (PANEL H; CENTRAL THETA CONTRAST = -1.51, SE = 1.47, P = .607). POSITIVE VALUES CORRESPOND TO EVENT-RELATED DESYNCHRONISATION (ERD); NEGATIVE VALUES CORRESPOND TO EVENT-RELATED SYNCHRONISATION (ERS).

Table 1. *Demographic characteristics and self-report questionnaires.*

		South Africa (*N* = 21)		United Kingdom (*N* = 15)		Group comparison (uncorrected)
		Mean (SD)	**Min - Max**	**Mean (SD)**	**Min - Max**	**Bootstrapped regression analysis**
Age		23.14 (7.32)	18 - 52	25.93 (6.39)	20 - 38	*b* = 2.79, *SE* = 2.23, *p* = .211, 95% CIs -1.58; 7.16
Number co-habitants		2.57 (1.72)	0 - 6	2.8 (2.4)	0 - 7	*b* = 0.23, *SE* = .71, *p* = .747, 95% CIs -1.16; 1.61
Religiosity		0.62 (1.5)	-2 - 2	-1.27 (0.88)	-2 - 1	*b* = -1.89, *SE* = .40, *p* < .001, 95% CIs -2.66; -1.11
ECR-R	Attachment anxiety	3.19 (1.24)	1.33 - 5.94	3.26 (1.15)	1.44 - 4.83	*b* = 0.07, *SE* = .39, *p* = .856, 95% CIs -0.70; 0.84
	Attachment avoidance	2.84 (1)	1.39 - 5.17	2.7 (1.18)	1 - 5.72	*b* = -0.14, *SE* = .38, *p* = .710, 95% CIs -0.89; 0.61
TEAQ	Family and friends touch	3.79 (0.66)	2.45 - 4.91	3.79 (0.93)	2.09 - 5	*b* = 0.00, *SE* = .27, *p* = .998, 95% CIs -0.53; 0.53

	Current intimate touch	3.33 (0.73)	1.93 - 4.64	3.7 (0.9)	1.64 - 4.86	*b* = 0.37, *SE* = .28, *p* = .186, 95% CIs -0.18; 0.93
	Childhood touch	3.82 (0.77)	2.44 - 5	3.62 (1.3)	1.33 - 5	*b* = -0.19, *SE* = .36, *p* = .587, 95% CIs -0.89; 0.50
	Attitude to self care	3.77 (0.83)	2.2 - 5	3.59 (1.19)	0.8 - 5	*b* = -0.19, *SE* = .34, *p* = .584, 95% CIs -0.86; 0.48
	Attitude to intimate touch	3.98 (0.76)	2.62 - 4.92	4.38 (0.66)	3 - 5	*b* = 0.40, *SE* = .23, *p* = .086, 95% CIs -0.06; 0.85
	Attitude to unfamiliar touch	2.77 (0.83)	1.6 - 4.6	3.41 (0.89)	1.4 - 4.8	*b* = 0.65, *SE* = .28, *p* = .021, 95% CIs 0.10; 1.20
		***N* (%)**		***N* (%)**		**Chi square test**
Ethnicity	Arab	0 (0)		1 (6.67)		Pearson $\chi^2(5) = 25.27$, $p < .000$
	Asian	1 (4.76)		1 (6.67)		
	Black	16 (76.19)		0 (0)		
	Latin American	0 (0)		1 (6.67)		
	Mixed	3 (14.29)		2 (13.33)		
	White	1 (4.76)		10 (66.67)		
	Single	17		7		Pearson χ^2 (1) = 5.84 p = .016

Marital status	In a relationship	3	8	
Highest level of education	Diploma	0 (0)	1 (6.67)	Pearson χ^2 (3) = 16.36, *p* = .001
	High school	17 (80.95)	2 (13.33)	
	Postgraduate degree	2 (9.52)	7 (46.67)	
	Undergraduate degree	2 (9.52)	5 (33.33)	

Note. ECR-R = Experiences in Close Relationships Revised Questionnaire; TEAQ = Touch Experiences and Attitudes Questionnaire. Marital status was 'divorced' for one SA participant, not included here as unclear whether or not they were single. All participants reported being biologically female and self-identified as women.

Table 2. *Descriptive statistics for touch ratings by country.*

			South Africa						United Kingdom					
Body region	Velocity	Rating	Mean	*SD*	*N*	Min	Max	Range	Mean	*SD*	*N*	Min	Max	Range
Palm	Slow	Like	74.71	25.25	21	21	100	79	67.73	23.52	15	21	100	79
		Want	62.62	30.29	21	0	100	100	58.07	26.49	15	0	89	89
		Intense	28.14	31.55	21	0	100	100	45.80	27.61	15	0	90	90
		Comfortable	80.52	25.35	21	2	100	98	75.47	15.27	15	50	100	50
		Pleasant	79.71	21.30	21	28	100	72	75.13	17.19	15	40	100	60
	Fast	Like	76.24	22.05	21	25	100	75	55.20	26.69	15	13	100	87
		Want	65.33	27.38	21	5	100	95	46.40	23.27	15	5	78	73
		Intense	28.43	31.28	21	0	100	100	53.80	26.06	15	3	90	87
		Comfortable	82.76	20.88	21	34	100	66	66.0	19.63	15	33	100	67
		Pleasant	77.76	20.46	21	41	100	59	61.00	22.93	15	25	100	75
Arm	Slow	Like	87.10	20.10	20	16	100	84	64.80	22.31	15	21	93	72
		Want	75.95	21.57	20	29	100	71	49.40	24.14	15	0	79	79
		Intense	27.15	30.25	20	0	85	85	49.53	14.63	15	13	70	57

	Comfortable	84.65	26.10	20	8	100	92	73.60	20.75	15	30	100	70
	Pleasant	89.00	19.59	20	14	100	86	68.60	16.15	15	37	100	63
Fast	Like	73.33	27.64	21	10	100	90	54.93	22.77	15	25	100	75
	Want	64.19	24.07	21	2	100	98	47.20	24.48	15	0	85	85
	Intense	27.81	30.09	21	0	100	100	52.13	25.99	15	0	90	90
	Comfortable	82.57	19.10	21	38	100	62	62.27	21.13	15	30	100	70
	Pleasant	77.67	19.93	21	40	100	60	60.00	18.65	15	29	100	71

Table 3. *Linear mixed modelling results for evaluative (multivariate) and intensity (univariate) touch rating outcomes.*

		Evaluation					Intensity				
		b	*SE*	*p*	95% CIs		*b*	*SE*	*p*	95% CIs	
Predictors of interest	Country (SA is reference)	-18.53	6.19	**.003**	-30.66	-6.40	34.01	9.28	**< .001**	15.82	52.20
	Velocity (fast is reference)	7.95	2.58	**.002**	2.90	13.00	-1.75	4.07	.667	-9.73	6.23
	Country × velocity	0.05	3.95	.989	-7.70	7.80	-0.85	6.25	.892	-13.10	11.40
	Body region (arm is reference)	1.08	2.53	.669	-3.88	6.05	0.62	4.01	.877	-7.23	8.47
	Country × body region	-0.03	3.93	.993	-7.73	7.66	1.05	6.21	.866	-11.12	13.21
	Velocity × body region	-9.08	3.61	.012	-16.16	-2.00	1.47	5.71	.797	-9.73	12.66
	Country × velocity × body region	13.03	5.57	.019	2.11	23.95	-6.87	8.81	.436	-24.13	10.40
Covariates	Attachment avoidance	1.77	3.29	.590	-4.67	8.22	2.07	4.88	.671	-7.50	11.64
	Attachment anxiety	-8.33	2.76	**.003**	-13.74	-2.91	-7.70	4.10	.061	-15.74	0.34
	Friends and family touch	0.94	4.39	.830	-7.66	9.54	7.21	6.51	.268	-5.55	19.98

Current intimate touch	-4.74	5.44	.383	-15.40	5.92	-13.59	8.07	.092	-29.41	2.24
Childhood touch	4.76	3.01	.114	-1.15	10.67	7.94	4.48	.076	-0.83	16.71
Attitude to self-care	-1.49	3.02	.623	-7.40	4.43	2.42	4.48	.589	-6.37	11.21
Attitude to intimate touch	5.38	7.05	.446	-8.45	19.21	3.14	10.47	.764	-17.39	23.67
Attitude to unfamiliar touch	2.03	3.60	.573	-5.03	9.10	-4.67	5.35	.383	-15.16	5.82
Intercept	68.58	24.87	.006	19.84	117.33	25.40	36.94	.492	-46.99	97.79

Note. Bold *p* values denote those effects that survived Benjamini-Hochberg corrections.

Table 4. *Multivariate linear mixed modelling results for country effects on alpha, beta, and theta ERD/S.*

			Central electrode sites					***Parietal electrode sites***				
Frequency band			***b***	***SE***	***p***	**95% CIs**		***b***	***SE***	***p***	**95% CIs**	
Alpha	*Predictors of interest*	Country (SA is reference)	9.01	8.34	.280	-7.33	25.34	8.58	4.36	.049	0.04	17.12
		Velocity (fast is reference)	-7.77	2.70	**.004**	-13.07	-2.48	2.09	2.30	.363	-2.41	6.60
		Country × velocity	1.69	3.89	.663	-5.93	9.32	-6.08	3.32	.067	-12.59	0.42
		Body region (arm is reference)	9.38	2.65	**<.001**	4.18	14.57	6.35	2.26	**.005**	1.92	10.78
		Country × body region	-9.09	3.86	.018	-16.65	-1.53	-0.59	3.29	.858	-7.04	5.86
		Velocity × body region	-2.61	3.87	.500	-10.21	4.98	-4.86	3.29	.140	-11.32	1.59
		Country × velocity × body region	10.92	5.54	.049	0.06	21.78	-0.07	4.72	.988	-9.32	9.19
	Covariates	Attachment avoidance	8.06	4.84	.096	-1.43	17.54	7.02	2.33	**.003**	2.47	11.58
		Attachment anxiety	-10.84	4.35	.013	-19.36	-2.32	-6.37	2.09	**.002**	-10.46	-2.28

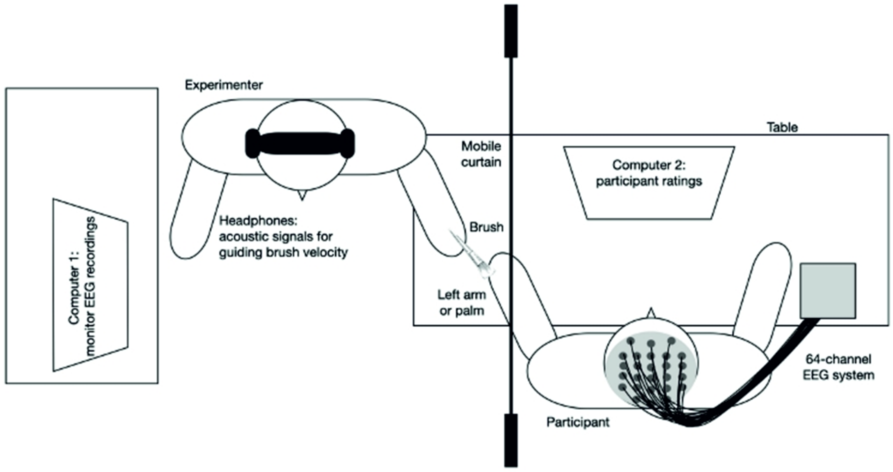
		Friends and family touch	1.90	6.08	.755	-10.02	13.82	0.45	2.92	.876	-5.26	6.17
		Current intimate touch	-11.19	7.52	.137	-25.94	3.55	-1.97	3.63	.587	-9.09	5.14
		Childhood touch	-3.37	4.15	.418	-11.51	4.77	1.87	1.99	.349	-2.04	5.78
		Attitude to self-care	-6.12	4.32	.156	-14.58	2.34	0.88	2.07	.671	-3.18	4.94
		Attitude to intimate touch	2.74	10.11	.787	-17.08	22.56	2.27	4.87	.642	-7.28	11.82
		Attitude to unfamiliar touch	8.77	5.22	.093	-1.46	19.01	2.74	2.51	.274	-2.17	7.65
	Intercept		38.76	34.57	.262	-29.01	106.52	-35.62	16.75	.033	-68.45	-2.79
Beta	*Predictors of interest*	Country (SA is reference)	7.64	3.53	.031	0.72	14.56	6.46	3.54	.068	-0.48	13.40
		Velocity (fast is reference)	1.41	1.42	.323	-1.38	4.20	0.36	1.38	.794	-2.35	3.07
		Country × velocity	-2.56	2.05	.212	-6.59	1.46	-2.30	1.99	.248	-6.21	1.60

	Body region (arm is reference)	10.30	1.40	**<.001**	7.56	13.04	4.82	1.36	**<.001**	2.16	7.48
	Country × body region	-7.45	2.04	**<.001**	-11.44	-3.46	-5.54	1.97	**.005**	-9.41	-1.67
	Velocity × body region	-8.22	2.04	**<.001**	-12.23	-4.22	-6.26	1.98	**.002**	-10.14	-2.37
	Country × velocity × body region	7.07	2.92	.016	1.34	12.80	9.69	2.84	**.001**	4.14	15.25
Covariates	Attachment avoidance	1.12	2.00	.573	-2.79	5.04	2.99	2.01	.138	-0.96	6.93
	Attachment anxiety	-1.80	1.79	.316	-5.31	1.72	-3.90	1.81	.031	-7.44	-0.36
	Friends and family touch	-1.94	2.51	.439	-6.85	2.97	-1.74	2.53	.492	-6.69	3.22
	Current intimate touch	-1.47	3.11	.636	-7.57	4.62	-0.42	3.13	.894	-6.56	5.72
	Childhood touch	-0.13	1.71	.937	-3.49	3.22	-1.14	1.73	.509	-4.53	2.24
	Attitude to self-care	0.65	1.78	.714	-2.84	4.14	1.90	1.80	.290	-1.62	5.42
	Attitude to intimate touch	-0.91	4.18	.827	-9.10	7.27	-1.30	4.21	.758	-9.55	6.96
	Attitude to unfamiliar touch	4.79	2.15	.026	0.57	9.02	5.24	2.17	.016	0.99	9.50

	Intercept		0.29	14.30	.984	-27.74	28.33	-6.14	14.41	.670	-34.38	22.10
Theta						***Frontal electrode sites***					***Central electrode sites***	
	Predictors of interest	Country (SA is reference)	6.09	4.43	.169	-2.60	14.77	6.22	4.32	.150	-2.25	14.70
		Velocity (fast is reference)	-0.19	1.78	.914	-3.68	3.29	3.51	2.00	.079	-0.41	7.43
		Country × velocity	-4.95	2.56	.053	-9.98	0.07	-5.43	2.88	.060	-11.08	0.22
		Body region (arm is reference)	6.32	1.75	**<.001**	2.90	9.74	4.32	1.96	.028	0.47	8.16
		Country × body region	-11.36	2.54	**<.001**	-16.34	-6.38	-7.86	2.86	**.006**	-13.47	-2.26
		Velocity × body region	0.64	2.55	.803	-4.36	5.63	0.64	2.86	.823	-4.97	6.26
		Country × velocity × body region	10.03	3.65	**.006**	2.88	17.19	3.43	4.10	.404	-4.62	11.47
	Covariates	Attachment avoidance	4.13	2.51	.100	-0.78	9.04	4.28	2.39	.073	-0.39	8.96
		Attachment anxiety	-4.43	2.25	.049	-8.85	-0.02	-2.92	2.14	.172	-7.12	1.28
		Friends and family touch	3.71	3.15	.238	-2.46	9.89	4.31	2.99	.150	-1.55	10.18

Current intimate touch	-6.46	3.90	.098	-14.11	1.19	-7.13	3.72	.055	-14.42	0.16
Childhood touch	-1.03	2.15	.632	-5.25	3.19	0.70	2.05	.731	-3.31	4.72
Attitude to self-care	-4.15	2.24	.063	-8.54	0.23	-6.39	2.13	**.003**	-10.56	-2.22
Attitude to intimate touch	0.80	5.25	.878	-9.48	11.09	1.54	5.00	.757	-8.25	11.33
Attitude to unfamiliar touch	5.99	2.71	.027	0.69	11.29	5.40	2.57	.036	0.35	10.44
Intercept	9.23	17.96	.607	-25.97	44.43	4.90	17.13	.775	-28.68	38.48

Note. *p* values that survived the Benjamini-Hochberg correction are highlighted in bold font.



THE SCHEMA DEPICTS THE EXPERIMENTAL SET-UP IN SOUTH AFRICA AND IN THE UNITED KINGDOM. SLIGHT ALTERATIONS IN THE ROOM SET-UP WERE MADE DUE TO CONSTRAINTS TO THE PHYSICAL LABORATORY SPACE BUT THE MAIN LAYOUT AND MATERIALS USED WERE STANDARDISED AND CONSISTENT ACROSS BOTH STUDY SITES.

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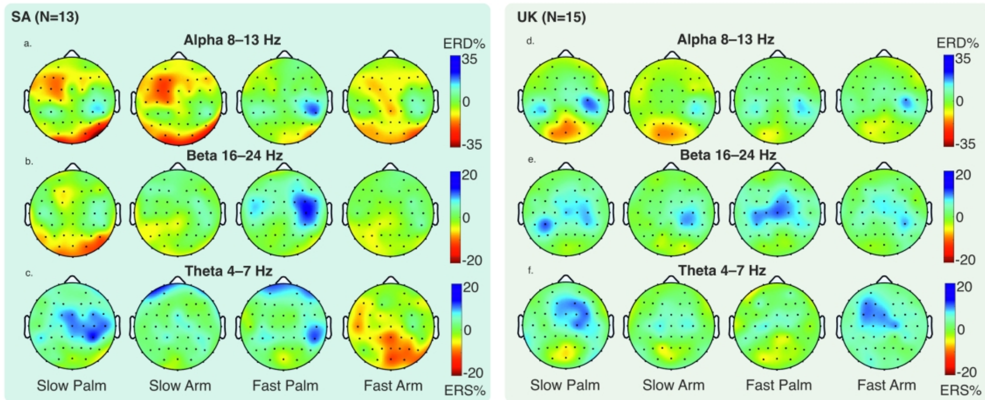

GRAND-AVERAGED EVENT-RELATED DESYNCHRONISATION/SYNCHRONISATION (ERD/S) DURING TOUCH (0-3 S) BY COUNTRY IN ALPHA (A, D), BETA (B, E) AND THETA (C, F) BANDS IN EACH OF THE FOUR CONDITIONS, FOR SA AND UK PARTICIPANTS. ONLY PARTICIPANTS WITH DATA FOR ALL CONDITIONS ARE SHOWN IN THE TOPOGRAPHIC PLOTS (AS MATRICES NEED TO BE EQUAL), RESULTING IN A SLIGHTLY SMALLER N HERE THAN THE NUMBER INCLUDED IN STATISTICAL ANALYSES (UK N=15, SA N=19 PARTICIPANTS). TOPOGRAPHIC PLOTS SHOW ONLY ELECTRODES WHICH WERE COMMON ACROSS COUNTRIES.

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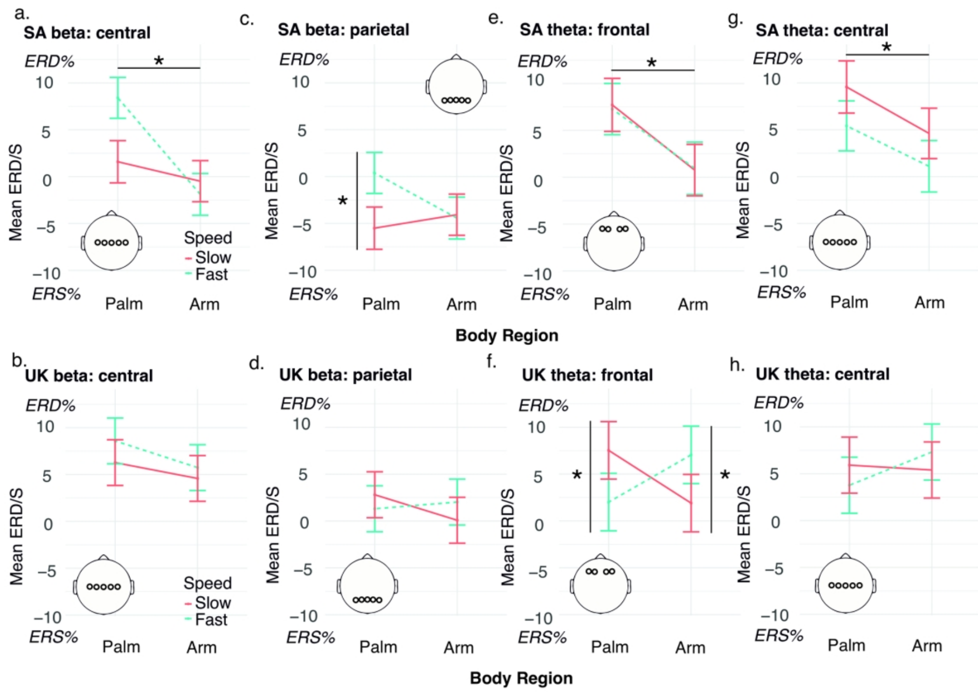


EFFECTS OF COUNTRY PLOTTED BY BODY REGION (X AXIS) AND VELOCITY (SEPARATE LINES; FAST = DOTTED LINES. UK N=15, SA N=19 PARTICIPANTS). ERROR BARS DENOTE ±1 STANDARD ERROR OF THE MEAN. FOR CENTRAL BETA, THE DIFFERENCE BETWEEN PALM AND ARM (ACROSS VELOCITIES) WAS SIGNIFICANT IN THE SA (A; PLANNED CONTRAST PALM VS. ARM = 6.19, SE = 1.0, P < .001) BUT NOT THE UK SAMPLE (B; CONTRAST = 2.27, SE = 1.05, P = .060). FOR PARIETAL BETA ERD/S IN SA PARTICIPANTS (C), THE SLOW VS. FAST CONTRAST WAS SIGNIFICANT ONLY AT THE PALM (CONTRAST SLOW VS. FAST = -5.92, SE = 1.57, P < .001) AND NOT THE ARM (CONTRAST SLOW VS. FAST = .34, SE = 1.56, P = .999) BODY REGION, WHILE IN THE UK (D), NEITHER OF THESE BONFERRONI-CORRECTED CONTRASTS WERE SIGNIFICANT (PALM SLOW VS. FAST CONTRAST = 1.50, SE = 1.19, P = .417; ARM CONTRAST = -1.94, SE = 1.19, P = .204). FOR FRONTAL THETA, ERD WAS REDUCED FOR THE ARM COMPARED TO PALM BODY REGIONS IN SA PARTICIPANTS (E; FRONTAL THETA CONTRAST = 6.64, SE = 1.24, P < .001) BUT NOT UK PARTICIPANTS (F; FRONTAL THETA CONTRAST = .30, SE = 1.31, P = .999). HOWEVER, IN THE UK SAMPLE (F), THE SLOW VS. FAST CONTRAST WAS SIGNIFICANT AT BOTH PALM (CONTRAST = 5.52, SE = 1.75, P = .003) AND ARM (CONTRAST = -5.15, SE = 1.75, P = .007) BODY REGIONS, BUT IN OPPOSITE DIRECTIONS, WITH GREATER ERD FOR SLOW VS. FAST TOUCH AT THE PALM, AND LOWER ERD FOR SLOW VS. FAST TOUCH AT THE ARM BODY REGION. FOR CENTRAL THETA, ERD WAS REDUCED FOR THE ARM COMPARED TO PALM BODY REGIONS IN SA PARTICIPANTS (PANEL G; CENTRAL THETA CONTRAST = 4.64, SE = 1.40, P = .002) BUT NOT UK PARTICIPANTS (PANEL H; CENTRAL THETA CONTRAST = -1.51, SE = 1.47, P = .607). POSITIVE VALUES CORRESPOND TO EVENT-RELATED DESYNCHRONISATION (ERD); NEGATIVE VALUES CORRESPOND TO EVENT-RELATED SYNCHRONISATION (ERS).

176x123mm (300 x 300 DPI)

Hewitt, D., Besharati, S., Williams, V., Leal, M., McGlone, F., Stancak, A., Henderson, J., & Krahé, C. Is cultural context the crucial touch? Neurophysiological and self-reported responses to affective touch in women in South Africa and the United Kingdom. *Social Cognitive and Affective Neuroscience.*

Supplementary Materials

Supplementary Table 1. *Descriptive statistics for touch ratings across countries.*

			Mean	SD	N	Min	Max	Range
Palm	Slow	Like	71.81	24.45	36	21	100	79
		Want	60.72	28.46	36	0	100	100
		Intense	35.50	30.85	36	0	100	100
		Comfortable	78.42	21.61	36	2	100	98
		Pleasant	77.81	19.56	36	28	100	72
	Fast	Like	67.47	25.95	36	13	100	87
		Want	57.44	27.10	36	5	100	95
		Intense	39.00	31.49	36	0	100	100
		Comfortable	75.78	21.76	36	33	100	67
		Pleasant	70.78	22.80	36	25	100	75
Arm	Slow	Like	77.54	23.58	35	16	100	84
		Want	64.57	26.03	35	0	100	100
		Intense	36.74	26.94	35	0	85	85
		Comfortable	79.91	24.27	35	8	100	92
		Pleasant	80.26	20.66	35	14	100	86
	Fast	Like	65.67	27.00	36	10	100	90
		Want	57.11	25.36	36	0	100	100
		Intense	37.94	30.59	36	0	100	100
		Comfortable	74.11	22.14	36	30	100	70
		Pleasant	70.31	21.08	36	29	100	71

Touch ratings:

As pre-registered, we carried out a confirmatory factor analysis on the ratings, specifying a model with four latent variables (the four conditions), each with five indicators (the five ratings). The specified model did not fit well, $\chi2(164) = 521.176$, $p < .001$; RMSEA = .25; CFI = .62; SRMR = .164. We next examined Cronbach's alphas for each condition both across countries and within countries. Intensity was negatively correlated with the other ratings, all alphas improved once intensity was removed, and alphas for the four-item scale were all excellent (see Supplementary Table 2). Theoretically, intensity refers more to discriminative and sensory than affective or hedonic aspects of touch, whereas the latter are captured by evaluative ratings of liking, wanting, and rating how comfortable and pleasant the touch is perceived to be.

Supplementary Table 2. *Cronbach's alpha for all five ratings vs. ratings excluding intensity.*

		SA		UK		Across countries	
		α	α without intensity	α	α without intensity	α	α without intensity
Palm	Slow	0.75	0.88	0.80	0.93	0.75	0.90
	Fast	0.84	0.95	0.86	0.95	0.85	0.92
Arm	Slow	0.80	0.90	0.82	0.90	0.86	0.96
	Fast	0.75	0.89	0.88	0.96	0.80	0.94

For evaluative touch ratings, across countries, slow touch was evaluated significantly more positively (*M* = 73.46, *SE* = 2.70) than fast touch (*M* = 67.37, *SE* = 2.70), though fast touch was still rated moderately positively (see Supplementary Table 3 for model results), in line with our hypothesis. There was no significant effect of body region (i.e., whether touch was administered to the arm or the palm), and no significant velocity by body region interaction. There were also no significant findings when intensity was the outcome.

Supplementary Table 3. *Linear mixed modelling results for evaluative (multivariate) and intensity (univariate) touch rating outcomes across countries.*

		Evaluation					Intensity				
		b	*SE*	*p*	95% CIs		*b*	*SE*	*p*	95% CIs	
Predictors of interest	Velocity (fast is reference)	7.90	1.98	**< .001**	4.01	11.79	-2.09	3.12	.502	-8.20	4.01
	Body region (arm is reference)	1.07	1.97	.586	-2.78	4.92	1.06	3.09	.732	-4.99	7.11
	Velocity × body region	-3.58	2.79	.200	-9.05	1.89	-1.41	4.39	.748	-10.00	7.19
Covariates	Attachment avoidance	-0.49	3.49	.887	-7.33	6.34	6.92	5.59	.216	-4.05	17.88
	Attachment anxiety	-7.75	3.02	.010	-13.68	-1.83	-8.94	4.85	.065	-18.45	0.56
	Friends and family touch	3.96	4.65	.395	-5.16	13.07	0.81	7.47	.914	-13.82	15.44
	Current intimate touch	-5.68	5.96	.340	-17.35	5.99	-11.60	9.56	.225	-30.34	7.13
	Childhood touch	5.56	3.29	.091	-0.89	12.01	6.22	5.28	.239	-4.13	16.57
	Attitude to self-care	-0.48	3.29	.884	-6.92	5.97	0.34	5.28	.948	-10.00	10.69
	Attitude to intimate touch	1.26	7.55	.867	-13.54	16.07	11.87	12.12	.328	-11.89	35.63
	Attitude to unfamiliar touch	-1.66	3.65	.649	-8.81	5.49	3.24	5.85	.580	-8.23	14.71
Intercept		78.74	26.84	.003	26.13	131.35	1.33	43.07	.975	-83.09	85.74

Note. These analyses did not include country as a predictor variable.

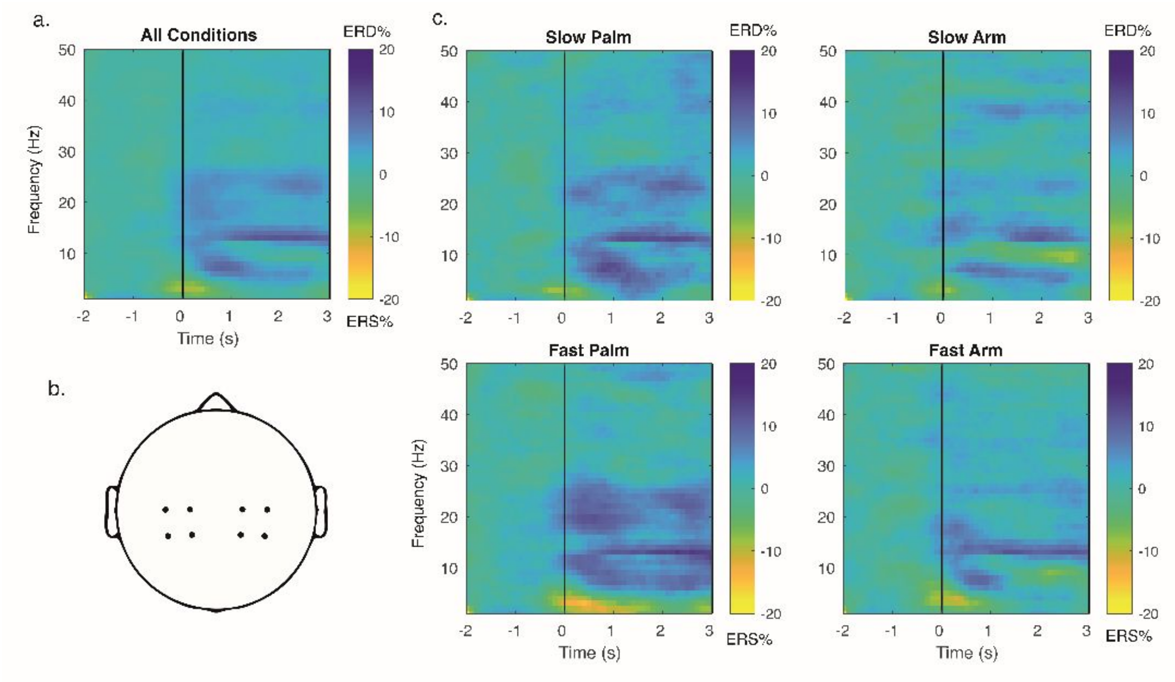
Electroencephalography:

Oculomotor artefacts were removed from the data using independent component analysis. Electrode channels with large artefacts were identified with visual inspection and interpolated (maximum of 10% of total electrodes). Outlier values were identified using *pop_eegthresh.m* with limits of -125 – 125 μV. Improbable data were marked using *pop_jointprob.m* using single channel and global channel limits of 5 standard deviations. For each participant, data were visually inspected and marked trials were manually reviewed. Mean accepted epochs per condition were: slow palm, 34.91 ± 5.93; fast palm, 36.15 ± 2.45; slow arm, 35.91 ± 3.32; fast arm, 35.59 ± 4.64. A univariate ANOVA with within-subject factors of body region and velocity and a between-subjects factor of country showed no significant difference in accepted trials between touch blocks (p > .05). Significantly more trials were rejected from the SA (35.71 ± 3.01) compared to the UK (37.18 ± 2.22) dataset (F(1,127) = 9.04, p = .003).

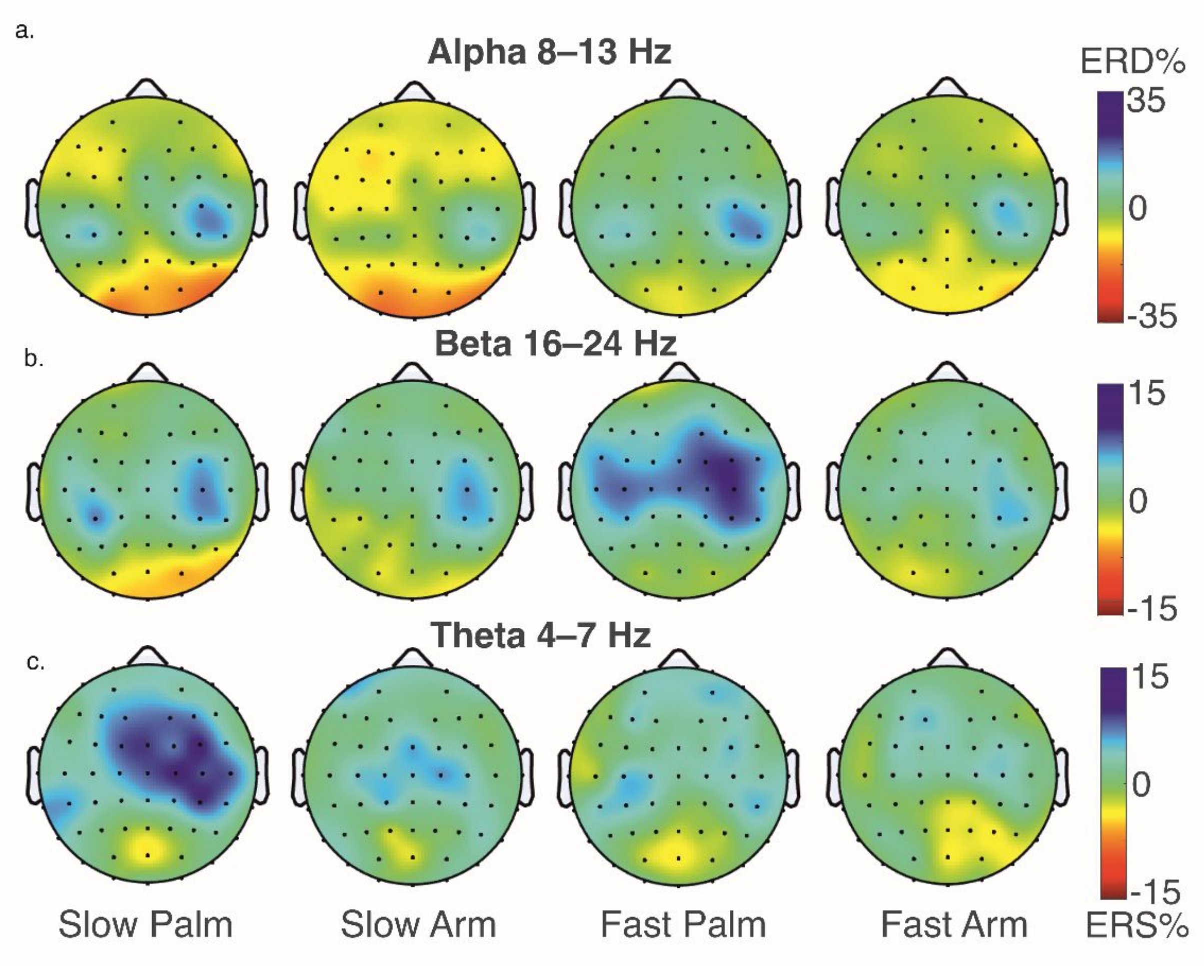
Following data cleaning, blocks with <30 trials were removed from further processing. No blocks were removed for the UK dataset. Eight blocks were removed from the SA dataset (2 participants with 2 blocks with <30 accepted trials, T19 and T23 in slow palm and fast arm conditions; 4 participants with 1 block with <30 accepted trials, T22, T25, T27 and T34 in fast arm, slow palm, slow arm and slow palm conditions, respectively).

ERD/S findings across countries

Grand average time-frequency plots from sensorimotor electrodes showed band power increases focused between 3–6 Hz around the onset of touch, followed by band power decreases concentrated from 4–27 Hz throughout the touch block (Supplementary Figure 1). Visual inspection of topographic plots (Supplementary Figure 2) showed a similar distribution of cortical activation over sensorimotor regions in alpha and beta frequency bands across countries, with the strongest bilateral ERD for touch on the palm, compared to more focal contralateral ERD for touch on the arm.



Supplementary Figure 1. *Grand-average time-frequency plots across all conditions (a, c) from electrodes over central and parietal regions of the scalp (b). Data is plotted averaged over all participants with complete datasets (N=28). Colour bar indicates percentage power change from baseline, with positive values indicating ERD, and negative values indicating ERS.*



Supplementary Figure 2. *Grand-averaged ERD/S over the entire touch duration (0-3 s) in (a) alpha, (b) beta and (c) theta bands in each of the four conditions, averaged over all participants with complete datasets (N=28). Topographic plots show only electrodes which were common across countries.*

Findings across countries

Alpha: Alpha ERD at central sites was significantly reduced for slow-velocity (*M* = -.34, *SE* = 3.48) compared to faster-velocity (*M* = 5.42, *SE* = 3.47) touch across body regions (i.e., arm or palm; see Supplementary Figures 3a, c). Moreover, alpha ERS was significantly greater for the arm (*M* = -.70, *SE* = 3.47) vs. palm (*M* = 5.87, *SE* = 3.47) at central and parietal sites (*M* = -5.48, *SE* = 1.76 for palm; *M* = -9.00, *SE* = 1.76 for arm) across stroking speeds (Supplementary Figure 3d, e; Supplementary Table 4). These findings are very similar to those reported in the main text, but please note this model did not include country as a predictor variable.

Beta: As for alpha, central beta ERD was significantly greater for the palm (*M* = 6.19, *SE* = 1.46) compared to the arm (*M* = 1.76, *SE* = 1.46 for arm; Supplementary Figure 3b, f), as expected. However, this body region effect was further qualified by a significant velocity by body region interaction (Supplementary Table 4). Planned contrasts showed stronger ERD for fast (*M* = 8.53, *SE* = 1.54) vs. slow touch (*M* = 3.77, *SE* = 1.56) at the palm (contrast = 4.75, *SE* = 1.04, $p < .001$) but not the arm region (fast arm: *M* = 1.72, *SE* = 1.56; slow arm: *M* = 1.80, *SE* = 1.54; contrast = -.07, *SE* = .104, *p* = .944), in line with our hypotheses.

Theta: Contrary to beta body region effects which were evident for the faster touch to the palm, the interaction between velocity and body region for frontal theta diverged for arm and palm: At the arm, ERD was greater for fast (*M* = 3.92, *SE* = 2.43) than slow (*M* = 1.20, *SE* = 2.41) touch (contrast = 2.72, *SE* = 1.31, *p* = .037), in contrast to von Mohr et al. (2018), while for the palm, ERD was reduced for fast (*M* = 4.88, *SE* = 2.40) vs. slow (*M* = 7.63, *SE* = 2.43) touch (contrast = -2.75, *SE* = 1.31, *p* = .035), in line with Kraus et al. (2020); see Supplementary Table 4 and Supplementary Figure 2c.

Supplementary Table 4. *Multivariate linear mixed modelling results for alpha, beta, and theta ERD/S across countries.*

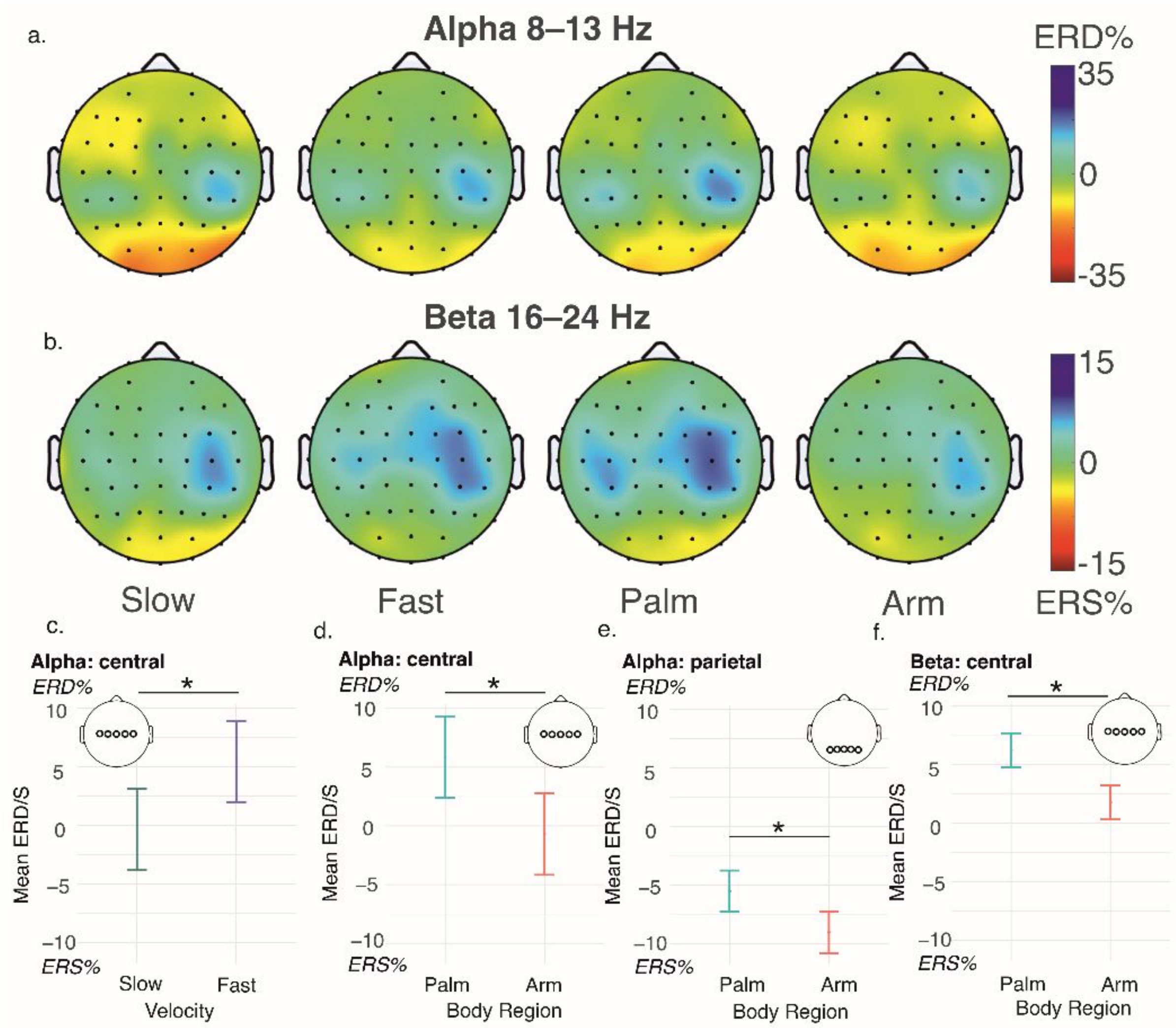
			Central electrode sites					***Parietal electrode sites***				
Frequency band		**Predictor**	**b**	**SE**	**p**	**95% CIs**		**b**	**SE**	**p**	**95% CIs**	
Alpha	*Predictors of interest*	Velocity (fast is reference)	-7.11	1.96	**<.001**	-10.96	-3.26	-0.82	1.67	**.001**	-4.09	2.44
		Body region (arm is reference)	5.24	1.94	**.007**	1.43	9.05	5.90	1.65	**.003**	2.67	9.14
		Velocity × body region	2.69	2.80	.337	-2.80	8.17	-4.85	2.37	.869	-9.50	-0.20
	Covariates	Attachment avoidance	8.68	4.85	.073	-0.82	18.18	7.55	2.36	.712	2.92	12.18
		Attachment anxiety	-10.63	4.41	.016	-19.27	-1.99	-6.28	2.14	.454	-10.48	-2.07
		Friends and family touch	0.58	6.02	.923	-11.22	12.38	-0.48	2.93	.773	-6.22	5.25
		Current intimate touch	-10.60	7.60	.163	-25.50	4.30	-1.37	3.72	.535	-8.66	5.92
		Childhood touch	-3.79	4.19	.365	-12.00	4.42	1.53	2.04	.086	-2.47	5.52
		Attitude to self-care	-6.59	4.36	.130	-15.13	1.95	0.61	2.12	.029	-3.54	4.77

		Attitude to intimate touch	4.08	10.15	.688	-15.81	23.97	3.08	4.96	**.001**	-6.64	12.80
		Attitude to unfamiliar touch	10.76	4.90	.028	1.16	20.35	4.09	2.38	**.003**	-0.58	8.76
	Intercept		35.10	34.62	.311	-32.76	102.95	-37.15	16.98	.869	-70.43	-3.88
Beta	*Predictors of interest*	Velocity (fast is reference)	0.07	1.04	.944	-1.96	2.11	-0.82	1.01	.416	-2.79	1.16
		Body region (arm is reference)	6.80	1.03	**<.001**	4.79	8.81	2.23	1.00	.025	0.28	4.19
		Velocity × body region	-4.82	1.48	**.001**	-7.72	-1.93	-1.51	1.44	.294	-4.32	1.31
	Covariates	Attachment avoidance	1.45	2.01	.470	-2.49	5.40	3.36	2.04	.099	-0.64	7.36
		Attachment anxiety	-1.68	1.83	.359	-5.27	1.91	-3.76	1.85	.043	-7.40	-0.13
		Friends and family touch	-2.71	2.50	.279	-7.61	2.19	-2.58	2.53	.309	-7.54	2.39
		Current intimate touch	-1.05	3.16	.740	-7.25	5.15	0.01	3.20	.997	-6.27	6.29
		Childhood touch	-0.40	1.74	.817	-3.81	3.01	-1.42	1.76	.422	-4.87	2.04

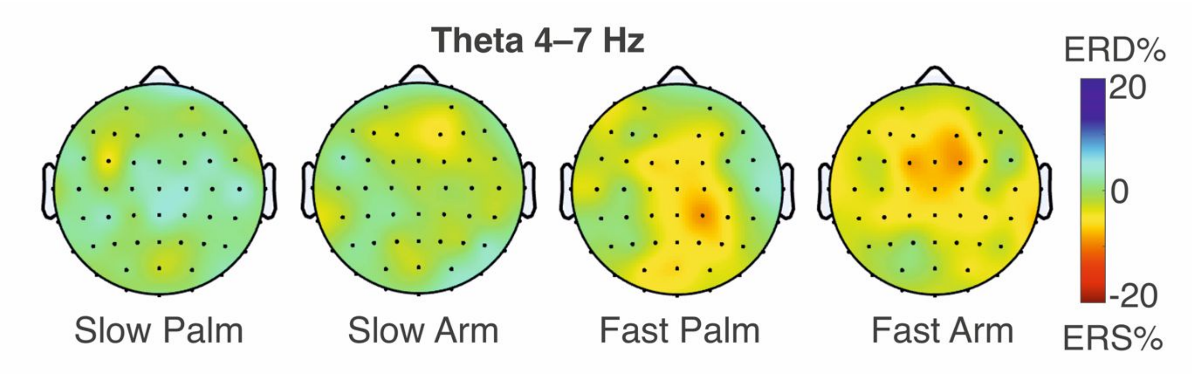
		Attitude to self-care	0.42	1.81	.815	-3.12	3.97	1.61	1.83	.380	-1.98	5.20
		Attitude to intimate touch	-0.32	4.22	.94	-8.59	7.95	-0.54	4.27	.899	-8.92	7.83
		Attitude to unfamiliar touch	5.91	2.03	**.004**	1.92	9.89	6.48	2.06	**.002**	2.44	10.52
	Intercept		-0.01	14.41	.999	-28.25	28.24	-7.73	14.59	.597	-36.33	20.88
Theta		***Frontal electrode sites***						***Central electrode sites***				
	Predictors of interest	Velocity (fast is reference)	-2.70	1.31	.039	-5.26	-0.14	0.82	1.46	.573	-2.03	3.67
		Body region (arm is reference)	0.98	1.29	.449	-1.56	3.51	0.55	1.44	.703	-2.28	3.37
		Velocity × body region	5.40	1.86	**.004**	1.75	9.05	2.19	2.07	.291	-1.87	6.25
	Covariates	Attachment avoidance	4.04	2.49	.104	-0.83	8.92	4.27	2.36	.070	-0.35	8.90
		Attachment anxiety	-4.37	2.26	.053	-8.80	0.06	-2.90	2.14	.176	-7.10	1.30
		Friends and family touch	3.57	3.09	.248	-2.48	9.62	4.16	2.92	.155	-1.58	9.89
		Current intimate touch	-6.30	3.90	.107	-13.95	1.35	-6.93	3.71	.062	-14.20	0.34

	Childhood touch	-1.10	2.15	.608	-5.31	3.11	0.62	2.04	.762	-3.38	4.61
	Attitude to self-care	-4.13	2.23	.064	-8.51	0.25	-6.35	2.12	**.003**	-10.50	-2.20
	Attitude to intimate touch	0.53	5.21	.920	-9.69	10.74	1.33	4.95	.788	-8.36	11.03
	Attitude to unfamiliar touch	6.13	2.51	.015	1.21	11.05	5.55	2.38	.020	0.89	10.21
Intercept	Constant	13.23	17.80	.457	-21.65	48.11	8.41	16.91	.619	-24.74	41.56

Note. p values that survived the Benjamini-Hochberg correction are highlighted in bold font. Country was not included as a predictor in these models.



Supplementary Figure 3. *Effects of touch velocity and body region on alpha (a) and beta (b) event-related synchronisation/desynchronisation (ERS/ERD) over the entire touch duration (0-3 s). Mean ERD/S for planned comparisons are plotted over central sites in alpha (c, d) and beta (f) bands, and in parietal sites in the alpha band (e). Error bars denote ±1 standard error of the mean.*



Supplementary Figure 4. *Effects of touch velocity and body region on theta event-related synchronisation/desynchronisation (ERS/ERD) following touch onset (0-0.5 s).*