



PDF Download
3771594.3771651.pdf
16 February 2026
Total Citations: 0
Total Downloads: 82

 Latest updates: <https://dl.acm.org/doi/10.1145/3771594.3771651>

RESEARCH-ARTICLE

Cyclic Patterns and Spatial Orientations in Artificial Impulsive Autonomous Sensory Meridian Response (ASMR) Sounds

[HENRIK HARALDSEN SVEEN](#), University of Oslo, Oslo, Oslo, Norway

[LAURA BISHOP](#), University of Oslo, Oslo, Oslo, Norway

[ALEXANDER REFSUM JENSENIUS](#), University of Oslo, Oslo, Oslo, Norway

Open Access Support provided by:

University of Oslo

Published: 30 June 2025

[Citation in BibTeX format](#)

[AM '25: 20th International Audio Mostly Conference](#)

June 30 - July 4, 2025

Coimbra, Portugal

Cyclic Patterns and Spatial Orientations in Artificial Impulsive Autonomous Sensory Meridian Response (ASMR) Sounds

Henrik Haraldsen Sveen

UiO / RITMO
Oslo, Norway
hhsveen@gmail.com

Laura Bishop

UiO / RITMO
Oslo, Norway
laurabi@uio.no

Alexander Refsum Jensenius

UiO / RITMO
Oslo, Norway
alexanje@uio.no

Abstract

Autonomous Sensory Meridian Response (ASMR) is a tingling sensation in the neck and spine often triggered by specific sounds. This paper reports a study on the impact of different cyclic patterns and spatial orientations—defined here as the perceived directionality and motion of sound sources in a three-dimensional auditory space—on inducing ASMR experiences. The results demonstrate that both the type of cyclic pattern and the spatial orientation significantly influence the intensity and nature of ASMR experiences. Furthermore, the research explores synthesizing ASMR-inducing sounds while preserving key audio characteristics from acoustically recorded ASMR content. Through survey data analysis and regression modeling, distinct patterns emerge regarding the relationship between personality traits and ASMR experience. The findings contribute to a deeper understanding of ASMR as a sensory phenomenon and provide insights into the potential applications of artificially generated ASMR stimuli. Additionally, the research sheds light on the role of spatiality in ASMR experiences and the synthesis of ASMR-inducing sounds for future studies and practical applications.

CCS Concepts

• **Human-centered computing** → *Empirical studies in accessibility*; • **Theory of computation** → *Pseudorandomness and derandomization*; • **Information systems** → *Multimedia and multimodal retrieval*.

Keywords

ASMR, Cyclic Patterns, Spatial Orientation, User Study

ACM Reference Format:

Henrik Haraldsen Sveen, Laura Bishop, and Alexander Refsum Jensenius. 2025. Cyclic Patterns and Spatial Orientations in Artificial Impulsive Autonomous Sensory Meridian Response (ASMR) Sounds. In *20th International Audio Mostly Conference (AM '25)*, June 30–July 04, 2025, Coimbra, Portugal. ACM, New York, NY, USA, 8 pages. <https://doi.org/10.1145/3771594.3771651>

1 Introduction

Autonomous Sensory Meridian Response (ASMR) is an auditory, visual, and tactile phenomenon associated with relaxation, stress relief, and improved well-being [1]. It is characterized by *tingles*, an electrostatic sensation that begins in the scalp and moves down

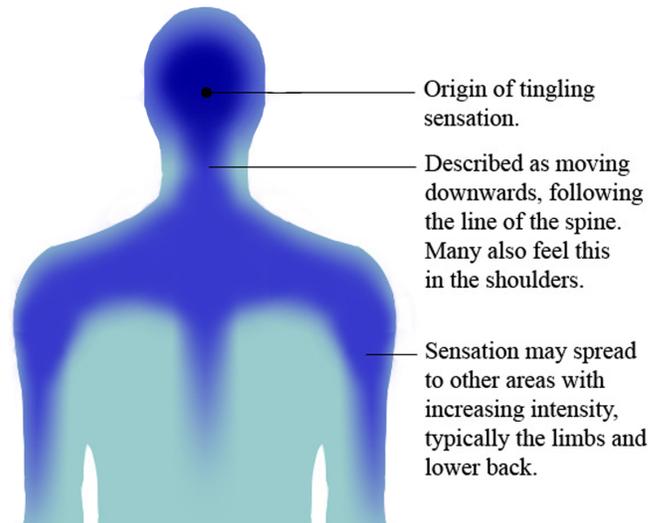


Figure 1: An illustration of ASMR experiences. Illustration by Barratt and Davis (CC-BY).

the spine, inducing comfort. ASMR experiences can arise from both real-life stimuli and recorded media [2]. Common ASMR triggers include whispering, soft-spoken voices, and tapping and scratching on resonant objects. ASMR recordings have gained traction in social media, both as audio and video, often captured using large-diaphragm condenser microphones to enhance intimacy and foster a close auditory connection with the listener [16].

While previous studies have explored the physiological and psychological effects of ASMR and its relationship to personality traits [19], an open question remains regarding how structural properties of sound influence ASMR perception. This study quantitatively investigates how predictability and randomness impact ASMR responses through generated ASMR clips with varying levels of rhythmic predictability and randomness. Using a combination of behavioral analysis and audio signal processing, we examined the extent to which these factors shape ASMR perception.

This paper aims to answer the following research questions:

- RQ1 How do different cyclic patterns affect the perception of artificially generated ASMR?
- RQ2 How does monophonic and stereophonic spatial orientation impact the perception of ASMR stimuli?

We define cyclic patterns as structuring impulsive sounds over time in a recording. Spatial orientation denotes how sounds are distributed, including amplitude, frequency, and time shifts between the left and right channels in a recording. In the following, we



This work is licensed under a Creative Commons Attribution 4.0 International License. *AM '25, Coimbra, Portugal*

© 2025 Copyright held by the owner/author(s).
ACM ISBN 979-8-4007-2065-9/25/06
<https://doi.org/10.1145/3771594.3771651>

will briefly overview relevant previous work before describing our experiment and its results.

2 Background

2.1 Impulsive Sounds

Barratt and Davis found that a majority (64%) of participants experienced ASMR from crisp, impulsive sounds [1]. Impulsive sounds are characterized by a sharp attack and rapid decay [13, p. 73] and are distinct from sustained sounds with a continuous energy transfer between the sound-producing objects. Plucking strings or striking hard surfaces typically lead to impulsive sounds [21, p. 193]. Many ASMR recordings are made by tapping or hitting resonant objects such as cardboard boxes or solid objects like book covers. There are also many ASMR recordings using whispering. However, recordings based on the voice may include language and narrative elements that open many perspectives beyond the scope of this research. So, we have decided to limit the focus to impulsive sounds for this study.

ASMR artists—ASMRtists—often use cyclic patterns when interacting with objects. These patterns vary from fast and dense rhythmic structures to slow and sparse fluctuations. Balancing predictability and novelty in such rhythmic patterns is key to sustaining engagement [2]. Predictable rhythms induce relaxation, while subtle variations maintain intrigue. The density of rhythmic impulses influences ASMR intensity: fast rhythms may enhance stimulation, whereas slower ones promote calmness [19]. Effective ASMR cyclic patterns thus blend repetition with unpredictability.

2.2 Spatial Orientations

Spatial orientation refers to how listeners perceive the location and direction of sound sources. The human auditory system relies on binaural cues to interpret spatial positioning, primarily Interaural Time Difference (ITD) and Interaural Level Difference (ILD) [3]. In ASMR, spatial orientation is central, often achieved using stereophonic or binaural microphones [23]. This study pertains explicitly to how sound is distributed between the left and right audio channels.

2.3 ASMR and Personality Traits

Previous studies suggest a link between ASMR receptivity and personality traits. Individuals who score high in neuroticism and who are prone to anxiety may be more likely to experience ASMR, possibly due to their inclination toward stress-relief mechanisms [8]. Studies of ASMR and misophonia have found that misophonia sufferers often exhibit post-traumatic stress disorder (PTSD) symptoms from an early age [22]. Neuroticism has been associated with PTSD [6], suggesting overlapping psychological factors between ASMR, misophonia, and trauma-related sensitivities. ASMR recipients also often score high on openness to experience, a trait linked to musical frisson [10, 20].

2.4 ASMR and Frisson

ASMR tingles share physiological similarities with musical frisson [4], a response characterized by chills or goosebumps triggered by emotional stimuli such as music [11]. Neuroimaging studies confirm

overlapping brain activity between ASMR and frisson experiences [18], highlighting ASMR's potential therapeutic benefits. Proximity plays a key role in ASMR. Research suggests that human-generated sounds recorded at close range induce stronger ASMR responses than distant natural sounds [23]. This proximity effect may also explain why some individuals find ASMR unsettling, as close sounds can evoke fear responses [16]. Furthermore, lower Interaural Cross-Correlation (IACC), affecting how sounds are spatially processed, has been linked to stronger ASMR responses, while higher IACC correlates with annoyance [23]. This interplay between spatial hearing and emotional response further underscores ASMR's complexity and variability among listeners.

3 Method

3.1 Study Design

The study involved two main parts: stimulus preparation and an experiment. The stimulus preparation started with extracting key audio features from the relevant YouTube source material. These features formed the basis for shaping the characteristics of the synthesized sounds. A focus group then provided feedback on the stimuli, refining their effectiveness and minimizing personal bias. The experiment phase consisted of a survey that incorporated the finalized ASMR stimuli. Participants listened to these sound examples and provided perceptual ratings, forming the quantitative component of the study.

3.2 Audio Feature Extraction

While it is possible to extract a significant amount of data from a monophonic summed analysis of a stereophonic audio file, examining audio features independently for the left and right channels offered insights into the spatial dynamics of sound between the channels. This approach enabled observing how sound evolved within the stereo field over time. Given that audio-based ASMR content is often captured using two microphones in a stereophonic or binaural setup, analyzing audio in a two-channel stereophonic format was considered to align closely with standard ASMR production practices. Several audio features were analyzed for both the left and right audio channels for every detected audio onset in the audio source material: Root Mean Square (RMS), spectral centroid, spectral bandwidth, spectral contrast, spectral rolloff, and

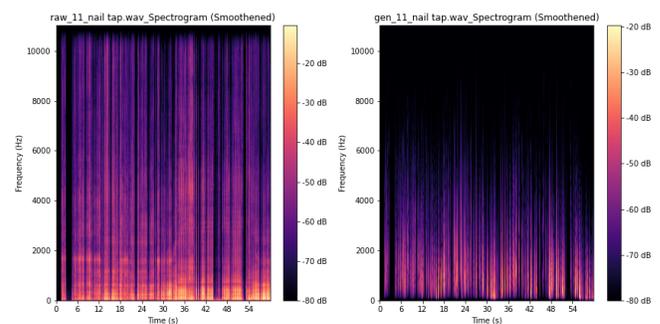


Figure 2: Original audio source material (left) and generated ASMR stimuli based on extracted audio features (right).

Interaural Phase Difference (IPD). Figure 2 compares the spectral and rhythmic representation of an audio source material, recorded from YouTube, to the generated ASMR stimuli based on extracted audio features.

3.3 Sonic Design

The sound synthesis engine¹ is programmed in Max for Live within Ableton Live and maps extracted audio features to synthesis parameters (Figure 3). Through building amplitude, frequency, and time information on extracted audio features from ASMR videos, the goal was to maintain a relationship between ASMRtist-generated and synthesized ASMR audio. A filtered noise source was modulated by amplitude using an impulsive envelope, with resonant 12 dB/oct low-pass and high-pass filters shaping spectral characteristics. A sample delay applied IPD data to create ITD-based localization, with a maximum delay of 1.46 ms to simulate spatial positioning. Spectral contrast controlled the attack sharpness, while resonant high-pass filters replicated object resonance. The extracted root-mean-square (RMS) values scaled the amplitude and filter resonance, reinforcing tonal characteristics. Monophonic versions summed left/right signals without IPD to avoid comb filtering. The audio was treated with a high-shelf equalizer (EQ) filter attenuating -6 dB at 5 kHz. This was incorporated because the focus group feedback on the sound examples indicated that the sounds were too sharp.

3.4 Cyclic Patterns

Three cyclic patterns were selected to explore listener perception and establish connections between rhythmic structures and ASMR stimuli. This selection was necessary to establish connections between what the listeners were experiencing and the rhythmic origin of the ASMR stimuli.

MIR: Music Information Retrieval This natural, human-like rhythmic content is extracted from ASMR performances by analyzing the temporal interaction between the ASMRtist and the sound-producing object in the source material (e.g., tapping or brushing). This was done using beat-tracking and onset detection methods to capture the performer’s timing and repetition style [7]. The resulting envelope curve $\mathcal{E}_{\text{MIR}}(t)$ represents the intensity of interaction over time and serves as a modulation source for synthesizing new sounds that mirror the original expressive timing.

RAN: Random This artificial, pseudo-random rhythmic content is generated using white noise modulated by a slow triangular low-frequency oscillator (LFO), creating a sense of pseudo-cyclic dynamics. Let $x(t)$ be white noise and $m(t) = \text{tri}_f(t)$ a triangular LFO at frequency f . The resulting envelope is:

$$\mathcal{E}_{\text{RAN}}(t) = x(t) \cdot m(t)$$

This modulation introduces slow, cyclical amplitude fluctuations in otherwise random textures.

FM: Frequency Modulation This artificial, repeated rhythmic content is generated using frequency modulation between two triangular waveforms: a slow modulator $m(t)$ and a faster carrier $c(t)$. The modulator influences the frequency

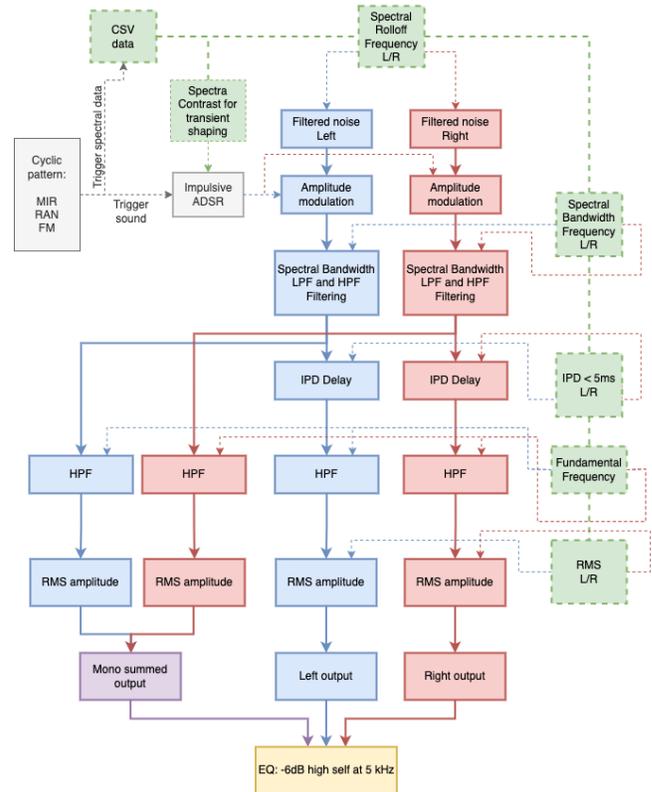


Figure 3: Sound Synthesis Engine – A flow diagram of C3_Sound Engine, the sound synthesis engine generating ASMR stimuli.

of the carrier, producing a structured but evolving rhythmic pattern:

$$\mathcal{E}_{\text{FM}}(t) = \text{tri}_{f_c + \Delta f \cdot \text{tri}_{f_m}}(t)$$

where f_c is the base frequency of the carrier, Δf is the frequency deviation, and f_m is the modulator frequency. This technique yields a more mechanical yet cyclically shifting temporal pattern.

Each cyclic pattern, consisting of organized impulses of filtered noise, was recorded into monophonic and stereophonic audio files to study how spatiality in sound affects the perception of the chosen cyclic patterns (see project repository).

Two audio files based on white noise were included, differing in their monophonic and stereophonic representations. White noise, characterized by its uniform spectral density across all frequencies, provided a neutral auditory stimulus without specific ASMR triggers. The inclusion of white noise established a baseline against which perceptual responses to ASMR stimuli could be compared.

3.5 Survey

We used an online survey published through gorilla.sc, an online platform for surveys containing multimedia data like audio files. Participants were recruited through ASMR-focused online communities on Reddit, Facebook, and ASMR University. The survey

¹C3_Sound Engine can be found in the project repository at osf.io/z8ae9

consisted of two sections: (1) listening to and rating sound examples, and (2) assessing personality traits, demographic data, and prior ASMR experience. Participants were not pre-informed about the survey’s specifics beyond its ASMR focus. The term “artificial” was omitted from the title to prevent anchoring bias.

At the beginning of the experiment, participants were instructed to use headphones and indicate their listening device. The survey’s main section featured a presentation of sound examples in a randomized order, with rating using Likert scales (1–7). Sound durations were set to 20 seconds to reduce fatigue and align with prior ASMR studies [9]. The Likert scale ratings covered the following topics:

- Q1 How strongly did you experience any bodily/psychological reactions?
- Q2 How would you rate your focus/attention while listening to the sound examples in regards to the physiological/psychological reaction, the sound, and other focus?
- Q3 How natural or artificial did you experience the rhythmic content of the sound example to be?

In the second part, participants answered 15 statements from the Big Five Index (BFI) to assess personality traits [17], using Likert scales (“strongly disagree” to “strongly agree”). Mean values for each personality dimension (OCEAN model: openness to experience, conscientiousness, extraversion, agreeableness, neuroticism) were calculated. Personality traits were assessed before demographic data to avoid biases in self-reporting [24]. The survey concluded with demographic questions (gender, age, ASMR familiarity) and an optional text box for comments.

4 Results

4.1 Demographics

A total of 67 survey responses were collected, of which 79.1% reported they had listened to ASMR before, and 70.1% reported they had experienced ASMR before participating in the research. A majority of the participants were familiar with ASMR. The average age of the participants was 33.5 years old, distributed over 41.8% male, 47.8% female, and 10.4% nonbinary. The reported playback devices used by participants while completing the survey were divided into the following categories: 44.8% headphones, 35.8% earbuds, 16.4% computer or phone speakers, and 6% external speakers.

The average mean values for each participant’s personality dimension were Openness (5.8), Conscientiousness (4.7), Extraversion (4.3), Agreeableness (4.7), and Neuroticism (4.6). These trait scores were used as thresholds to identify if a specific respondent scored high (above average) or low (below average) on certain traits compared to the average scores in the survey sample.

4.2 Statistical Analysis

By running data through the ANOVA and OLS regressions, comparisons with a p-value (p) lower than 0.05 (5%) were marked as significant. The p-value significance threshold of 0.05 was adjusted according to the Bonferroni correction when analyzing multiple questions in the analysis model, specifically resulting in a p-value threshold of 0.025 (2.5%) for Q1 in Section 4.3, combining questions for physical and psychological reaction strength.

Response data was gathered from each survey question for every sound example. The audio files containing white noise were excluded from the statistical analysis. The average mean values for all responses within each survey question are reflected for each sound example in the violin plots (Figure 5, 6, 7, 8, 9). The violin plots display the distribution of responses, identifying the different magnitudes in responses (Y-axis) for each of the questions (per plot) and all sound examples (X-axis). Q1 and Q2 had a 1–7 strength type scale, whereas Q3 and Q4 had natural–artificial and relaxed–stressful types of scaling with 4 as the neutral center point.

4.3 Physical and Psychological Reactions

Figure 4 illustrates a significant positive correlation ($p = 0.007$) between reported physical and psychological reaction strengths in Q1. This indicates that stronger physical responses were associated with stronger psychological responses. Therefore, physical and psychological responses were combined to analyze reaction strength. Using FM as a baseline, OLS regression (Table 1) revealed that MIR and RAN cyclic patterns had significantly stronger effects, with MIR having the highest coefficient. The stereophonic spatial orientation also had a statistically significant positive correlation with reaction strength. These findings align with Figure 5, showing that stereophonic stimuli generally produced stronger reactions and that MIR and RAN patterns elicited stronger responses than FM.

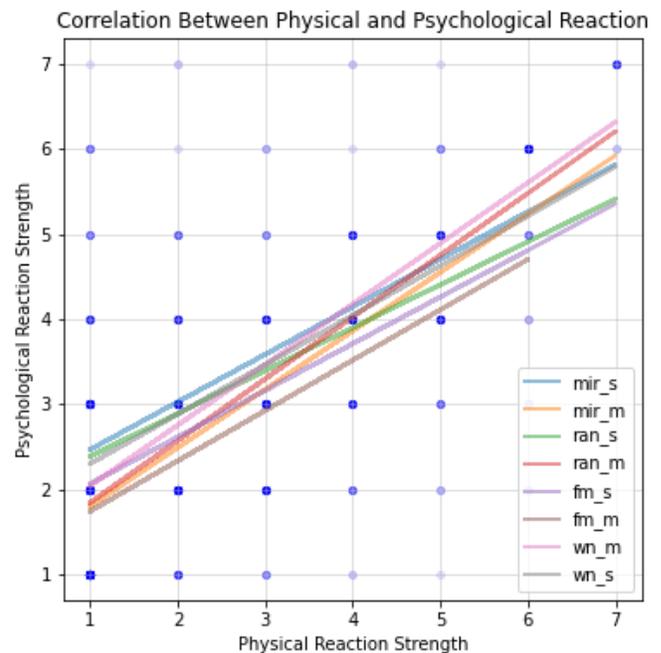


Figure 4: Correlation between physical and psychological reaction strength indicating that respondents who stated a strong physical reaction to the sound examples also stated a strong psychological reaction, and vice versa.

Comparison	Interaction	Coefficient	$p < 0.025$
MIR-FM		0.489	0.001
RAN-FM		0.470	0.001
Stereo-Mono		0.465	0.000
Spatial orientation	Cyclic pattern	0.433	0.034
MIR-FM	Mono	0.369	0.053
RAN-FM	Mono	0.515	0.012
MIR-FM	Stereo	0.582	0.004
RAN-FM	Stereo	0.425	0.038
Openness		0.214	0.082
Conscientiousness		-0.089	0.465
Extraversion		0.303	0.016
Agreeableness		0.193	0.122
Neuroticism		-0.170	0.178
RAN-FM	Extraversion(low)	0.543	0.012

Table 1: Q1: OLS regression results for independent and interaction analysis of cyclic pattern, spatial orientation, and BFI, regarding physical and psychological reaction strength.

Analysis of cyclic pattern and spatial orientation interactions (Table 1) found that MIR elicited the strongest reaction in stereophonic sound, while RAN was most effective in monophonic sound. Extraversion was significantly correlated with stronger physical and psychological reactions. Further analysis indicated that low-extraversion participants had stronger responses to RAN patterns.

Figure 5 illustrates that MIR-based audio files effectively triggered ASMR-related reactions. Responses weakened as cyclic patterns became more predictable and rhythmic. Across all conditions, stereophonic stimuli generally produced stronger reactions than monophonic ones, and psychological responses were stronger than physical ones.

4.4 Focus Rating

Among Q2 focus ratings, only tingles (T) showed statistically significant results, as detailed in Table 2. The stereophonic sound had a significant positive correlation with focus on tingles ($p = 0.012$), while cyclic patterns showed no significant effect on focus while listening. Openness had a strong positive correlation ($p = 0.000$), and extraversion also showed a positive correlation ($p = 0.016$). Stereophonic sound correlated positively with lower openness, while monophonic sound correlated positively with lower extraversion.

Figure 6 shows that focus on T mirrored reaction strength trends from Q1, reinforcing Q1’s findings. The stereophonic condition consistently produced stronger responses. Figure 7 illustrates that “other focus” (F) was the least reported, suggesting participants were engaged in evaluating the sounds. “Sound focus” (S) was prevalent, likely due to the research’s listening task.

4.5 Natural or Artificial Cyclic Pattern

Q3 responses were rated on a Likert scale, from natural (< 4) to artificial (> 4). The analysis in Table 3 shows that the MIR cyclic pattern had the most significant negative correlation, identifying

Comparison	Interaction	Coefficient	$p < 0.05$
MIR-FM		0.201	0.373
RAN-FM		0.396	0.081
Stereo-Mono		0.468	0.012
Spatial orientation	Cyclic pattern	0.507	0.113
MIR-FM	Monophonic	0.090	0.779
RAN-FM	Monophonic	0.567	0.077
MIR-FM	Stereophonic	0.313	0.327
RAN-FM	Stereophonic	0.224	0.484
Openness		0.922	0.000
Conscientiousness		-0.089	0.465
Extraversion		0.303	0.016
Agreeableness		0.193	0.122
Neuroticism		-0.170	0.178
Stereophonic	Openness(low)	1.2	0.012
Monophonic	Extraversion(low)	0.694	0.009

Table 2: Q2: OLS regression results for independent and interaction analysis of cyclic pattern, spatial orientation, and BFI, regarding focus on tingles (T).

Comparison	Interaction	Coefficient	$p < 0.05$
MIR-FM		-0.493	0.016
RAN-FM		-0.448	0.028
Stereo-Mono		-0.075	0.663
Spatial orientation	Cyclic pattern	-0.075	0.796
Openness		0.118	0.487
Conscientiousness		0.371	0.028
Agreeableness		0.609	0.000

Table 3: Q3: OLS regression results for cyclic pattern, spatial orientation, and BFI on rhythmic perception.

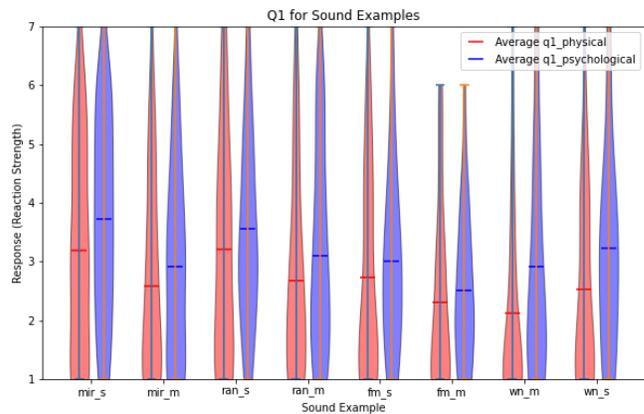


Figure 5: Average mean responses (line) and distribution (violin plot) for Q1 asking for the strength of the physical and psychological reaction.

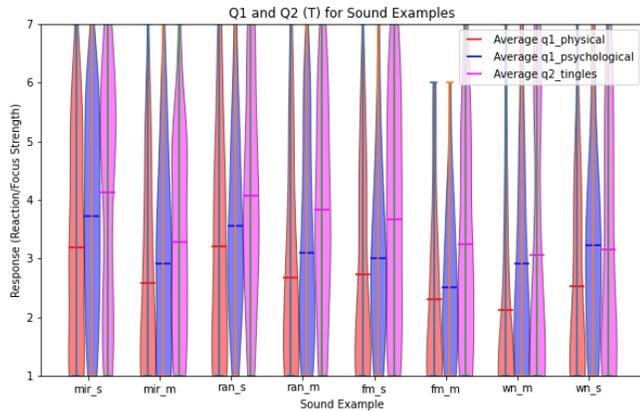


Figure 6: Average mean responses (line) and response distribution (violin plot) for Q1 reaction strength and Q2 tingles (T) focus strength, visualizing similar tendencies for the reaction strength of Q1 and the focus strength of Q2 T.

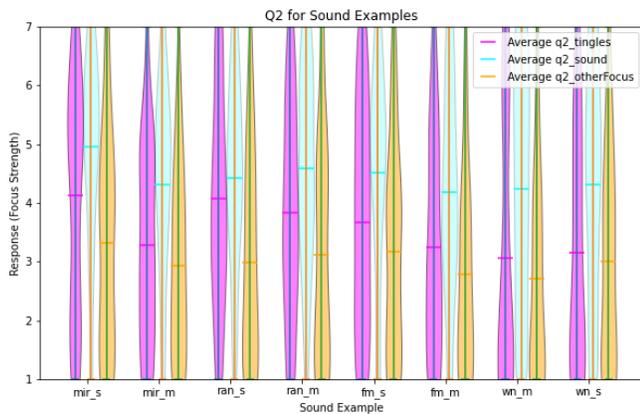


Figure 7: Average mean responses (line) and response distribution (violin plot) for Q2 asking for a rating of focus strength for each sound example, regarding focus on tingles (T), sound (S), and other focus (F).

it as the most natural. The RAN cyclic pattern also showed a significant negative correlation. Spatial orientation and interaction effects had no significant impact.

Respondents who rated sounds as more artificial showed higher agreeableness and conscientiousness. Figure 8 shows a trend where sound examples were perceived as increasingly artificial in line with the cyclic pattern origin. MIR was rated most natural, while FM was rated most artificial. This suggests that more repetitive patterns were perceived as mechanical, pushing ratings towards the artificial end.

For control conditions, WNS was perceived as more natural than WNM. This may be because stereophonic noise is common in everyday environments, whereas monophonic noise is rare, given the human auditory system’s binaural perception.

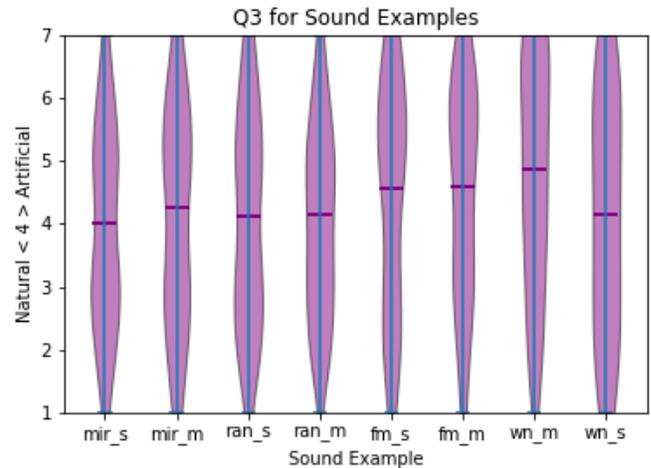


Figure 8: Average mean responses (line) and response distribution (violin plot) for Q3 on rhythmic perception.

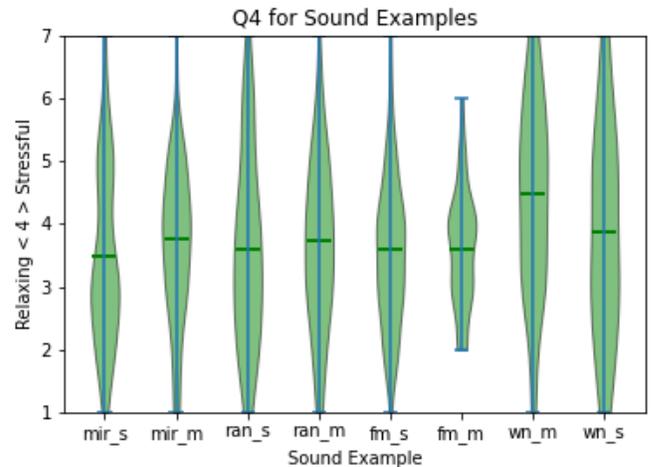


Figure 9: Average mean responses (line) and response distribution (violin plot) for Q4 on general experience.

4.6 General Experience

Q4 responses were rated on a Likert scale from relaxing (< 4) to stressful (> 4). As shown in Table 4, no statistically significant effects were found for cyclic patterns or spatial orientations. Higher agreeableness correlated positively with perceiving the sounds as more stressful. Figure 9 shows that WNS was rated as more relaxing than WNM, likely due to stereophonic noise resembling natural relaxation sounds such as ocean waves and rustling leaves [15].

The stereophonic MIR and FM-based audio files were rated as the most relaxing, and stereophonic sound examples were generally perceived as more relaxing than monophonic ones. However, these differences were minor and not statistically significant, making it difficult to establish a clear relationship between cyclic patterns, spatial orientation, and general experience outside the noise control conditions.

Comparison	Interaction	Coefficient	$p < 0.05$
MIR–FM		-0.030	0.849
RAN–FM		0.052	0.739
Stereo–Mono		-0.109	0.392
Spatial orientation	Cyclic pattern	-0.045	0.840
Agreeableness		0.623	0.000

Table 4: Q4: OLS regression results for cyclic pattern, spatial orientation, and BFI on general experience.

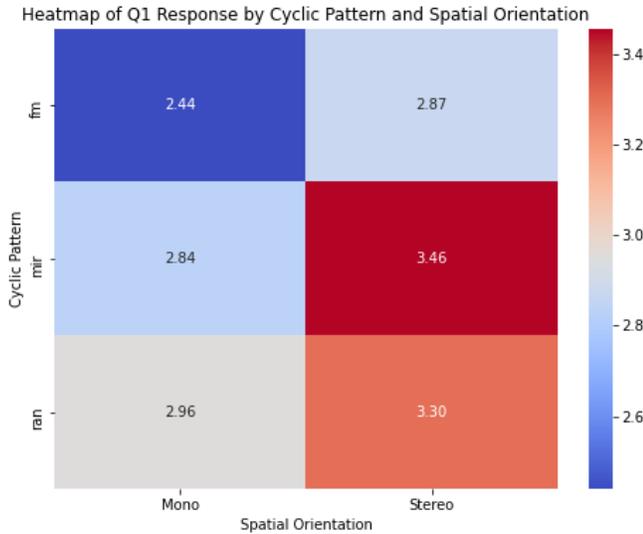


Figure 10: Heatmap of response by cyclic pattern and spatial orientation for Q1 reaction strength.

5 Discussion

5.1 Impact of Different Cyclic Patterns

The analysis revealed that more unpredictable cyclic patterns (MIR and RAN) elicited stronger ASMR responses than FM (Figure 10). Notably, MIR was most effective in a stereophonic orientation, while RAN showed a significant positive correlation in a monophonic orientation. This suggests that unpredictability influences ASMR responses differently depending on spatial audio presentation. MIR’s complexity may be enhanced by the spatial separation in stereo, while RAN’s randomness remains effective even without spatial cues. These findings reinforce the link between unpredictability and ASMR intensity.

Unpredictability may enhance reactive listening, triggering ASMR-like musical frisson [16]. FM’s structured pattern may introduce musical predictability, supporting earlier reports on musical elements suppressing ASMR responses, previously discussed by Barratt and Davis [2]. The higher engagement of MIR and RAN could explain their stronger ASMR effects, as dense and fast rhythms enhance arousal [19].

Extraversion correlated positively with Q1 reaction strength, particularly for the RAN pattern in participants with below-average extraversion. This contradicts findings of ASMR sensitivity being

associated with lower extraversion [10]. MIR showed an almost significant correlation with openness, aligning with research linking openness to ASMR and frisson [5]. No significant correlation was found between neuroticism and ASMR, diverging from previous findings [8, 10, 20].

Q3 responses indicated that increasing predictability led to sounds being perceived as more artificial. MIR was rated most natural, reflecting its organic origin, followed by RAN, despite its synthetic nature. The stereophonic orientation of MIR may have contributed to its natural perception, as human hearing relies on binaural cues. FM, perceived as the most artificial, aligns with its repetitive rhythmic structure and can thus be considered a more musical and cultural construct. Future research could introduce amplitude fluctuations in RAN to enhance its variability and mimic ASMRtist techniques, following Zwicker’s findings on fluctuation strength [25].

5.2 Influence of Spatial Orientation

The analysis demonstrated a highly significant positive correlation between stereophonic spatial orientation and ASMR reaction strength, supporting its role in enhancing immersion. This aligns with findings that lower interaural cross-correlation (IACC) elicits stronger ASMR effects [23] and reinforces the role of proximity in unpredictability [16]. The stereophonic orientation correlated significantly with a stronger focus on tingles, reinforcing that immersive sound enhances ASMR perception and engagement. Stereophonic and binaural audio enhances listener immersion more effectively than monophonic sound, as outlined by Blauert [3]. The precedence effect, where closer sound sources elicit stronger ASMR responses, further supports this [23]. The relationship between ASMR and misophonia suggests they exist on opposite ends of a sensitivity spectrum [1, 12]. Recent research links misophonia aversiveness to spectral and temporal modifications, emphasizing immersion’s impact on perception [14].

5.3 Immersiveness of Sound

The results suggest that sound immersiveness is a key factor in inducing ASMR. Stereophonic presentation enhances immersiveness by engaging the listener’s spatial localization abilities, potentially explaining why some find it relaxing while others experience stress.

Cyclic patterns contribute to immersiveness through rhythmic unpredictability, which demands more attention and yields stronger ASMR reactions. Stereophonic spatial orientation further increases unpredictability by allowing sounds to appear from unexpected directions and proximity to the sound source. This combination of spatial and rhythmic unpredictability enhances ASMR by maintaining novelty and surprise, potentially eliciting stronger responses.

Impulse density also plays a role, as denser rhythmic patterns (MIR and RAN) were more effective in inducing ASMR than sparser ones (FM). Higher impulse density sustains listener attention and deepens sensory engagement [19]. The focus strength response further supports this by reflecting participants’ attentional shifts towards tingles and sound while listening to the more dense and busy cyclic patterns. This possibly indicates that rhythmic density aligns with the effects of rhythmic unpredictability. Understanding

the interplay of impulse density, spatial orientation, and predictability can inform the optimization of ASMR content for stronger and more consistent responses.

6 Conclusion

The present study sheds light on several aspects influencing the perception of ASMR stimuli. The findings suggest a significant correlation between the predictability of cyclic patterns and the strength of ASMR reactions. Specifically, the more unpredictable cyclic patterns induced stronger ASMR reaction responses. This aligns with previous research suggesting that unpredictability can trigger ASMR and related sensory experiences. Additionally, the correlation between cyclic patterns and personality traits, such as extraversion and openness, offers insights into individual differences in ASMR responsiveness.

The research also highlights the importance of spatial orientation in enhancing the immersive quality of ASMR content. Stereophonic spatial orientation was found to positively correlate with the strength of ASMR reactions, indicating its role in creating a more immersive auditory experience. This finding resonates with existing literature on the significance of spatial audio cues in eliciting emotional and sensory responses in listeners. Furthermore, the correlation between spatial orientation and personality traits underscores the interplay between auditory stimuli and individual predispositions.

The results suggest that synthesized ASMR sounds, generated to replicate key audio characteristics in acoustically recorded ASMR content, can effectively induce ASMR sensations. This opens possibilities for creative exploration in ASMR content creation, offering opportunities for developing novel stimuli and experiences. However, further research is needed to explore how different audio features can be used in sound synthesis to affect ASMR perception and to compare synthesized artificial ASMR with conventionally recorded ASMR stimuli.

ASMR is still an under-researched topic, and there are many possibilities for further studies. When it comes to cyclic patterns, future work could explore relationships between modulators and carrier waves to introduce more natural fluctuation in pattern generation. It would also be interesting to explore more complex spatial representations, investigating the effects of spatial positioning and motion. There is also much potential in more detailed comparisons of synthesized and acoustically recorded ASMR sounds. Then, it would be relevant to study the effects of unintended ambient sounds often found in recordings, including room sounds, clothing rustle, and breathing. Future research can elucidate these factors, advance our knowledge of ASMR, and inform the development of tailored stimuli for therapeutic and recreational purposes.

Acknowledgments

The Research Council of Norway has supported this project through projects 262762 (RITMO) and 324003 (AMBIENT).

References

- [1] Emma Barratt and Nick Davis. 2015. Autonomous Sensory Meridian Response (ASMR): A flow-like mental state. *PeerJ* 3 (2015), e851. doi:10.7717/peerj.851
- [2] Emma Barratt, Charles Spence, and Nick Davis. 2017. Sensory determinants of the autonomous sensory meridian response (ASMR): Understanding the triggers. *PeerJ* 5 (2017), e3846. doi:10.7717/peerj.3846
- [3] Jens Blauert. 1997. *Spatial Hearing: The Psychophysics of Human Sound Localization* (2 ed.). MIT Press. doi:10.7551/mitpress/6391.001.0001
- [4] Marisa Campo and Thomas Kehle. 2016. Autonomous sensory meridian response (ASMR) and frisson: Mindfully induced sensory phenomena that promote happiness. *International Journal of School & Educational Psychology* 4 (2016), 99–105. doi:10.1080/21683603.2016.1130582
- [5] Mitchell Colver and Amani El-Alayli. 2015. Getting aesthetic chills from music: The connection between openness to experience and frisson. *Psychology of Music* 44 (March 2015). doi:10.1177/0305735615572358
- [6] Ateka Contractor, Tory Durham, Julie Brennan, Cherie Armour, Hanna Wutrick, B. Frueh, and Jon Elhai. 2013. DSM-5 PTSD's symptom dimensions and relations with major depression's symptom dimensions in a primary care sample. *Psychiatry research* 215 (Oct. 2013). doi:10.1016/j.psychres.2013.10.015
- [7] Coromo Sara. ASMR. 2021. ASMR for Those Who Want to Sleep Soundly Now / 3Hr (No Talking). https://www.youtube.com/watch?v=-SYwOAe6V_4 Accessed: Jan 11, 2024. URL: https://www.youtube.com/watch?v=-SYwOAe6V_4.
- [8] Charlotte M. Eid, Colin Hamilton, and Joanna M. H. Greer. 2022. Untangling the tingle: Investigating the association between the Autonomous Sensory Meridian Response (ASMR), neuroticism, and trait & state anxiety. *PLOS ONE* 17, 2 (2022), e0262668. doi:10.1371/journal.pone.0262668 Publisher: Public Library of Science.
- [9] Zexin Fang, Bin Han, C. Clark Cao, and Hans D. Schotten. 2023. Artificial ASMR: A Cyber-Psychological Approach. In *2023 IEEE 33rd International Workshop on Machine Learning for Signal Processing (MLSP)*. 1–6. doi:10.1109/MLSP55844.2023.10285977
- [10] Bev Fredborg, Jim Clark, and Stephen Smith. 2017. An Examination of Personality Traits Associated with Autonomous Sensory Meridian Response (ASMR). *Frontiers in Psychology* 8 (Feb. 2017), 247. doi:10.3389/fpsyg.2017.00247
- [11] Avram Goldstein. 1980. Thrills in response to music and other stimuli. *Physiological Psychology* 8, 1 (March 1980), 126–129. doi:10.3758/BF03326460
- [12] Agnieszka B. Janik McErlean and Michael J. Banissy. 2018. Increased misophonia in self-reported Autonomous Sensory Meridian Response. *PeerJ* 6 (2018), e5351. doi:10.7717/peerj.5351
- [13] Alexander Refsum Jensenius. 2022. *Sound actions: conceptualizing musical instruments*. The MIT Press, Cambridge, Massachusetts London, England.
- [14] Savvas Kazazis, Iza Korsmit, and Stephen Mcadams. 2024. Triggering Misophonia: The Importance of Spectral Information, Temporal Information, and Action Identification. *Auditory Perception & Cognition* 7 (Jan. 2024), 1–13. doi:10.1080/25742442.2024.2302295
- [15] Catherine Kerr, Matthew Sacchet, Sara Lazar, Christopher Moore, and Stephanie Jones. 2013. Title: Mindfulness starts with the body: Somatosensory attention and top-down modulation of cortical alpha rhythms in mindfulness meditation. *Frontiers in human neuroscience* 7 (Feb. 2013), 12. doi:10.3389/fnhum.2013.00012
- [16] Alexandra Kovacevich and David Huron. 2018. Two Studies of Autonomous Sensory Meridian Response (ASMR): The Relationship between ASMR and Music-Induced Frisson. *Empirical Musicology Review* 13, 1-2 (2018), 39–63. doi:10.18061/emr.v13i1-2.6012 Number: 1-2.
- [17] Frieder Lang, Dennis John, Oliver Lüdtke, Jürgen Schupp, and Gert Wagner. 2011. Short assessment of the Big Five: Robust across survey methods except telephone interviewing. *Behavior research methods* 43 (2011), 548–67. doi:10.3758/s13428-011-0066-z
- [18] Bryson C. Lochte, Sean A. Guillory, Craig A. H. Richard, and William M. Kelley. 2018. An fMRI investigation of the neural correlates underlying the autonomous sensory meridian response (ASMR). *BioImpacts : BI* 8, 4 (2018), 295–304. doi:10.15171/bi.2018.32
- [19] Giulia Poerio, Emma Blakey, Thomas Hostler, and Theresa Veltri. 2018. More than a feeling: Autonomous sensory meridian response (ASMR) is characterized by reliable changes in affect and physiology. *PLOS ONE* 13 (June 2018), e0196645. doi:10.1371/journal.pone.0196645
- [20] Natalie Roberts, Alissa Beath, and Simon Boag. 2020. Autonomous Sensory Meridian Response: Sensitivity and Personality Correlates. *Journal of Individual Differences* 42 (2020), 1–8. doi:10.1027/1614-0001/a000337
- [21] Thomas D. Rossing, F. Richard Moore, and Paul A. Wheeler. 2001. *The Science of Sound, 3rd Edition* (3rd ed.). Pearson, San Francisco.
- [22] Romke Rouw and Mercede Erfanian. 2018. A Large-Scale Study of Misophonia. *Journal of Clinical Psychology* 74, 3 (2018), 453–479. doi:10.1002/jclp.22500
- [23] Ryota Shimokura. 2022. Sound Quality Factors Inducing the Autonomous Sensory Meridian Response. *Audiology Research* 12, 5 (2022), 574–584. doi:10.3390/audiolres12050056
- [24] Amos Tversky and Daniel Kahneman. 1974. Judgment under Uncertainty: Heuristics and Biases. *Science* 185, 4157 (1974), 1124–1131. doi:10.1126/science.185.4157.1124 Publisher: American Association for the Advancement of Science.
- [25] Everhard Zwicker and Hugo Fastl. 2007. *Psychoacoustics* (3 ed.). Springer Berlin, Heidelberg. <https://doi.org/10.1007/978-3-540-68888-4>