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# Touching you, touching me: Higher incidence of mirror-touch synaesthesia and positive (but not negative) reactions to social touch in Autonomous Sensory Meridian Response

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A B S T R A C T

The characterisation of autonomous sensory meridian response (ASMR) as an audio-visual phenomenon overlooks how tactile experiences are not just perceptual *concurrents* of ASMR (i.e., tingling) but also commonly strong ASMR *inducers*. Here we systematically investigated whether ASMR-responders show altered tactile processing compared to controls. Using a screening measure of vicarious touch with a predefined cut-off for mirror-touch synaesthesia (MTS; a condition where tactile sensations are experienced when viewing, but not receiving, touch), we found that ASMR-responders had more frequent and intense vicarious touch experiences, as well as a strikingly higher incidence of MTS, than non-responders. ASMR-responders also reported greater reactivity to positive, but not negative, interpersonal touch. Correlations further showed these patterns to be more prevalent in those responders with stronger ASMR. We discuss the implications of our findings in terms of heightened sensory sensitivity, bodily awareness, and the underlying neuro-cognitive mechanisms driving vicarious tactile perception in ASMR and MTS.

## 1. Introduction

Autonomous sensory meridian response (ASMR) is a pseudo-scientific term used to describe a complex emotional state that some, but not all, people are capable of experiencing (e.g., Poerio, 2016). The ASMR sensation is described as a tingling sensation starting in the crown of the head and spreading down the body, and is accompanied by feelings of relaxation and immersion (Roberts, Beath, & Boag, 2019; McErlean & Osborne-Ford, 2020). People who experience ASMR (ASMR-responders) report it as developing in childhood (Barratt & Davis, 2015; Poerio, Blakey, Hostler, & Veltri, 2018) and describe a common set of ‘triggers’ that give rise to the ASMR experience. Common triggers include auditory stimuli (e.g., whispering, soft speaking, tapping, and crinkling), visual stimuli (e.g., delicate hand movements, repetitive actions) and interpersonal stimuli (e.g., close personal attention, caring and touch).

Early theorising suggested that ASMR may be a form of touch and/or emotional synaesthesia because ASMR triggers in one modality (e.g., sights and sounds) automatically elicit an experience (tactile, tingling sensations, feelings of calm) in another modality (Poerio, 2016). Research partially supports this characterisation because a higher proportion of self-reported synaesthetic experiences

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are observed in ASMR-responders (5.9%) compared to the general population (4.4%) (Barratt & Davis, 2015). ASMR also tends to co-occur with another synaesthetic-like experience, misophonia (Janik McErlean & Banissy, 2018; Barratt et al., 2017; Rouw & Erfanian, 2018), where people experience aversive feelings in response to certain sounds (e.g., tapping, chewing, eating, lip smacking, pen clicking) (Jastreboff & Jastreboff, 2001; Wu, Lewin, Murphy, & Storch, 2014). Rouw and Erfanian (2018) also found that 'other' types of synaesthesia (a collection of associations that were not hearing-colour, sequence-colour or sequence-shape) were associated with both misophonia and ASMR. However, research has not yet examined the co-occurence of ASMR and synesthesia with more objective tools (e.g., a quantitative evaluation of synaesthesia with a diagnostic cut-off).

Although ASMR may co-occur with synaesthetic experiences generally, given the tactile characteristics of ASMR and its frequent elicitation from real and simulated interpersonal touch, we expect it to be closely related to mirror-touch synaesthesia (MTS). MTS is defined as the conscious experience of first-hand tactile sensations when viewing touch on others (Ward & Banissy, 2015; see also Gillmeister, Bowling, Rigato, & Banissy, 2017). Similar to ASMR, MTS is a non-universal experience: the self-reported prevalence is 10.8% (Chun & Hupé, 2013) while objective tests estimate prevalence at 1.6% (Banissy et al., 2009). In MTS, vicarious touch occurs when observing tactile events on another person's body at an anatomically or specularly corresponding location on the observer's body (Ward & Banissy, 2015). The phenomenology of state-ASMR differs somewhat - a wide range of triggers elicit *the same* tactile sensation (tingling) in specific body regions (the head, spreading down to the neck and shoulders) (Swart et al., 2021).

ASMR and MTS sensations are both described as tactile. However, unlike MTS, the stimuli that elicit an ASMR response are often not tactile themselves, with common triggers spanning auditory (e.g., whispering, tapping, mouth sounds) and visual (e.g., watching delicate hand movements) modalities (Barratt & Davis, 2015; Poerio et al., 2018). The fact that visual and auditory stimuli trigger a tactile response (state-ASMR) makes it indicative of a synaesthetic type response (inducer-concurrent relationship; Ward & Banissy, 2015), with some researchers even suggesting that the phenomenon be renamed Audio Visual Elicitation of Somatosensation (AVES, Niven & Scott, 2021).

It is important to note that audio-visual triggers are neither necessary nor sufficient for ASMR induction. Previous research that has asked about real-life *tactile* ASMR triggers shows that they are commonly endorsed by ASMR responders. For example, 'getting your hair brushed/played with' was rated as an ASMR trigger by 73% of ASMR-responders, the second most commonly endorsed trigger after 'soft speaking' which was endorsed by 74% of the sample, and notably higher than prototypical visual (e.g., 'hand movements' 48%) and auditory ('tapping' 51%, 'scratching sounds' 47%) ASMR triggers (Poerio et al., 2018, Study 1). More recent work from our lab, which specifically examines tactile ASMR triggers, shows that ASMR is overwhelmingly elicited by interpersonal touch, both real and simulated. Physical social touch (e.g., back or hair stroking) is both the most commonly endorsed (by 97% of respondents) and the most intense ASMR trigger (average intensity of $\sim$ 5 on a 6-point scale; Poerio et al., in preparation). It is therefore possible that audio-visual stimuli that trigger ASMR primarily do so because they serve as reminders of, or antecedents to, (anticipated) physical social touch.

Several other lines of converging research also suggest that the experiences of MTS and ASMR are related, perhaps more so than other types of synaesthesia. First, they share a socio-cognitive profile characterised by higher self-reported empathy (Banissy & Ward, 2007; Janik McErlean & Banissy, 2017; but see Poerio et al., 2018) and superior performance on facial emotion recognition tasks (Banissy et al., 2011; Swart et al., submitted). Second, they have developmental origins, with ASMR emerging in childhood prior to puberty (Barratt & Davis, 2015; Poerio et al., 2018) and synaesthesia typically described as being present for as long as synaesthetes can remember (e.g., Simner & Bain, 2013). Third, their underlying neurophysiology shows similarities, with studies suggesting that both may be marked by structural and functional imbalances in lower-level sensory regions on the one hand, and in higher-level frontal-parietal regions on the other (Blakemore et al., 2005; Holle et al., 2013; Lochte et al., 2018; Smith, Fredborg, & Kornelsen, 2017, 2019, 2020). Such imbalances are reflected in subjective and behavioural sensory sensitivities and atypical body awareness (e.g., Davies & White, 2013; Banissy, Walsh, & Ward, 2009; Maister, Banissy, & Tsakiris, 2013; Poerio et al., 2022; Roberts et al., 2021).

A relationship between mirror touch and ASMR could imply shared mechanisms underlying both experiences at a trait level (e.g., individual differences in neural connectivity, flexibility of self-other representations, or differences in social cognition). In the present study, we examine, for the first time, whether mirror touch experiences and MTS incidence are higher in ASMR. We used a shortened version of a screening tool for MTS (Ward, Schnakenberg, & Banissy, 2018), which allowed us to: (1) establish a cut-off point for classifying ASMR-responders and non-responders as MTS, (2) test whether mirror touch and other vicarious bodily experiences are heightened in ASMR-responders, that is, whether they are quantitatively different from non-responders, and (3) determine whether the vicarious tactile experiences reported by ASMR-responders are characteristic of MTS, that is, whether they are qualitatively similar to those of other mirror-touch synaesthetes reported in the literature. With regard to the latter, we used the screening tool to test whether (a) those identified as MTS adopt predominantly specular reference frames (e.g., when seeing someone touched on the right side of the viewed face they report a feeling on their own right side, as if looking in a mirror) compared to anatomical ones (e.g., when seeing someone touched on the right side of the face they report a feeling on their own left side, in the same anatomical location), (b) mirror touch experiences occur more frequently and more intensely when viewing touch on another person compared to touch on inanimate objects, and (c) the observation of another person scratching elicits tactile sensations rather than other vicarious bodily experiences (e.g., feelings of itchiness or tingling).

Given the dominance of social touch as an ASMR trigger, we were also interested in whether ASMR-responders have more sensitive reactions to interpersonal touch than non-responders. As a simple exploration of this idea, we assessed attitudes towards negative and positive social touch via the Social Touch Questionnaire (STQ; Wilhelm et al., 2001) to determine (1) whether average attitudes differ between ASMR responders and non-responders and (2) whether greater self-reported ASMR intensity (as measured by the ASMR-15; Roberts et al., 2020) is systematically associated with attitudes towards touch. We hypothesised that, in addition to heightened mirror touch, ASMR-responders would have heightened reactivity to social touch and thus score more highly on the STQ than non-responders. Because ASMR is typically reported as a pleasant and euphoric experience (e.g., Roberts et al., 2019), we expected these differences to be particularly evident for positive relative to negative social touch items. Finally, we explored whether higher STQ scores were systematically related to self-reported ASMR intensity (as measured by the ASMR-15) and to the frequency and intensity of mirror touch experiences.

## 2. Method

### 2.1. Participants

Participants were 375 individuals (ASMR-Responders = 263; non-responders = 112) recruited from multiple sources. Social media recruitment sources comprised Facebook ASMR community groups (ASMR Discussion & Research Forum; ASMR UK & Ireland; ASMR Italia; ASMR Deutschland), Twitter, Reddit (/r/ASMR) and the social media channels of ASMR content creators. Participants were also recruited through a UK University staff and student mailing list as well as a human participant pool software system (SONA). Non-responders and responders were recruited from the same sources and it was made clear in the advertisement for the study that participants did not have to be familiar with ASMR or experience it in order to partake "Some people experience ASMR and others do not and we are interested in finding out more about both people who have ASMR and those who don't. If you are not sure whether you experience ASMR, you are still welcome to take part.". Participants were from multiple (30) countries across the world, with 273 participants completing the survey in English, 93 in Italian and 9 in German. The full sample had a mean age of 29.24 (SD = 10.98; Range: 18–71) and was predominantly female (72% female, 26% male, 2% non-binary) and predominantly white (83% white, 17% non-white). Average ages of ASMR responders ($M$ = 30.21, $SD$ = 10.73) and non-responders ($M$ = 29.04, $SD$ = 11.55) were not significantly different, $t(372) = 1.03$, $p$ =.305. Proportions of those identifying as male or female were not significantly different between ASMR-responders and non-responders, $\chi(1) = 0.01$, $p$ =.932. Ethical approval was provided by the University of Essex Ethics Sub-committee 3.

### 2.2. Measures

**Assessing ASMR-responder vs. non-responder status.** Participants were provided with a written description of ASMR (see Poerio et al, 2018) encompassing its key characteristics (pleasurable tingling originating at the head), typical inducers (example triggers) and distinction from frisson/musical chills. Participants were then invited to watch an example ASMR video previously shown to consistently induce ASMR (Poerio et al., 2018; standard ASMR video used in Study 2). They were provided with the following information "The video below is an example of a scenario that may trigger ASMR. If you are unsure about what ASMR is and whether you experience it, then please watch this video. If you know for certain what ASMR is and know that you experience it, then feel free to skip this video." Participants then answered the following question: "Having now read the ASMR description and watched the video, do you think you experience ASMR?" (Yes vs. No), which was used to classify participants as ASMR-responders or non-responders. Note that responses to the ASMR video were not used as the criterion for ASMR-responder status because the idiosyncratic and context-dependent nature of ASMR triggers mean that responses to a single video will not be sufficient to classify participants (e.g., a participant with trait ASMR may not experience the ASMR sensation in response to every ASMR video). The video in this instance was simply used to provide a concrete example of the kinds of stimuli that may trigger the ASMR response for those who are unfamiliar with the term 'ASMR'.

**ASMR Intensity.** The ASMR-15 (Roberts et al., 2019; Italian and German translations created by native speakers, authors AS and HG, see https://osf.io/nsp93/) was given to ASMR-responders (i.e., those answering 'Yes') to provide an assessment of ASMR response intensity (e.g., as in Poerio et al., 2021). The ASMR-15 is an individual difference measure that indexes the perceived intensity of multiple dimensions of the ASMR response, including the extent to which it induces tactile sensations, relaxation, positive affect, and a state of absorption. ASMR-responders rated their experience of ASMR on 15 items (e.g., "*The sensation feels 'tingly'*", "*I find the sensation intensely pleasurable*", "*It feels as though I have slipped into a hypnotic, trance-like state*") from 1 (*completely untrue for me*) to 5 (*completely true for me*). Items were averaged to provide an overall score where higher scores indicated greater ASMR intensity (Cronbach's α = 0.83).

**Screening for mirror-touch synaesthesia.** Participants were given a shortened version of Ward et al.'s (2018) screening measure of MTS (Italian and German translations created by native speakers, authors AS and HG, see https://osf.io/nsp93/). Ward et al.'s online screening tool assesses the frequency and intensity of tactile sensations arising from the observation of videos depicting touch. It was developed to determine the presence of MTS in participants in a standardised way and without the need for specialist equipment required by other measures (e.g., visuo-tactile interference task; Banissy & Ward, 2007). MTS scores obtained with the tool have been shown to positively relate to emotional reactivity (but not cognitive empathy), recognition of emotional facial expressions and vicarious pain experiences (Ward et al., 2018). The subset of stimuli used in the present study were 12 short video clips, comprising examples from each of the three categories used in the original study (human touch, inanimate touch, human scratching). Six clips depicted touch to a human; specifically, they showed a finger touching: the left and right cheek, the left and right hand from an allocentric perspective, and the left and right hand from an egocentric perspective. Four videos depicted inanimate touch; specifically, they showed a human finger touching: the left and right cheek of a dummy head, and the left and right hands of a dummy from an egocentric perspective. Two videos depicted a person scratching their left and right upper arm for 20 s.

After watching each video clip participants were asked a series of questions (see Ward et al., 2018): "Do you experience anything on YOUR body? (excluding feelings of unease, disgust, or flinching)" [*Yes* vs. *No*]. Affirmative answers were followed by three additional questions regarding: (1) the sensation: "How would you describe the sensation?" [*Touch (without pain)/Pain (without touch)/Painful touch/Tingling/Itchiness/Feeling of being scratched/Other (please describe)*], (2) the location: "Where on your body was it felt?" [*Not localisable/Left face/Right face/Left hand/Right hand/Left arm/Right arm/Other (please describe)*], and (3) the intensity: "How intense was it?" rated on a sliding scale from 0 (*not at all intense*) to 10 (*highly intense*). Follow-up questions were always asked in the same order and questions regarding sensation and location required participants to select only one option from the list provided (which included the option to self-describe).

**Self-evaluations of social touch.** Positive and negative reactions to social touch were assessed with the social touch questionnaire (STQ; Wilhelm et al., 2001; German translation by Lapp & Croy, 2020; Italian translation created by native speaker, author AS, see https://osf.io/nsp93/). Participants were asked to indicate how characteristic 20 statements were of them from 0 (*not at all*) to 4 (*extremely*). Items comprised broad emotional reactions to social touch across a range of contexts including giving and receiving touch and tactile interactions involving close others, strangers and acquaintances. The 10 items capturing positive reactions to social touch (e.g., "*I like being caressed in intimate situations*"; "*I generally like when people express their affection towards me in a physical way*") were averaged to create an overall score where higher scores indicated more positive reactions to social touch ($\alpha = 0.74$). The 10 items capturing negative reactions to social touch (e.g., "*It would make me feel anxious if someone I had just met touched me on the wrist*"; "*It annoys me when someone touches me unexpectedly*") were averaged to create an overall score where higher scores indicated more negative reactions to social touch ($\alpha = 0.86$). Unsurprisingly, positive and negative reactions to social touch were negatively correlated across our total sample, $r(365) = -0.42$, $p < .001$.

### 2.3. Procedure

Participants reported on their ASMR status (Yes vs. No), and, if they answered affirmatively, they then completed the ASMR-15 (measure of the perceived intensity of their ASMR response in general). All participants then completed the MTS screening tool, followed by the STQ. Items on the MTS screening tool were pseudorandomised, intermixing the different trial types (human touch, dummy touch, scratching) and body locations (left and right side), and presented to all participants in the same fixed order. STQ items were individually randomised per participant. Participants also answered several other questionnaires about trait affect, well-being, and ASMR more generally, as part of a broader research project on ASMR. These were not the focus of the current investigation and so are not discussed or reported here.

### 2.4. Data analysis

Prior to any analyses we examined whether participants failed attention check measures (e.g., "Please select 'always' for this question"). Participants who failed 2 or more attention checks (N = 23, 5.8%) were excluded from any further analyses. Subsequent analyses were based on N = 375 (please see https://osf.io/8jyda/ for complete raw data and associated syntax files for details on our data cleaning and screening procedures).

The data for intensity and frequency of sensations to touch videos were non-normally distributed (most people reported no MT-like sensations - see Fig. 1); non-parametric tests were therefore used to: (1) examine differences between ASMR-responders vs. non-responders on key variables (Mann-Whitney U), (2) compare responses to different types of touch (Wilcoxon signed rank), and (3) examine associations between MT-sensations and ASMR intensity (Spearman's correlations).

Chi-squared tests of associations were used to examine: (1) whether the incidence of MTS (according to a cut-off score) was higher in ASMR-responders compared to non-responders and (2) whether specular or anatomical mirror touch mappings were observed. Independent t-tests were used to examine differences between ASMR-responders and non-responders on (1) positive and (2) negative affective reactions to social touch.

Pearson's correlations were conducted on ASMR-responders to examine associations between perceived ASMR intensity (measured by the ASMR-15) and (1) positive and (2) negative affective reactions to social touch.

Where possible, we report effect sizes (Cohen's d) and the relative probabilities of our data given the null and alternative hypotheses (Bayes factor, $BF_{01}$), which are are less dependent on sample size and together with frequentist statistics complete a more rounded picture of the balance of evidence in our data.

The cleaned and preprocessed data and syntax files associated with our analyses are available via OSF (see https://osf.io/8jyda/).

## 3. Results

### 3.1. Vicarious bodily experiences and incidence of MTS

**Distribution of bodily sensations when viewing human touch.** For the total sample (N = 375) the overall mean number of reports of any sensations (/6) when observing touch to a human was 1.0 (SD = 1.55, range = 0–6). That is, on average there was one affirmative answer (out of six possible) to the question whether participants felt something on their own body while watching the six human touch videos. The relative proportions of all reported sensations, which participants were asked to describe following an affirmative answer, were as follows (in descending order): 42.8% touch (without pain); 28.6% tingling; 13.4% other; 7.2% painful touch; 4.6% itchiness; 1.9% pain (without touch); and 1.6% the feeling of being scratched. These distributions were similar across both ASMR-responders and non-responders and matched those reported by Ward et al. (2018) for the most frequent categories of touch without pain (41.4%) and tingling (33.9%). 'Other' sensations were often described as unease or irritation, or as a form of touch (poking, prodding and pressure). Although the relative distributions of sensations were similar across ASMR-responders and non-responders, those with ASMR reported significantly more sensations overall when observing human touch (N = 263, mean frequency = 1.16, SD = 1.67, range: 0–6) compared to non-ASMR participants (N = 112, mean frequency = 0.61, SD = 1.17, range: 0–6), Mann-Whitney U = 12,226.50, z = −2.96, p =.003, d = 0.15 (small effect size), $BF_{01}$ = 0.077 (strong evidence in favour of alternative hypothesis).

**Frequency and intensity of mirror touch experiences.** To derive an index of experiences that could be described as mirror touch (MT) as per Ward et al. (2018), we combined categories of touch (without pain), painful touch, feeling of being scratched, and 'other' responses that described touch (i.e., poking, prodding and pressure) in response to the 6 videos depicting human touch. The reporting of tactile sensations when observing touch to a human (i.e., MT scores of 1 or above) was almost twice as prevalent in the ASMR group (28.9%) than in the non-ASMR group (16.1%) and relative prevalence of ASMR-responders largely increased with increasing MT scores (see Fig. 1). Mean MT scores (/6) were more than twice as high in ASMR-responders (mean frequency = 0.66, SD = 1.26) than in non-responders (mean frequency = 0.29, SD = 0.77), suggesting that ASMR-responders experience mirror touch more frequently, U = 12,724.00, z = −2.74, p =.006, d = 0.14 (small effect size), $BF_{01}$ = 0.21 (moderate evidence in favour of alternative hypothesis). The perceived intensity (/10) of MT was also higher in ASMR-responders (mean intensity = 0.73, SD = 1.37) than in non-responders (mean intensity = 0.45, SD = 1.22), but here the balance of evidence was less clear, U = 12,980.00, Z = −2.41, p =.016, d = 0.12 (small effect size), $BF_{01}$ = 2.098 (anecdotal evidence in favour of null hypothesis). Consistent with Ward et al. (2018), the intensity of MT sensations positively correlated with their frequency across all participants, rs(375) = 0.96, p <.001, $BF_{01}$ < 0.001 (strong evidence in favour of alternative hypothesis).

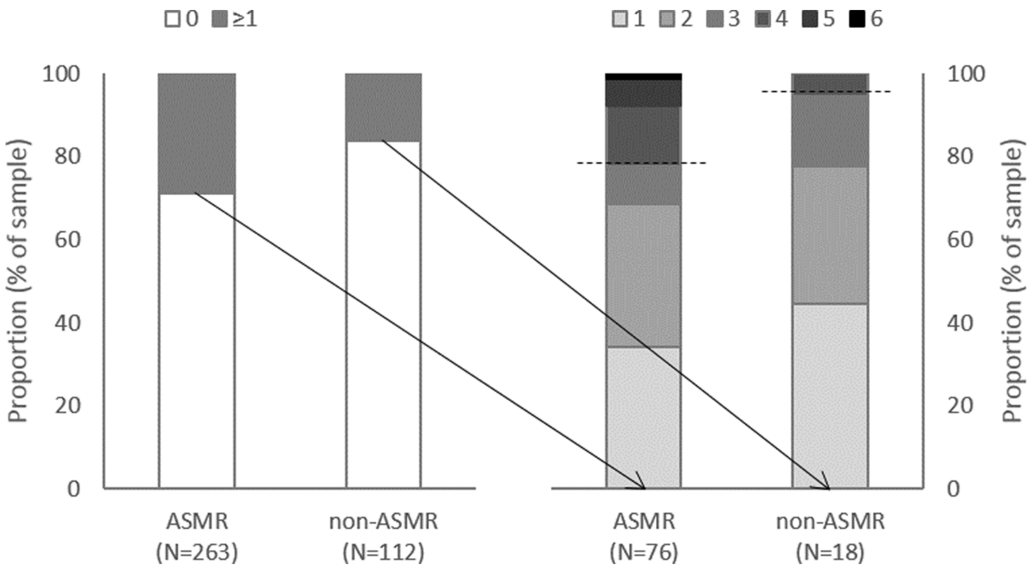


**Fig. 1.** Relative proportions of MT experiences in ASMR and non-ASMR groups. Left panel shows the proportion of ASMR and non-ASMR participants reporting no (white portion of bar) or at least 1 (grey portion) tactile experience in response to the six videos depicting human touch. Right panel shows proportions of MT scores of 1 or above in detail. Dotted black lines mark the cut-off score for MTS (4 or above).

Because ASMR is also a trait that can vary in intensity, we examined whether more intense ASMR (as indexed by the ASMR-15) was associated with more frequent and intense MT experiences (ASMR-responders only). ASMR-15 scores were positively correlated with the frequency, rs(263) = 0.19, p =.003, $BF_{01}$ = 1.867 (anecdotal evidence in favour of null hypothesis), and intensity, rs(263) = 0.20, p =.001, $BF_{01}$ = 0.601 (anecdotal evidence in favour of alternative hypothesis), of tactile sensations to human touch observation, but this was only seen in frequentist statistics.

**Is the incidence of MTS higher in ASMR?** Although our results indicate that mirror touch experiences are substantially higher in ASMR participants, we wanted to determine whether ASMR participants were also more likely to meet a formal diagnostic criterion for MTS. To do this, we calculated a cut-off frequency of tactile sensations in response to human touch videos by reanalysing the raw data from Ward et al.'s (2018) original sample of 283 naive undergraduates. In Ward et al. (2018), a score of 7/14 or above led to a 2.1% prevalence of MTS, which was close to the objectively verified prevalence of 1.6% reported by Banissy et al. (2009). As our study used only 6 of Ward et al.'s 14 videos depicting human touch, we determined a new cut-off score of 4/6 on the basis of their original data for these 6 videos. This score of 4/6 identified the same six MTS cases that were identified with the 7/14 cut-off in Ward et al. (2018).

Using this newly derived cut-off score, our sample contained 18/375 individuals who scored 4 or above (a MTS prevalence of 4.8%). Seventeen of the 18 were ASMR-responders (a prevalence of 6.5% within this group), and the remaining one participant belonged to the non-responder group (a MTS prevalence of 0.9% within this group). Subsequent analysis showed that ASMR participants were more likely to be identified as MTS than non-ASMR participants, $\chi(1) = 5.34$, $p$ =.021, $d$ = 0.24 (small effect size).

**Spatial reference frames in MTS.** MTS often display systematic spatial correspondences between seen and experienced touch, adopting predominantly specular, rather than anatomical, reference frames (e.g., Banissy et al., 2009; Ward et al., 2018; although see Chun & Hupé, 2013). To determine whether this was also true for our participants who fulfilled the diagnostic criterion for MTS, we coded the laterality (left vs. right) of reported tactile sensation in response to the four videos depicting human stimuli from an allocentric perspective (two showing touch to the face and to the hands, respectively). We then determined the mapping type for each participant to be anatomical (same side of the body), specular (opposite side) or ambivalent (where the difference between anatomical and specular responses was 0). Of the 18 participants with MT scores of 4 or above, significantly more used a specular spatial reference frame (72.2%), followed by ambivalent (16.7%) and anatomical (11.1%) spatial reference frames, $\chi(2) = 12.33$, $p$ =.002. These proportions are in line with previous findings (Banissy et al., 2009; Ward et al., 2018), where the majority of people with MTS adopt a specular (mirrored) spatial reference frame when viewing touch to others (e.g., when seeing someone touched on the right side of the face they report a feeling on their own right side, as if looking in a mirror).

**Human versus inanimate (dummy) touch.** The literature on vicarious touch has repeatedly shown that there is a sensitivity for *human touch* in eliciting mirror-like sensations. Specifically, MTS occurs more frequently and more intensely when viewing touch on another person compared to touch on inanimate objects (Banissy & Ward, 2007; Holle, Banissy, Wright, Bowling, & Ward, 2011; Ward et al., 2018). To establish whether this pattern of responding was also present in our sample, we compared MT scores in response to human versus dummy touch videos. Because MT scores represent frequencies that depend on the number of videos, to compare them we created new scores by dividing MT scores by the number of videos shown in each condition (6 vs. 4, respectively).

Paralleling previous literature, these new MT scores were found to be twice as high when observing human (mean score = 0.092, SD = 0.19) compared to dummy touch (mean score = 0.046, SD = 0.15), Wilcoxon's W = 4,183.50, z = 4.98, p <.001, d = 0.26 (small effect size), $BF_{01} < 0.001$ (strong evidence in favour of alternative hypothesis). This difference was true for ASMR-responders, W =

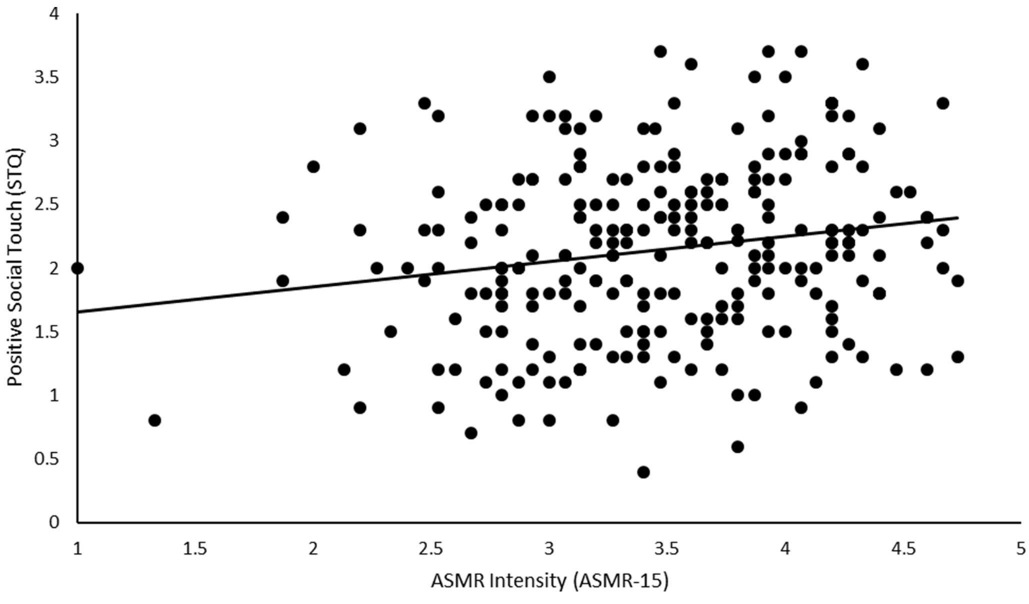


**Fig. 2.** Scatterplot with linear regression line illustrating the relationship between the intensity of trait-ASMR (ASMR-15 score) and responsiveness to positive social touch (STQ score) in ASMR-responders.

2,725.00, z = 4.48, p <.001, d = 0.28 (small effect size), $BF_{01}$ < 0.001 (strong evidence in favour of alternative hypothesis), but less convincing for non-responders, W = 164.50, z = 2.24, p =.025, d = 0.21 (small effect size), $BF_{01}$ = 1.575 (anecdotal evidence in favour of null hypothesis).

Similarly, perceived intensity for MT sensations was almost three times higher when observing human touch (mean score = 0.64, SD = 1.33) than dummy touch (mean score = 0.22, SD = 0.81), W = 4,553.00, z = 6.99, p <.001, d = 0.36 (medium effect size), $BF_{01}$ < 0.001 (strong evidence in favour of alternative hypothesis). This difference in intensity was true for both ASMR-responders, W = 2,929.00, z = 6.30, p <.001, d = 0.39 (medium effect size), $BF_{01}$ < 0.001 (strong evidence in favour of alternative hypothesis), and non-responders, W = 188.00, z = 3.11, p =.002, d = 0.29 (small effect size), $BF_{01}$ = 0.118 (moderate evidence in favour of alternative hypothesis).

**Other vicarious bodily experiences (scratching videos).** Previous research shows that people in general frequently share feeling states (e.g., feeling itchy after watching someone else scratching themselves). However, genuine MTS responses to scratching videos are characterised more by tactile sensations than by itchiness or tingling (Ward et al., 2018). If there is a higher incidence of mirror touch in ASMR-responders, we would expect human scratching videos to elicit higher frequencies and intensities of tactile sensations, but similar (or lower) frequencies and intensities of itchiness and tingling sensations, in ASMR-responders than non-responders.

In line with this, tactile sensations were three times more frequent (/2) in the ASMR group (mean frequency = 0.13, SD = 0.42) than in the non-ASMR group (mean frequency = 0.04, SD = 0.25), although the statistical evidence for this difference was weak, U = 13,904.00, z = −1.88, p =.060, d = 0.10, $BF_{01}$ = 1.976 (anecdotal evidence in favour of null hypothesis). The perceived intensity of such tactile sensations was also three times higher for ASMR-responders (mean intensity = 0.33, SD = 1.20) than for non-responders (mean intensity = 0.09, SD = 0.51), but again the evidence for this difference was weak, U = 13,896.00, z = −1.90, p =.057, d = 0.10, $BF_{01}$ = 1.529 (anecdotal evidence in favour of null hypothesis). In contrast, there was more convincing evidence that the frequencies of itchiness and tingling sensations were not substantially different in ASMR-responders (mean score = 0.48, SD = 0.76) and non-responders (mean score = 0.38, SD = 0.73), U = 13,679.50, z = -1.36, p =.174, d = 0.07, $BF_{01}$ = 6.033 (moderate evidence in favour of null hypothesis). The intensities of these sensations also did not differ for ASMR-responders (mean intensity = 1.08, SD = 1.94) and non-responders (mean intensity = 0.78, SD = 1.61), U = 13,580.50, z = −1.48, p =.139, d = 0.08, $BF_{01}$ = 4.195 (moderate evidence in favour of null hypothesis). This suggests that ASMR-responders were similar to non-responders in the sharing of feeling states elicited by scratching.

### 3.2. *Responsiveness to interpersonal touch*

**Are affective reactions to social touch higher in ASMR?** Two independent-sample t-tests assessed whether negative and positive reactions to social touch differed between ASMR-responders and non-responders. ASMR-responders, on average, reported higher levels of *positive* affective reactions to social touch ($M$ = 2.15, $SD$ = 0.69) compared to non-responders ($M$ = 1.97, $SD$ = 0.70), although the balance of evidence for this was not strong, $t$(363) = 2.17, $p$ =.031, $d$ = 0.25 (small effect size), $BF_{01}$ = 1.134 (anecdotal evidence in favour of null hypothesis). There was no difference in negative reactions to social touch between ASMR-responders ($M$ = 1.74, $SD$ = 0.83) and non-responders ($M$ = 1.78, $SD$ = 0.91), $t$(363) = −0.42, $p$ =.676, $d$ = 0.05, $BF_{01}$ = 10.164 (strong evidence in favour of null hypothesis).

**Association between ASMR intensity and affective reactions to social touch.** For ASMR-responders, we were also interested in assessing whether greater self-reported intensity of ASMR (as indexed by the ASMR-15) was associated with positive and negative reactions to social touch. ASMR intensity was positively correlated with positive reactions to social touch ($r$(257) = 0.19, $p$ =.003, $BF_{01}$ = 0.232 (moderate evidence in favour of alternative hypothesis); see Fig. 2) but not correlated with negative reactions to social touch ($r$(257) = 0.07, $p$ =.284, $BF_{01}$ = 11.362 (strong evidence in favour of null hypothesis). This suggests that ASMR-responders who experience trait-ASMR with greater intensity are also more likely to have more positive (but not more negative) affective reactions to social touch.

**Associations between MT and affective reactions to social touch.** We also examined how MT experiences (frequency and intensity of tactile sensations to human touch videos) were related to affective reactions to social touch. Positive reactions to social touch were positively correlated with both MT frequency ($rs$(365) = 0.11, $p$ =.040, $BF_{01}$ = 5.83 (moderate evidence in favour of null hypothesis) and intensity ($rs$(365) = 0.13, $p$ =.012, $BF_{01}$ = 1.447 (anecdotal evidence in favour of null hypothesis), although the balance of evidence for this was weak. There was no significant association between negative reactions to social touch and MT frequency ($rs$(365) = 0.09, p =.091, $BF_{01}$ = 8.623 (moderate evidence in favour of null hypothesis) or intensity ($rs$(365) = 0.07, $p$ =.149, $BF_{01}$ = 11.428 (strong evidence in favour of null hypothesis). This shows that vicarious touch is not systematically related to *negative* reactions to social touch, but tentatively suggests that those who have more frequent and intense vicarious tactile experiences may be more likely to have more *positive* affective reactions to social touch.

## 4. Discussion

ASMR is a complex emotional response frequently elicited by real or anticipated interpersonal touch as well as other triggers such as whispering, close personal attention, and delicate hand movements (e.g., Barratt & Davis, 2015; Poerio et al., 2018). Researchers have speculated that ASMR may be a synaesthetic-like response in which tactile sensations (tingling) originating in the scalp are induced by a core set of visual, auditory, tactile and interpersonal triggers (Poerio, 2016). Given the tactile characteristics of both the ASMR response and its common triggers, we aimed to delineate how trait-ASMR is related to state and trait vicarious bodily experiences (specifically, mirror touch and MTS) and trait sensitivity to positive and negative social touch.

Using a brief 12-item version of Ward et al.'s (2018) diagnostic measure of MTS we found a link between ASMR and vicarious bodily experiences including MTS. Compared to those without ASMR, ASMR participants reported more frequent and intense vicarious tactile sensations when they watched videos depicting human touch. There was reliable evidence (seen in both frequentist and Bayesian statistics) that these sensations, which are characteristic of mirror touch, were more than twice as frequent among the ASMR group. Within the ASMR group, there was weak evidence (seen in frequentist but not Bayesian statistics) that individual differences in trait-ASMR intensity were systematically related to mirror touch sensations: the stronger the intensity of a participants' ASMR (as indexed by the ASMR-15; Roberts et al., 2020), the more frequent and intense their tactile experiences when viewing human touch.

Although these data already indicate that vicarious tactile experiences may be much more common amongst those with ASMR, we also examined whether the incidence of MTS was higher in ASMR-responders by using a predefined cut-off. In our sample, 18 participants (4.8%) met the diagnostic criteria for MTS (MT scores of $\geq 4/6$). Strikingly, the overwhelming majority (17/18) identified as MTS also experienced ASMR, suggesting a 6.5% prevalence rate of MTS in our ASMR group, which is substantially higher than the 1.6% or 2.1% prevalence reported in the general population (Banissy et al., 2009; Ward et al., 2018).

There are several reasons to believe that the heightened mirror touch sensations in our ASMR group are characteristic of MTS specifically, rather than reflecting a general tendency to experience vicarious tactile sensations or to respond in a biased way as a result of increased sensory suggestibility (Keizer, Chang, O'Mahony, Schaap, & Stone, 2020). First, MT responses were based on systematic spatial correspondences: there was a predominance of specular mapping (i.e., mirrored sensations) between seen and felt touches similar to previous reports of MTS (Banissy et al., 2009; Ward et al., 2018; although see Chun & Hupé, 2013). Second, there were quantitative but not qualitative differences in vicarious tactile responses between those with and without ASMR; both groups' MT responses were stronger for human touch compared to inanimate (dummy) touch; and the two groups had largely similar responses to human scratching videos. These patterns reflect those typically found in mirror touch research (Banissy & Ward, 2007; Holle et al., 2011; Ward et al., 2018). Importantly, if the ASMR group were prone to over-responding to visually observed events in general, it is highly unlikely that they would produce these *specific* patterns of vicarious tactile responses.

Our findings also demonstrate a tentative link between ASMR and responsiveness to social touch more broadly. ASMR-responders reported greater reactivity to positive social touch than non-responders on Wilhelm et al.'s (2001) Social Touch Questionnaire (seen in frequentist but not Bayesian statistics), but no greater reactivity to negative social touch (seen in both frequentist and Bayesian statistics). This was further reflected within the ASMR group such that those who reported stronger trait-ASMR were also more likely to express heightened reactivity to positive (but not negative) social touch (seen in both frequentist and Bayesian statistics). Taken together, this suggests that ASMR may be an exaggerated form - one that is experienced bodily - of the pleasant reactions people develop in response to interpersonal tactile encounters such as hugging or other physical expressions of affection. In support of the idea that ASMR is a (highly specific) type of anticipatory bodily reaction to touch, we found some evidence that reactivity to positive social touch was positively associated with the frequency and intensity of vicarious tactile experiences when viewing human touch, although this evidence was weak (seen in frequentist but not Bayesian statistics). If such an association can be replicated in future studies, it could add support to existing evidence for positive associations between social touch preferences and somatosensory cortical activity reported during the viewing of social touch (Masson, Van De Plas, Daniels, & De Beeck, 2018).

What common underlying mechanism may explain the co-occurence of ASMR and vicarious touch/MTS observed in our study? Both appear to be characterised by heightened sensitivity / responsiveness to (implied) tactile stimuli, but are they driven by similar underlying neuro-cognitive processes? Of course, our current data cannot speak to potential underlying mechanisms but by drawing on previous literature we offer some speculative suggestions that we hope may be instructive for future research in this area. MTS is often explained in terms of a lowered threshold for conscious sensations and/or less control over self-other representations that results in the flexible attribution of touch to one's own body (e.g., Ward & Banissy, 2015). This may arise from altered processing in regions of the temporo-parietal junction (TPJ), anteromedial prefrontal cortex (amPFC), premotor cortex (PMC) or in their functional connectivity with bodily processing regions such as somatosensory and insular cortices, which inherently convey self-related/affective information. TPJ, amPFC and PMC are thought to underlie the process by which non-bodily external information becomes integrated and explicitly attributed to the self (Qin, Wang, & Northoff, 2020). The right TPJ, for example, is implicated in the co-representation of self- and other-related information (e.g., Santiesteban, Banissy, Catmur, & Bird, 2012) as well as in the integration of external objects that are body-related (rubber hand vs. neutral object) into one's own body representation (Tsakiris, Costantini, & Haggard, 2008). Accordingly, MTS has been associated with reduced grey matter density in the right TPJ and mPFC, coupled with enlarged grey matter and heightened functional activation of somatosensory cortex (Holle, Banissy, & Ward, 2013). Altered activity within and across these regions may thus explain how events such as viewed touch on another person can become self-relevant and consciously experienced on one's own body in MTS.

Similar fronto-parietal networks may be involved in ASMR, both in terms of underlying connectivity and functional activations. Compared to non-responders, ASMR-sensitive individuals show heightened resting-state functional connectivity within frontal (e.g., mPFC) and medial posterior cortical regions (e.g., precuneus, posterior cingulate), as well as within thalamus (Lee, Kim, & Tak, 2020; Smith et al., 2017). Enhanced activity in mPFC and regions associated with reward (nucleus accumbens) and emotional arousal (region between insula and inferior frontal gyrus, dorsal anterior cingulate, supplementary motor area) have been shown to be coupled with greater somatosensory cortical activations during ASMR relative to baseline states (Lochte et al., 2018; Smith et al., 2019). Additionally, ASMR-responders have overall greater sensorimotor activity in the paracentral lobule - the medial continuation of the pre- and postcentral gyri - than non-responders (Smith et al., 2019; see also Smith et al., 2020) and, recently, functional connectivity in the posteriorly adjacent precuneus has been associated with touch triggers in ASMR-responders (Smith et al., 2020).

In light of these observations (although see Hupé & Dojat, 2015, for a critical review of neuroimaging studies of synaesthesia in general), both ASMR and MTS appear to be driven by altered patterns of functional connectivity within and between higher-level fronto-parietal networks and hyperactivity in lower-level sensory regions. We tentatively propose that one common underlying mechanism underpinning both ASMR and MTS may be one in which altered functional connectivity reduces the capacity for inhibitory suppression of sensory (MTS) and sensory-affective (ASMR) experiences in affected individuals compared to controls. This may result in both heightened sensory sensitivity to stimuli that show or imply touch *and* a heightened capacity to consciously experience this in a bodily fashion (as ASMR tingles or vicarious touch). In line with this proposal, individuals experiencing MTS show heightened sensory sensitivity specific to touch: they have better tactile acuity (lower threshold for discriminating tactile gratings at the fingertip), but not better visual acuity, compared to other types of synaesthetes and non-synaesthetes (Banissy, Walsh, & Ward, 2009). There is also emerging evidence that atypical sensory sensitivity may not only be shared between synaesthesia and autism (Ward, Hoadley, Hughes, Smith, Allison, Baron-Cohen, & Simner, 2017) but also with ASMR: those with (stronger) ASMR have heightened general sensory sensitivity at a subjective level (Poerio et al., 2022; Roberts et al., 2020). Consistent with our suggestion that both ASMR and MTS share an increased awareness of observed or anticipated touch, which at its extreme is expressed bodily, recent work demonstrates greater bodily (interoceptive) awareness in ASMR-responders (Poerio et al., 2022). Atypical (over-extensive) bodily awareness and heightened interoceptive awareness also uniquely characterise MTS and mirror-pain synaesthesia (Davies & White, 2013; Bowling, Botan, Santiesteban, Ward, & Banissy, 2019; Cioffi, Moore, & Banissy, 2014; Derbyshire, Osborn, & Brown, 2013; Maister et al., 2013; Ward & Banissy, 2015).

Future studies should delineate the specific neural pathways that give rise to the characteristic experiences of ASMR and MTS, respectively. First, why does heightened sensory sensitivity to (implied) touch give rise to scalp tingles on the one hand (ASMR), tactile sensations on corresponding locations on one's own body on the other (MTS), or both, as in the 17 cases of co-occurring ASMR-MTS in the current study? Second, what proportion of the spectrum of ASMR experiences can be explained by the more tactile-specific mechanisms underlying MTS? In this regard it is important to acknowledge that the majority of ASMR-responders in our study (71%) did not experience *any* mirror touch from Ward et al.'s (2018) videos. It would be of interest to explore whether the preferred ASMR triggers of those with and without mirror touch experiences differ, for example in the extent to which they typically contain tactile or close interpersonal information. Third, how much of the two seperate (but seemingly related) conditions of ASMR and MTS can be accounted for by underlying cortical hyperexcitability, which has been found in synaesthesia more broadly (e.g., Jonas & Hibbard, 2015; Terhune, Tai, Cowey, Popescu, & Kadosh, 2011; Ward et al., 2017), or by other physiological arousal mechanisms, and how may this relate to the differential intentional control of these sensory experiences? Finally, what are the roles played by sensory-emotional childhood experiences, memory and cognition, and therefore, which levels of explanation will best suit an account of either MTS, ASMR, and their co-occurrence? Areas involved in (and regulation of) social cognition and affective bodily processing are likely to be of particular interest in these further investigations. Relevant target regions to investigate would be the TPJ, somatosensory cortices and insula, which are specifically implicated in the decoding (valence, affect) of social touch information (Björnsdotter & Olausson, 2011; Masson et al., 2018).

We have argued that the co-occurrence of MTS and ASMR could imply shared neuro-cognitive mechanisms involved in tactile processing, giving rise to both phenomena at the trait and state level. This, in turn, may go some way towards explaining why interpersonal touch, both real and simulated, is a compelling inducer for ASMR tingles. It also suggests that triggers in other modalities (e.g., audio, visual) may be effective, not due to their perceptual properties per se, but because they are reminders of, or antecedents to, interpersonal touch. Indeed, tactile processing and conscious touch experience is altered specifically when visual or auditory stimuli have properties suggestive of events within peripersonal space - the space immediately surrounding the body surface. Such properties include the static or dynamic spatial and temporal congruence with (expected) touch on the body (e.g., Cléry, Guipponi, Odouard, Pinède, Wardak, & Hamed, 2017; Haans & IJsselsteijn, 2009; for a recent critical review see Holmes, Martin, Mitchell, Noorani, & Thorne, 2020). Intriguingly, a recent study demonstrates that individual differences in the size of peripersonal space are associated with differences in the strength of background functional connectivity between pre-motor and parietal cortices (Spadone, Perrucci, Di Cosmo, Costantini, Della Penna, & Ferri, 2021). Similar patterns of functional connectivity in ASMR-responders may underlie increased tactile sensitivity via dynamic changes in the multisensory representations of peripersonal space.

Limitations of our study are its reliance on subjective measures for ASMR and social touch responsiveness, which should be replicated using more objective profiling of ASMR (e.g., Swart et al., 2021; see also Hostler, Poerio, & Blakey, 2018) and laboratory-based tactile tasks (e.g., Burgoon, Walther, & Baesler, 1992; Gazzola, Spezio, Etzel, Castelli, Adolphs, & Keysers, 2012; Nummenmaa, Tuominen, Dunbar, Hirvonen, Manninen, Arponen et al., 2016; Sussman & Rosenfeld; 1978; von Mohr, Krahé, Beck, & Fotopoulou, 2018). It may further be prudent to replicate our findings with the full set of stimuli comprising the MTS screening measure (Ward et al., 2018). Future studies should also seek to disentangle the relative influences of positive affective reactions towards giving versus receiving touch in different contexts, which are conflated in the STQ, and how these relate to both ASMR and MTS. Finally, future research should also seek to recruit more representative and balanced samples of ASMR-responders and ideally matched controls using mass screening procedures. Although we recruited participants from a variety of sources including ASMR online communities and existing research participant pools, it is possible that the recruitment methods used may have resulted in selection bias. One possibility, for example, is that our ASMR-responder group may overrepresent people who experience ASMR and seek out these experiences regularly through engaging with the online ASMR community. It is possible that ours was a systematically biased sample if people who seek out ASMR experiences online are also more likely to be people who experience mirror touch sensations and/or have especially strong reactions to positive social touch. Although we have no way of knowing whether that is indeed the case, if true, it may have exaggerated any associations found between ASMR and MTS/social touch. We suggest that future ASMR studies should, as a minimum, measure engagement with ASMR content online, and capture their recruitment sources (to statistically assess the potential impact of these variables on their conclusions), and, ideally, recruit prescreened ASMR-responders and matched controls.

Advantages of our study are its large and international sample size, its verified measure of mirror touch and a predefined, data-driven cut-off to determine MTS with an independent sample. Our findings are novel because they show, for the first time: (1) close links between mirror touch and ASMR, which may be indicative of alterations in tactile processing in both, an idea that has been largely overlooked in the empirical work on ASMR, and (2) the relationship between mirror touch and ASMR with heightened responsiveness to positive interpersonal touch, which may shed light on the developmental origins, outcomes, or concomitants of both ASMR and MTS. We do not propose that the close relationship between mirror touch / MTS and ASMR means that they are the same phenomenon, as should be clear from their divergent phenomenologies and the findings shown here. However, our findings are suggestive of the idea that atypical tactile sensory sensitivity might be a common core 'symptom' that gives rise to both some types of synaesthetic experiences (mirror touch / MTS) and some (but not all) types of ASMR. We hope that our findings catalyse further research on the (affective) tactile nature of these two fascinating, but non-universal, experiences, and on how individual differences in tactile processing may impact well-being more generally.

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*CRediT authorship contribution statement*

**Helge Gillmeister:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Angelica Succi:** Data curation, Funding acquisition, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **Vincenzo Romei:** Formal analysis, Software, Supervision, Validation, Writing – original draft, Writing – review & editing. **Giulia L. Poerio:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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