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Research Article

More relaxing than nature? The impact of ASMR content on psychological and physiological measures of parasympathetic activity

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Abstract

Autonomous sensory meridian response (ASMR) is a sensory–emotional phenomenon characterized by distinct tingling sensations and a sense of relaxation induced by specific auditory and visual stimuli. Although ASMR is recognized as a cross-modal experience, psychological and physiological mechanisms behind ASMR remain only partially understood. Across two experiments, we investigated these mechanisms. Experiment 1 showed that ASMR videos with combined audiovisual content elicited stronger tingling sensations than those with auditory-only content, suggesting an additive effect through sensory processing. In Experiment 2, we measured responses to ASMR and nature videos using finger photoplethysmography (PPG) and found that both types of videos reduced pulse rates compared to rest. Notably, ASMR videos caused a greater reduction in pulse rate than nature videos. These findings are discussed in relation to autonomic nervous system activation, cross-modal interactions, and the social grooming hypothesis, which posits that ASMR may replicate comforting effects of social bonding behaviors, such as grooming.

Keywords: autonomous sensory meridian response; tingling sensation; pleasantness; parasympathetic nervous system; photoplethysmography

Introduction

More than half of Japanese workers suffer from psychological stress, with reports of mental illness doubling over the last decade (Ministry of Health, Labour and Welfare 2018). In light of this disturbing trend, there has been growing public interest in accessible and effective methods to reduce stress. One technique that has gained significant popularity is the use of autonomous sensory meridian response (ASMR) content (Barratt and Davis 2015, Barratt et al. 2017). ASMR content began to appear on platforms such as YouTube around 2010, with the intent of creating sensations of pleasurable scalp-orientated tingling and relaxation in viewers (Poerio 2016, Tada et al. 2022). The tingling sensation produced by ASMR is widely regarded as highly pleasant. Although not everyone who views ASMR videos experiences anticipated tingling effects (Poerio et al. 2022b), many people anecdotally report watching ASMR videos to relax, reduce stress, and promote restful sleep. Despite their widespread popularity and seemingly beneficial effects, it is surprising that we still know very little about how ASMR stimuli promote relaxing bodily sensations and physiological responses.

A well-established body of research on natural environments provides a valuable framework for comparing relaxation effects of ASMR. Natural environments are consistently shown to have calming effects on individuals (Hartig et al. 1991, Ulrich et al. 1991, Kaplan 1995, Gidlow et al. 2016), with different theories proposed to explain such effects. For instance, the stress-recovery hypothesis assumes that exposure to non-threatening nature sounds, such as flowing water and gentle wind, induces a calming effect, thereby reducing physiological arousal (Ulrich et al. 1991). The attention-restoration hypothesis postulates that viewing natural landscapes restores attentional resources (Kaplan 1995). A core component of both theories to explain restorative effects of natural environments includes escaping from daily routines and avoiding sensory, social, and emotional overstimulation. In contrast, relaxation in ASMR seems to be driven predominantly by

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sensory and social triggers, such as whispers, role-playing situations, repetitive movements, and personal attention—elements not typically associated with natural environments but nonetheless effective in promoting relaxation. Thus, ASMR appears to be a form of self-induced relaxation, which, unlike exposure to nature, leverages sensory experiences in a simulated social context (Poerio et al. 2018). We refer to this as the social grooming hypothesis of ASMR.

What is it about ASMR content that is relaxing and potentially restorative? ASMR content typically lacks natural environments, making it difficult to explain relaxation effects through the stress-recovery or attention-restoration hypotheses. One factor that has received attention in the literature is acoustic characteristics of common ASMR stimuli. Lower-pitched sounds are more frequently associated with intense ASMR sensations (Barratt et al. 2017). Dark timbre in ASMR videos has been shown to enhance the intensity of tingling sensations (Koumura et al. 2021), and vocal auditory stimuli tend to produce stronger relaxation effects than non-vocal stimuli (Poerio et al. 2018). An electroencephalography (EEG) study has demonstrated the significant impact of the auditory aspects of ASMR stimuli on relaxation (Fredborg et al. 2021). However, since the auditory and audiovisual stimuli used in that study differed in content, it remains unclear whether the integration of visual information affects the tingling sensations associated with ASMR. Virtual reality studies on natural environments have found more pronounced relaxation effects when auditory and visual information are presented simultaneously (Annerstedt et al. 2013, Naef et al. 2022, Browning et al. 2023). Is ASMR relaxation facilitated by both watching and listening to ASMR content? We addressed this question in Experiment 1, predicting that ASMR sensations and relaxation would be enhanced when multiple senses are engaged. On the basis of the social grooming hypothesis, we hypothesized that auditory and visual inputs have an additive effect on bodily sensations during the ASMR experience.

Not everyone is sensitive to ASMR. Approximately 60% of those who viewed ASMR videos were classified as ASMR responders (Tada et al. 2022, Poerio et al. 2022b). A large-scale online survey found no gender difference in ASMR sensitivity (Poerio et al. 2022b). ASMR can be triggered by various types of stimuli, and survey results indicate that about 77% of ASMR responders perceive the pitch of trigger sounds as influencing the intensity of tingling sensations (Barratt et al. 2017). Specifically, the majority of participants reported that lower-pitched sounds induce more intense tingling than higher-pitched sounds. This perception is consistent with experimental findings showing that sounds with a darker timbre are strongly associated with increased tingling intensity (Koumura et al. 2021). In contrast, trigger object color appeared to be unimportant in eliciting ASMR (Barratt et al. 2017), suggesting that visual characteristics of trigger stimuli have a limited effect on ASMR. However, the extent to which combined auditory and visual features of ASMR videos influence tingling intensity remains unclear. Furthermore, many studies have assessed sensitivity to ASMR using retrospective measures (Barratt and Davis 2015, Barratt et al. 2017, McErlean and Banissy 2017, Fredborg et al. 2018, Poerio et al. 2018). In this study, we used continuous measurement of ASMR to quantitatively investigate whether the intensity of tingling sensations differs between audiovisual and audio-only content.

In addition to examining subjective, self-reported effects of ASMR, we were interested in objective measures, which are crucial for potential clinical applications of ASMR content and for understanding possible physiological benefits (Smejka and Wiggs 2022). One underlying mechanism that may explain beneficial effects of ASMR is activation of the parasympathetic nervous system. There is evidence supporting this idea, highlighting how ASMR differs from related experiences such as chills or awe-type responses, which can be triggered by stimuli like music or natural environments. Although ASMR and chills both appear to involve somatosensory experiences, such as tingling and goosebumps, they are considered distinct phenomena (Roberts et al. 2020). Psychologically, ASMR can be induced by various types of stimuli and influenced by sound localization (Koumura et al. 2021), whereas musical chills largely depend on specific sound properties (Goldstein 1980, Panksepp 1995, Grewe et al. 2009). Physiologically, chills are often accompanied by piloerection (Craig 2005), increased electrodermal activity, pupil dilation, and elevated heart rate (Laeng et al. 2016, Mori and Iwanaga 2017), all indicative of sympathetic activity during profound emotional experiences, accompanied by shivers. Recent research has identified two distinct types of musical chills. The first type, known as vigilance chills, is strongly associated with unexpected musical changes, while social chills are linked to empathy and the enhancement of social bonding (Bannister and Eerola 2023). Although ASMR does not typically evoke profound aesthetic appreciation, it may share similarities with social chills in terms of interpersonal interaction.

A previous study found that skin conductance level increased while heart rate decreased during ASMR video viewing in ASMR responders (Poerio et al. 2018), suggesting simultaneous activation and deactivation of the autonomic nervous system. An EEG study on ASMR video viewing reported a decrease in alpha and theta power, an increase in beta power, and heightened electrodermal activity (Engelbregt et al. 2022). A neuroimaging study further demonstrated that brain activity varies between audiovisual and auditory stimulation (Sakurai et al. 2023). Additionally, neuroimaging evidence suggests that individuals who experience ASMR exhibit neural mechanisms that prioritize visual information processing more than those who do not (Smith et al. 2019). This raises the possibility of specialized mechanisms for processing visual elements of ASMR videos, such as slow hand movements. In summary, although ASMR is generally associated with relaxation, it may also involve modulations in arousal level, attention focus, and stimulus processing. While anecdotal reports suggest that ASMR induces a sense of calm (Barratt and Davis 2015), this hypothesis requires rigorous empirical testing.

To explore this concept, we examined physiological responses to combinations of ASMR content and nature content using photoplethysmography (PPG). PPG is a non-invasive optical measurement to detect changes in blood volume of microvascular beds (Challoner and Ramsay 1974). By measuring PPG signals with near-infrared light, valuable insights into cardiovascular dynamics can be obtained (Kamal et al. 1989). Since peripheral pulse is typically synchronized with the heartbeat (Allen 2007, Minakuchi et al. 2013), a decrease in pulse rate is commonly observed when the parasympathetic nervous system dominates, as during states of relaxation. Given that PPG reflects autonomic nervous system activity, it provides an objective measure to assess the relaxation effects of ASMR. In Experiment 2, we hypothesized that ASMR, which is associated with parasympathetic activity, would induce an increase in pulse wave amplitude, indicative of vasodilation, and a reduction in pulse rate due to heart rate deceleration. In addition, we sought to compare physiological effects of ASMR with those elicited by nature videos, a more established form of relaxation content. Previous studies on physiological effects of nature videos have yielded mixed results, particularly regarding measures such as blood pressure and cortisol concentration (Bowler et al. 2010). In Experiment 2, we also examined relaxation effects of nature videos using pulse rate measures to clarify how their effects differ from those of ASMR.

The present study

Transparency and ethics statement

Below, we report how we determined sample size, participant recruitment, measures, data analyses, and ethical guidelines. Prior to data collection, sample size was computed using G*Power software (ver. 3.1.9.2) (Faul et al. 2009). All participants were right-handed with normal hearing and with normal or corrected-to-normal vision. Data presented in this study are included in the supplementary data. Statistical analyses were carried out with IBM SPSS Statistics (ver. 25) and JASP (ver. 0.19) (https://jasp-stats.org/). The design and analysis of the study were not preregistered but were approved by the Research Ethics Committee of Chukyo University (approval no. RS21–026). This study was carried out in accordance with Ethical Guidelines for Medical and Biological Research Involving Human Subjects. Participants gave written informed consent after procedures had been fully explained to them. They were compensated 1,000 yen for their participation.

Experiment 1

Methods

Participants

Thirty-two college students were recruited for Experiment 1. Participants were randomly assigned to either the audiovisual or audio-only condition to investigate the main effect of ASMR modality. Sample size ($N = 32$) was based on an *a priori* power analysis with a power of 0.80 (α-level = 0.05) to detect a main effect (effect size: Cohen's $f = 0.40$) in a mixed-design analysis of variance (ANOVA). Two participants were excluded from subsequent analyses because they did not experience any tingling sensations, leaving data from 30 participants (12 men and 18 women; mean ± SD age = 20.5 ± 0.13 years, range 19–26). Numbers of men and women were balanced between two conditions to control for gender effects. Twelve participants self-reported that they regularly use ASMR media, but none had ever watched the ASMR stimuli presented in Experiment 1.

Stimuli, procedures, and data analyses

We investigated the extent to which auditory and visual components of ASMR videos contribute to tingling sensations. The experiment comprised two conditions: audiovisual and audio-only, with each condition including five 2-min trials (Fig. 1). Participants were randomly assigned to either condition using a between-subjects design. The order of trials was consistent among participants.

ASMR videos distributed under Creative Commons licenses were sourced from YouTube (https://www.youtube.com/watch?v=7MZtaAgqoTY and https://www.youtube.com/watch?v=asGLp12NSIE). The stimuli consisted of selected excerpts from these videos, the links to which are provided. Audiovisual stimuli were created by editing segments from videos that elicited tingling sensations in three of the authors. The ASMR triggers primarily consisted of binaural brushing and tapping sounds, without any performers' voices. To minimize potential confounding effects of facial expressions on participant responses, no facial information was presented in the stimuli.

For the audiovisual condition, visual stimuli were presented on an LCD monitor with a temporal resolution of 60 Hz. Participants

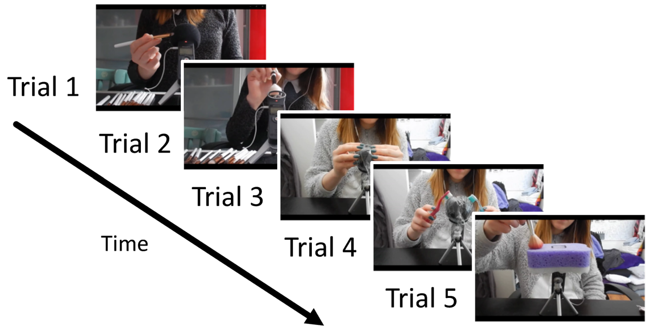

Figure 1. Task paradigm and visual stimuli. Experiment 1 consisted of audiovisual and audio-only conditions (five 2 min trials for each). Participants were randomly assigned to either condition. Under audiovisual conditions, they observed audiovisual stimuli and continuously indicated the intensity of tingling sensations using a 4-point Likert scale. Stimuli and task procedures under audio-only conditions were identical to those under audiovisual conditions, except for removal of visual information from stimuli.

viewed stimuli with a spatial resolution of 1280 × 720 pixels (visual angle of 16.0 × 9.0 degree) at a distance of approximately 57 cm. For the audio-only condition, participants heard the same sounds as in the audiovisual condition while looking at a blank screen. In both conditions, participants dichotically listened to audio stimuli through Sennheiser HD 599 headphones.

During 10-min stimulus presentations, participants were instructed to continuously indicate their tingling sensations using a 4-point Likert scale: "none," "slightly," "moderate," and "very." A key press indicating a response was held until a subsequent key press. Stimulus presentation and data collection were controlled using a PC with Presentation software (Neurobehavioral Systems, Berkeley, CA, USA). Responses of participant right fingers were collected via four keys on a computer keyboard with a sampling rate of 1000 Hz. Responses were converted to ASMR ratings on a scale of 0, 1, 2, or 3. The intensity of ASMR for each participant was calculated by averaging these ratings for each trial, with higher scores indicative of greater experienced tingling across trials. Shapiro–Wilk tests revealed that data of averaged ASMR ratings followed a normal distribution: $W > 0.964$, $P > 0.38$. After the experiment, we conducted interviews to validate ASMR data based on continuous measurement. Participants retrospectively rated the strength of ASMR experience throughout all trials using a visual analogue scale (range 0–100). We used Bonferroni correction for post hoc comparisons (α-level = 0.05) when performing ANOVAs and t-tests. We also calculated 95% confidence intervals (CIs) for correlation analyses.

Results and discussion

Time-series data of ASMR intensity ratings are shown in Fig. 2a. We conducted a 2 (between-subjects factor: condition) × 5 (within-subjects factor: stimulus type) ANOVA on ASMR intensity ratings (Fig. 2b). There was a significant main effect of stimulus type: $F(1, 28) = 5.12$, $P = 0.032$, $\eta_p^2 = 0.16$. ASMR intensity ratings (mean ± standard error) were greater for audiovisual conditions (1.36 ± 0.13) than for audio-only conditions (0.96 ± 0.13). The main effect of stimulus type was also significant: $F(4, 112) = 10.42$, $P < 0.001$, $\eta_p^2 = 0.27$. ASMR intensity ratings during Trials 2 and 3 (1.21 ± 0.08 and 1.52 ± 0.13) were larger than those during Trials 1 and 4 (0.96 ± 0.09 and 1.00 ± 0.10) but did not differ from those during Trial 5 (1.12 ± 0.13). The interaction between stimulus type and trial number was not significant: $F(4, 112) = 1.70$,

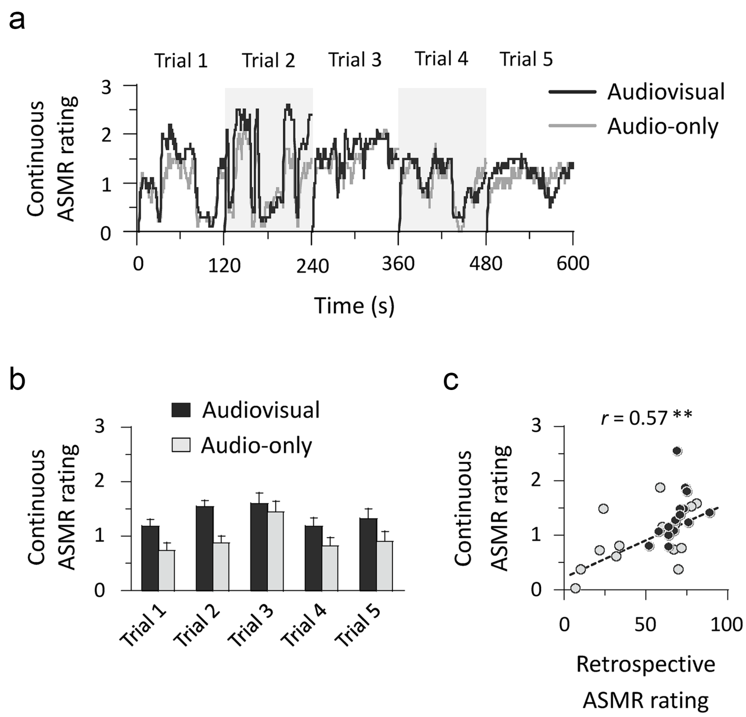

Figure 2. Results of Experiment 1 ($N = 30$). (a) Time-series data of continuous (real-time) ASMR intensity ratings averaged over participants under audiovisual and audio-only conditions ($n = 15$ for each). (b) Mean ASMR intensity ratings for each 2 min trial. Intensities for all trials were greater in audiovisual conditions than in audio-only conditions. Error bars indicate standard errors of means. (c) Scatterplots for the relationship between continuous and retrospective ASMR ratings. Dashed lines represent linear regression. $^{**}p < 0.01$.

$P = 0.15$, $\eta_p^2 = 0.057$. Overall, consistent with our hypothesis, the results indicate that presenting visual stimuli alongside auditory stimuli enhances ASMR intensity.

We have discussed the results of ASMR intensity ratings captured through continuous measurement, a method that offers the advantage of capturing moment-to-moment experiences more accurately than recall-based self-reports, which can be influenced by recency effects (Hurlburt and Heavey 2015). To validate our continuous measurement findings, we also obtained retrospective reports of tingling sensations following all trials. The results were consistent with those obtained from the continuous ASMR measurements. Specifically, retrospective ASMR ratings were significantly higher in the audiovisual condition (69.0 ± 2.2) compared to the audio-only condition (49.9 ± 6.6): $t(28) = 2.76$, $P = 0.010$, Cohen's $d = 1.01$. Moreover, retrospective and continuous ASMR ratings were significantly positively correlated: $r(28) = 0.57$, $P < 0.001$, 95% CI [0.24, 0.76] (Fig. 2c). When we analyzed the data separately by condition, positive correlations were observed in both groups: $r(13) = 0.47$, $P = 0.080$, 95% CI [–0.06, 0.79] for the audiovisual condition; $r(13) = 0.53$, $P = 0.042$, 95% CI [0.02, 0.82] for the audio-only condition. Although the correlation in the audiovisual condition did not reach statistical significance, the effect size suggests a moderate relationship. These correlations indicate that continuous ASMR ratings reliably reflect the overall intensity of tingling sensations experienced by participants, though the strength of this relationship may vary across conditions.

Auditory events occurring near the head can evoke skin-related sensations, such as an itchy sensation on the back of the neck triggered by the sound of a nearby mosquito (Kitagawa and Spence 2006). In the context of ASMR, it is known that the intensity of tingling sensations increases with sound localization cues, such as interaural time differences and interaural level differences (Honda et al. 2020). Moreover, sound with a dark timbre, characterized by a centroid frequency of less than 1.5 kHz, is a critical factor for ASMR ratings (effect size: $r_s = 0.48$) (Koumura et al. 2021). However, the ASMR literature has not clearly established whether a combination of audio and visual content enhances tingling sensations. Here, we demonstrated that audiovisual ASMR content has a greater impact on self-reported tingling sensations compared to audio-only content. Notably, our study is likely the first to highlight the importance of audiovisual integration in ASMR experiences, as we used identical ASMR stimuli in both audiovisual and auditory conditions.

This additive effect of auditory and visual inputs suggests that ASMR experiences are primarily derived from bottom-up sensory processing and integration of sensory modalities. Our findings are consistent with previous research on natural environments, in which relaxing effects are amplified by simultaneous presentation of auditory and visual content (Annerstedt et al. 2013, Naef et al. 2022). Similarly, in task paradigms designed to elicit emotions, audiovisual stimuli induced more intense emotional states than visual stimuli (Hagemann et al. 1999).

Experiment 2

Building on the finding that audiovisual stimuli elicit stronger ASMR experiences, Experiment 2 explored the physiological effects of ASMR using the same audiovisual content. To effectively measure changes in physiological responses, we collected PPG data from participants while they watched ASMR videos. Given that ASMR videos are often used to induce relaxation and aid sleep, we hypothesized that viewing ASMR content would be associated with markers of parasympathetic activity. Specifically, we predicted an increase in pulse wave amplitude and a decrease in pulse rate during ASMR viewing, compared to a resting state. This approach allowed us to examine the transformation of sensory inputs into bodily sensations through changes in ASMR ratings and physiological responses.

In addition, we sought to explore how ASMR content compares with a more well-established form of relaxation: engaging with nature. Spending time in natural environments and green space is widely recognized as beneficial for relaxation (Gidlow et al. 2016), with a meta-analysis indicating that walking in natural environments has positive effects on emotions, including reducing fatigue, sadness, and anxiety (Bowler et al. 2010). Beyond real-life encounters, nature videos have been shown to elicit similar feelings of relaxation (Ulrich et al. 1991, Browning et al. 2023, Mahady et al. 2023). Interestingly, just as ASMR videos aim to simulate real-life social interactions to induce relaxation, nature videos provide an audiovisual method to replicate calming effects of being in natural environments. This approach allowed us to compare relaxing effects of ASMR videos with those of nature videos.

Methods

Participants

Thirty-five college students participated in Experiment 2, none of whom had participated in Experiment 1. Sample size ($N = 34$) was determined through an *a priori* power analysis, aiming for power of 0.80 (α-level = 0.05) to detect a main effect (effect size: Cohen's $f = 0.25$) in a repeated-measures ANOVA. One participant was excluded from subsequent analyses due to mean pulse rate exceeding 110 bpm during rest periods, leaving data from 34 participants (18 men and 16 women; mean ± SD age = 25.2 ± 4.6 years, range 19–35). All participants confirmed that they had never previously watched the nature stimuli used in this experiment.

Stimuli and procedures

The task had a total duration of 12 min, structured as follows: 1-min rest, 4-min test, 2-min rest, another 4-min test, and final 1-min rest periods (Fig. 3a). The four 1-min ASMR videos used during test periods were edited versions of stimuli employed in Trials 1, 2, 3, and 5 of Experiment 1. Nature videos served as control stimuli to clarify the characteristics of ASMR. The four 1-min nature videos were selected from YouTube, featuring segments depicting various natural elements: babbling brooks, lapping waves, crackling bonfires, and breezy landscapes (Terashima et al. 2024). Importantly, these videos contained no social content, meaning no people were visible.

To control for order effects, participants were divided into two groups: one group watched ASMR videos first, whereas the other group watched nature videos first. During test periods, participants viewed either ASMR or nature videos, while a blank screen was presented during rest periods. The order of the 1-min videos was randomized for each participant. Before each test period, participants received a visual cue indicating whether ASMR or nature videos would be presented. Subjective rating procedures mirrored those of the audiovisual condition in Experiment 1; that is, participants continuously rated their levels of tingling sensations or pleasantness using a 4-point Likert scale: “none,” “slightly,” “moderate,” and “very.” Previous research has demonstrated that participants can distinguish between tingling sensations and pleasantness (Terashima et al. 2024). Stimulus presentation and data collection methods were identical to those in Experiment 1.

A PPG sensor was attached to participant left middle fingers (Fig. 3b). PPG signals were recorded throughout the experiment using MP36 data acquisition units (Biopac Systems, Goleta, CA, USA) with an SS4LA PPG transducer at a sampling rate of 2000 Hz. At the beginning of the experiment, participants practiced key presses for continuous ASMR measurement and were instructed to minimize body movements throughout the 12-min data recording period.

Data analyses

Psychological data analyses were the same as those used in Experiment 1. Participant responses were converted to tingling or pleasantness ratings (0, 1, 2, or 3), with the mean of intensity ratings calculated for each of the four 1 min trials. PPG data were analyzed using Biopac Student Lab Pro (version 4.1). High- and low-pass filtering at 0.5- and 35-Hz cutoff frequencies were applied to these data. After data preprocessing, pulse rate was evaluated for each participant. We extracted time points of peaks for all spikes and computed peak-to-peak intervals (PPIs) (Fig. 3c). PPI values that deviated more than 3 SDs from the mean were removed as outliers in subsequent analyses. Pulse rates were calculated as the inverse of the PPI. We also computed the pulse wave amplitude as the difference between maximum and minimum values of the PPG signal in each spike interval. Means of pulse rate and pulse wave amplitude were calculated for each of the four 1-min trials. Based on previous studies on heart rate variability (Shaffer and Ginsberg 2017, Goldbeck et al. 2021), the SDs of pulse rate and pulse wave amplitude were used as measures of variability during test and rest periods. This measure is known to reflect parasympathetic modulation.

Psychological and physiological data followed a normal distribution ($W > 0.955$, $P > 0.17$), except for pleasantness rating data, which did not ($W = 0.929$, $P = 0.028$). However, Smirnov–Grubbs tests did not identify any outliers in the pleasantness rating data. Thus, all data were included in subsequent analyses. The three separate rest periods were combined into a single dataset and ANOVAs were conducted to analyze effects of between-subjects stimulus order and within-subjects stimulus type.

Results and discussion

The time course of psychological and physiological measures is shown in Fig. 4a and 4b. A 2 (stimulus order) × 2 (stimulus type: ASMR vs. Nature) ANOVA on subjective ratings revealed that ratings for nature videos (mean ± standard error: 1.70 ± 0.12) were higher than those for ASMR videos (0.99 ± 0.11): $F(1, 32) = 24.87$, $P < 0.001$, $\eta_p^2 = 0.44$. Neither the main effect of stimulus order nor the interaction was significant: $F(1, 32) = 0.40$, $P = 0.53$, $\eta_p^2 = 0.013$; $F(1, 32) = 1.63$, $P = 0.31$, $\eta_p^2 = 0.048$. ASMR evokes transient tingling sensations (see also Fig. 2a), whereas feelings of pleasantness are relatively more prolonged. This difference likely accounts for higher ratings of pleasantness when averaged across test periods. Similar patterns have been observed in previous research (Terashima et al. 2024). We found a non-significant but positive correlation between ASMR and pleasantness ratings: $r(32) = 0.21$, $P = 0.23$, 95% CI [–0.14, 0.51]. These findings suggest that although both ASMR and pleasantness ratings reflect positive affect, participants are able to distinguish between the two.

A 2 (stimulus order) × 3 (stimulus type: ASMR, Nature, and Rest) ANOVA on pulse rate revealed a significant main effect of stimulus type: $F(2, 64) = 24.66$, $P < 0.001$, $\eta_p^2 = 0.44$ (Fig. 4c). Post hoc multiple comparisons showed the following pattern: Rest (79.8 ± 1.7 bpm) > Nature (78.4 ± 1.8 bpm) > ASMR (76.6 ± 1.7 bpm) periods. Neither the main effect of stimulus order nor the interaction was significant: $F(1, 32) = 0.04$, $P = 0.85$, $\eta_p^2 = 0.001$; $F(2, 64) = 1.64$,

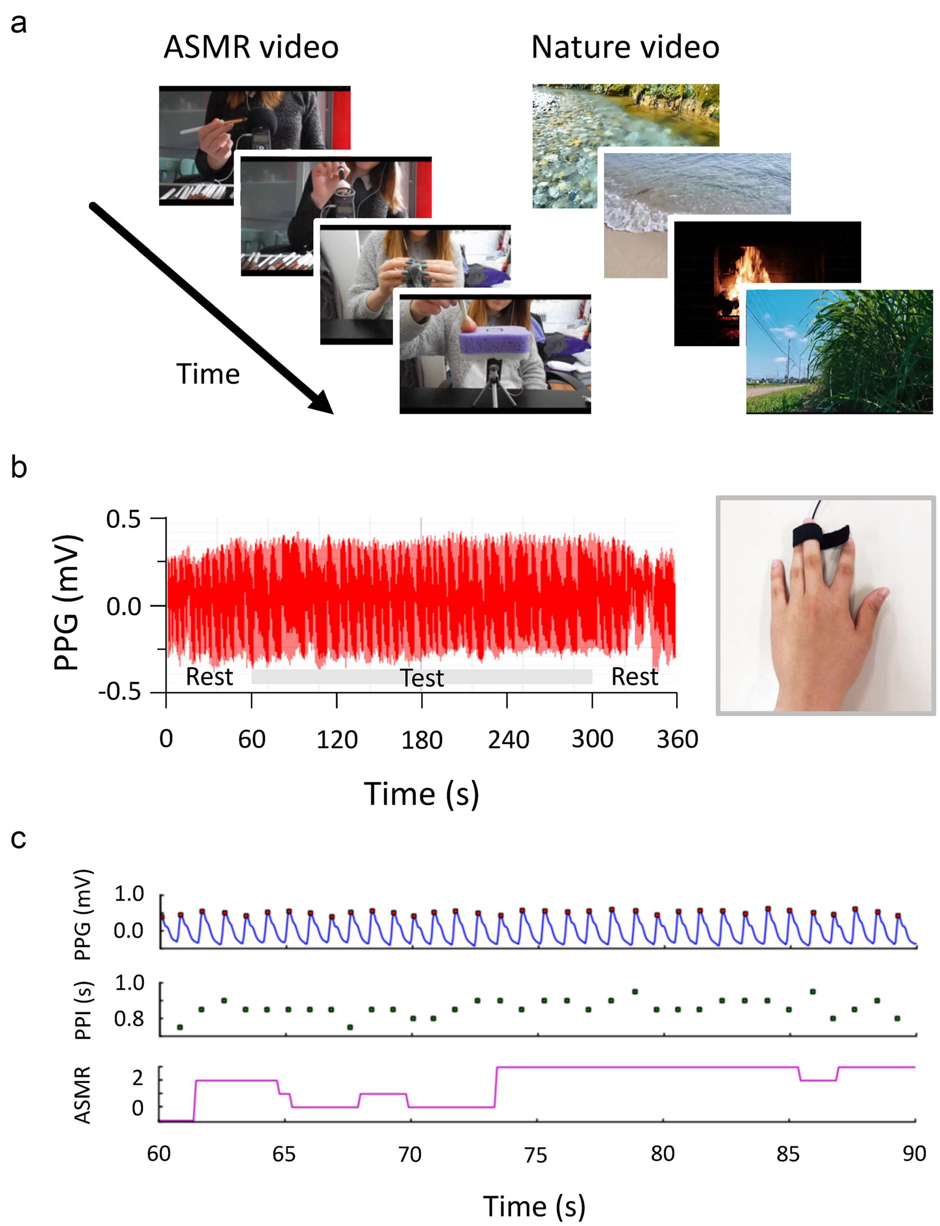

Figure 3. Task paradigm and experimental data. (a) Participants viewed four 1 min ASMR videos or four 1 min nature videos, providing continuous subjective ratings as photoplethysmography (PPG) data were recorded. For ASMR videos, participants rated tingling sensations, while for nature videos, they rated pleasantness. Video order was randomized across participants. (b) PPG data were collected from sensors attached to participant left middle fingers throughout the 12 min experiment. Parasympathetic activity, associated with vasodilation, was assessed via changes in pulse wave amplitude. (c) Psychological and physiological data from a representative participant. Pulse rate was derived as the inverse of peak-to-peak intervals (PPIs) in the pulse wave data.

$P = 0.21$, $\eta_p^2 = 0.049$. This indicates that both ASMR video viewing and nature video viewing predominantly engage parasympathetic activity. Notably, despite the higher intensity of pleasantness associated with nature video viewing, a greater reduction in pulse rate was found during ASMR video viewing.

A 2 × 3 ANOVA showed that pulse wave amplitudes did not differ between ASMR (1.23 ± 0.08 mV), Nature (1.22 ± 0.07 mV), and Rest (1.19 ± 0.07 mV) periods: $F(2, 64) = 1.20$, $P = 0.31$, $\eta_p^2 = 0.036$ (Fig. 4d). No significant main effect of stimulus order or interaction was observed: $F(1, 32) = 3.39$, $P = 0.075$, $\eta_p^2 = 0.096$; $F(2, 64) = 0.00$, $P = 0.99$, $\eta_p^2 < 0.001$. In contrast to pulse rate results, no clear increase in pulse wave amplitude was found during ASMR or nature video viewing. This discrepancy could be attributed to several factors. First, pulse wave amplitude may be less sensitive to subtle physiological changes induced by ASMR and nature videos compared to pulse rate. Second, although pulse rate or heart rate is more directly influenced by autonomic nervous system activity (Berntson et al. 1997), pulse wave amplitude may be more affected by peripheral factors such as vascular tone (Allen 2007), which may not vary significantly under the conditions tested. Finally, the relatively small effect sizes observed in pulse wave amplitude suggest that any changes may be too minor to detect under the current experimental setup.

Finally, we compared the variability of physiological measures, presumed to reflect parasympathetic modulation, across different stimulus types. Pulse rate variability during ASMR (1.74 ± 0.19 bpm) and Nature (1.59 ± 0.18 bpm) periods was lower than during Rest (1.96 ± 0.22 bpm), but these differences did

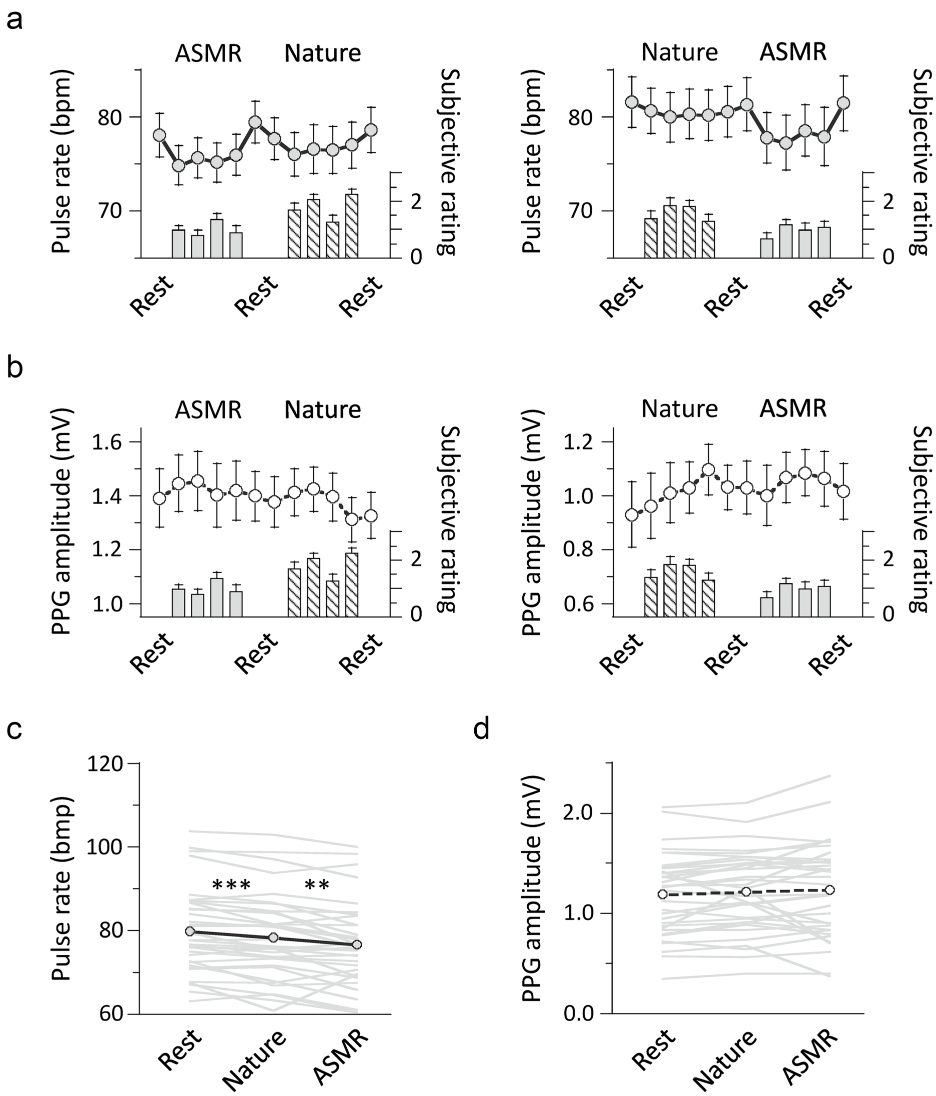

Figure 4. Results of Experiment 2 ($N = 34$). (a and b) Time course of pulse rate and pulse wave amplitude throughout ASMR, Nature, and Rest periods (1 min for each). Bars represent averaged tingling and pleasantness ratings with standard errors of means. (c and d) Individual data for pulse rate and pulse wave amplitude. Thick lines indicate means of these measures. $^{***}p < 0.001$, $^{**}p < 0.01$.

not reach statistical significance: $F(2, 66) = 1.11$, $P = 0.34$, $\eta_p^2 = 0.033$. For pulse wave amplitude variability, the results were as follows: Rest (0.141 ± 0.019 mV) > ASMR (0.102 ± 0.016 mV) and Nature (0.100 ± 0.014 mV) periods, with a statistically significant difference: $F(2, 66) = 3.78$, $P = 0.028$, $\eta_p^2 = 0.10$. These findings suggest that physiological responses tended toward a more restful state when participants viewed ASMR or nature videos compared to the resting baseline.

General discussion

We investigated effects of ASMR and nature videos on various psychological and physiological measures, including tingling sensation, pleasant feeling, pulse rate, and pulse wave amplitude. Experiment 1 showed that ASMR videos with audiovisual content elicit stronger tingling sensations than audio-only content. Physiologically, in Experiments 2, both ASMR and nature videos were associated with a decrease in pulse rate, despite differences in the audiovisual content of these videos. Compared to nature videos, ASMR videos elicited more pronounced autonomic responses that were similar in magnitude to those found in previous research (Poerio et al. 2018). This cross-modal sensory experience offers valuable insights into the interaction between perceptual and emotional systems (Poerio et al. 2024).

We demonstrated parasympathetic activation in participants, regardless of whether they watched ASMR or nature videos. Previous research has shown that exposure to natural landscapes, compared to urban environments, enhances alpha wave activity in EEG, particularly in the occipital region during states of wakeful relaxation (Ulrich 1981). Similarly, nature scenes presented through immersive virtual reality induces relaxation responses, such as reductions in heart rate, respiration rate, and blood pressure (Naef et al. 2022). In contrast, a previous ASMR study found that while heart rate decreased, skin conductance response increased, indicating concurrent activation of both the sympathetic and parasympathetic nervous systems during viewing of preferred ASMR videos (Poerio et al. 2018). Moreover, ASMR experience appears to be affected by arousal level and focused attention (Engelbregt et al. 2022), suggesting that ASMR is a multifaceted phenomenon. People can experience mixed emotions, such as happiness and sadness simultaneously while watching films or listening to music (Larsen and Stastny 2011, Larsen and Green 2013). Therefore, ASMR may be fundamentally a stimulus-dependent experience that varies across individuals and contexts.

ASMR can evoke cutaneous sensations through auditory and visual stimuli, even in the absence of physical touch. Multisensory interactions—often occurring within the peri-personal space, the area immediately surrounding the body——are crucial for environmental awareness (Kitagawa and Spence 2006, Zampini et al. 2007, Occelli et al. 2011). The ability to localize sound is closely associated with ASMR sensitivity; tingling sensations are enhanced by auditory stimuli that move around the head (Honda et al. 2020) or by a darker timbre that seems to loom overhead (Koumura et al. 2021). These findings suggest that perceptual integration mechanisms play a crucial role in triggering ASMR. Moreover, combining binaural beats with ASMR stimuli has been shown to promote comfort and improve sleep quality (Lee et al. 2019). While a previous EEG study reported greater alpha power during audio-only presentation compared to audiovisual presentation (Fredborg et al. 2021), the reason for this pattern remained unclear. Auditory and audiovisual stimuli differed in content, making it difficult to isolate the effect of visual input. Addressing this limitation, our study directly examined cross-modal interactions by presenting identical ASMR stimuli across auditory and audiovisual conditions. Our findings further reveal that visual information in ASMR videos significantly amplifies tingling sensations. Taken together, these results suggest that auditory and visual inputs influence ASMR intensity in both independent and additive ways.

ASMR shares many similarities to the concept of affective touch, in which pleasant tactile sensations, such as a gentle stroke on the arm, induce a sense of comfort and well-being (Ackerley et al. 2014, Pawling et al. 2017). Indeed, recent studies have shown that bodily touch is the most commonly reported and strongest trigger of ASMR (Poerio et al. 2023b), that individuals with ASMR are more likely to seek out tactile experiences in their daily lives (Poerio et al. 2023a), and that they report greater enjoyment of positive social touch (Gillmeister et al. 2022). Furthermore, ASMR responders are more likely to experience mirror-touch sensations (Gillmeister et al. 2022). This is consistent with various theoretical perspectives suggesting that ASMR and affective touch may be underpinned by similar neurophysiological mechanisms (McGeoch and Rouw 2020, Villena-Gonzalez 2023, Lin and Kondo 2024). Neuroimaging studies have shown that the insular cortex, a region involved in affective touch (Gordon et al. 2013), is activated during ASMR experiences (Lochte et al. 2018, Sakurai et al. 2023). However, the insular cortex is also known to play a broader role in emotional and interoceptive processing (Craig 2002, Critchley et al. 2004) and is activated in other sensory-emotional phenomena such as misophonia and musical chills (Blood and Zatorre 2001, Kumar et al. 2017, 2021), even though these phenomena are less directly related to affective touch. The convergence of insular activity across these different experiences highlights its integrative role in linking sensory and emotional states. This suggests that ASMR may not be solely a tactile phenomenon but rather a complex sensory-emotional experience that engages multiple processing domains within the brain, contributing to its unique nature.

ASMR has been suggested to be linked to misophonia (Barratt and Davis 2015), a condition in which specific sounds elicit extreme discomfort. While ASMR and misophonia are considered to evoke opposite emotional valences (Andermane et al. 2023), they may share underlying mechanisms. Certain sounds—such as eating sounds—act as common triggers for both phenomena (Fredborg et al. 2017, Jager et al. 2020). Additionally, approximately half of ASMR responders reportedly find eating sound ASMR videos unpleasant (McErlean and Banissy 2017). Insular cortex activation has also been observed in individuals with misophonia when they hear their trigger sounds, similar to what occurs during ASMR video viewing (Schröder et al. 2019). In this study, we demonstrated that relaxation effects of ASMR videos were enhanced by simultaneous audiovisual presentation. A similar phenomenon has been observed in misophonia, in which emotional responses are shaped by the perceptual reinterpretation of auditory stimuli (Heller and Smith 2022). These findings suggest that both ASMR and misophonia may share common mechanisms, in which the interpretation of auditory context influences emotional responses.

The theoretical model proposed by McGeoch and Rouw (2020) suggests that ASMR sensations arise from cross-activation of sensory and interoceptive regions, specifically those associated with affective touch in the insula. This cross-activation is believed to link exteroceptive sensations with internal bodily sensations, giving rise to ASMR experiences. Individuals who respond to ASMR triggers exhibit heightened interoceptive awareness (Poerio et al. 2022a), which refers to the perception of internal bodily states and is associated with increased autonomic reactivity (Craig 2002). Moreover, tingling sensations are likely tied to activation of C-tactile afferents, specialized nerve fibers that respond to gentle, caress-like touch (Olausson et al. 2002, Morrison et al. 2010). The interaction between sympathetic arousal and parasympathetic relaxation may contribute to unique and occasionally contradictory emotional experiences during ASMR, in which individuals feel both relaxed and stimulated. These findings suggest that ASMR is not merely a passive relaxation response, but rather a dynamic interplay between perception and autonomic regulation.

The social grooming hypothesis posits that these tactile sensations, whether experienced through physical or virtual means, play a crucial role in strengthening social bonds and promoting emotional well-being (Poerio et al. 2018). ASMR, by mimicking such sensory experiences, may thus serve a similar function. However, it should be noted that not everyone experiences ASMR; approximately 60% of individuals report tingling sensations with pleasant feelings when viewing ASMR videos (Tada et al. 2022, Poerio et al. 2022b). This interindividual variability suggests that ASMR sensitivity can be influenced not only by bottom-up sensory processing but also by perceptual learning and contextual factors (Koumura et al. 2021, Terashima et al. 2024). Individual preferences for ASMR content likely reflect an accumulation of experiences that progressively refine and enhance positive emotional aspects of ASMR.

The present study has some limitations. First, we conducted experiments with young adults, who represent the core demographic of ASMR video viewers. However, the generalizability of our findings to older adults or other age groups remains uncertain, as physiological and psychological responses to ASMR stimuli may vary among generations. Additionally, we did not account for potential cultural differences in perception of ASMR videos (Mesquita and Frijda 1992, Hostler et al. 2024). Second, although none of participants had previously viewed ASMR videos used in this study, we did not consider their prior familiarity with ASMR as a broader phenomenon. Familiarity with ASMR content may moderate response intensity, suggesting that future research should explore whether the observed effects persist among participants with varying degrees of ASMR exposure and preference (Poerio et al. 2018). Third, the type of ASMR videos employed in this study was somewhat restricted. We excluded whispering from the stimuli to minimize the influence of performers' facial expressions on

ASMR experiences. Additionally, participant preferences were not considered in the selection of stimuli, which may have reduced the effectiveness of ASMR videos used. Future studies could benefit from incorporating personalized ASMR triggers and exploring the impact of different types of ASMR content. Finally, this study focused on short-term responses to ASMR and nature videos, without examining potential long-term effects of repeated exposure to these stimuli. Understanding whether observed effects persist or change with repeated exposure could provide insights into habituation processes associated with ASMR experiences.

Conclusions

We have discussed the importance of perceptual integration and perceptual-emotional interaction in ASMR. Our findings suggest that ASMR experiences contribute to a shift toward parasympathetic activity. Notably, the reduction in pulse rate was more pronounced during ASMR video viewing compared to nature video viewing. These results provide insights into the potential of ASMR for cross-modal research on bodily awareness and its possible applications in clinical treatments for depressive moods and mental stress. Since ASMR video content does not typically involve natural environments, these relaxation effects cannot be fully explained by existing concepts such as the stress-recovery hypothesis or the attention-restoration hypothesis. Thus, further investigation into the role of ASMR in enhancing social well-being is warranted to better understand underlying mechanisms of this intriguing phenomenon.

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Author contributions

Daigo Hozaki (Conceptualization, Data curation, Formal analysis, Investigation, Writing—original draft, Writing—review & editing), Takahiro Ezaki (Data curation, Formal analysis, Funding acquisition, Methodology, Resources, Visualization, Writing—original draft), Giulia L. Poerio (Writing—original draft, Writing—review & editing), and Hirohito M. Kondo (Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Visualization, Writing—original draft, Writing—review & editing)

Supplementary data

Supplementary data is available at *Neuroscience of Consciousness* online.

Conflict of interest

We declare we have no competing interests.

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Data availability

Data presented in this study are included in the supplementary data, and further inquiries may be directed to the corresponding author. An early version of this article was posted to the preprint archive, https://doi.org/10.21203/rs.3.rs-1026254/v1.

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