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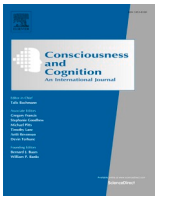

What is autonomous sensory meridian response (ASMR)? A narrative review and comparative analysis of related phenomena

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ABSTRACT

A narrative review of autonomous sensory meridian response (ASMR) was carried out. Definitional factors relevant to ASMR were canvassed. Related, but distinctly unique, sensorial phenomena, including frisson, synaesthesia, and misophonia were considered. Finally, the status of literature with respect to clinical outcomes, individual differences, and current research applications was evaluated. ASMR is a nascent phenomenon that has rapidly progressed in scope and depth of study throughout the past decade; a notable shift from brief-form studies to an increase in formalised trials is noted. Yet, critical questions remain unaddressed, including expectancy and placebo effects, that future research should interrogate.

1. Introduction

Emerging from a sensationalised internet trend commencing in 2008 (Andersen, 2014), Autonomous Sensory Meridian Response (ASMR) has gained research traction concerning its clinical efficacy and underlying psychological mechanisms. ASMR is an experience-dependent sensation in which specific audio, visual and/or tactile stimuli, such as tapping or whispering, induce a (usually pleasant) tingling sensation, typically occurring around the scalp and spine (Barratt & Davis, 2015). Unlike most sensory psychological phenomena that are first captured in the laboratory and later proliferate into the public sphere, ASMR demonstrates a curious inverse pattern, having been observed via informal online discussion boards at onset. Its online community, referred to as the ASMR community or 'Whisper Community', was born out of small online forums, and continues to grow with creators on YouTube (Google, CA, USA), with some earning subscriber counts of over two million (see Andersen, 2014; Smith & Snider, 2019).

Existing reviews on ASMR are brief, and typically serve as broad overviews of the topic for medical practitioners or academic professionals who are unaware of its online popularity and pleasurable effects (see Niven & Scott, 2021; Reddy & Mohabatt, 2020). These are helpful for providing information that is concise and scrutable but fail to capture the depth of ASMR research. This literature review aims to provide a comprehensive overview of current ASMR research, as well as research in adjacent fields, such as that of meditation and alertness, to garner deeper understanding of how ASMR should be conceptualised. Upon conclusion of the review, criteria for the necessary components that define ASMR are outlined. The review will cover i) definitional factors, ii) ASMR's potential therapeutic benefit, iii) related sensations, iv) individual differences, v) neurophysiological factors, vi) attentional concepts of ASMR, vii) the role of intimacy and copresence, and viii) the role of placebo and expectancy. In doing so, this review will serve as a useful resource for researchers aiming to understand ASMR or apply it in future studies.

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2. Definitional factors

Definitional issues relevant to ASMR have raised questions about the nature and legitimacy of the phenomenon, especially in early foundations of the research. The tingling sensation is involuntary, atypical, non-medical and non-harmful, and is accompanied by feelings of relaxation and calmness (Valtakari, 2019). The stimuli that induce tingling, termed triggers, are characteristically gentle, low frequency and repetitive, such as whispering or softly tapping on plastic objects (Barratt et al., 2017). Most commonly, people seek out the experience of ASMR via online videos, wherein ASMR triggers are produced in close proximity to a microphone and camera to optimise the likelihood of inducing tingling (Barratt et al., 2017; Gallagher, 2016, Smith & Snider, 2019; Engelbregt et al., 2022). Colloquially, the term is often conflated with the genre of online content which aims to induce ASMR (e.g., "I watched the ASMR" as opposed to "the video induced ASMR"). Thus, it is important to distinguish between the sensation of ASMR and the modality or the 'affective genre' that is utilised to induce ASMR (Smith & Snider, 2019). We recommend opting to use terms such as 'ASMR content', 'ASMR stimuli', or 'ASMR videos' to differentiate. Alternatively, ASMR is sometimes situated as a condition or a state of consciousness (Andersen, 2014; Roberts et al., 2019), due to the unique sensory components that overlap with altered states such as flow or Kundalini (Valanciute & Thampy, 2011). That is, someone who experiences ASMR 'has ASMR' (i.e., "I have ASMR"). Because the term has seen use in so many different ways, for clarity we recommend using distinct and separate terms, such as 'ASMR experiencer' or 'ASMR user'.

Despite being intentionally induced, the tingling sensation occurs involuntarily (McGeoch & Rouw, 2020; Poerio et al., 2018; Smith & Snider, 2019). ASMR it is often accompanied by increased skin conductance and reduced heart rate (Engelbregt et al., 2022; Poerio et al., 2018; Valtakari, 2019). Typically beginning in the head, scalp and spine, ASMR sensations travel slowly outwards along the spine and to the limbs (Barratt & Davis, 2015; Kovacevich & Huron, 2019). It is also less commonly reported to occur in the legs, stomach, and throat (Barratt & Davis, 2015; Roberts et al., 2019). Sensations in these areas may resemble an inducer-concurrent relationship, where different ASMR triggers cause sensations in different parts of the body (Barratt & Davis, 2015). The tingling is generally pleasant, and the experience has been equated to a low-grade euphoria (Ahuja, 2013).

ASMR triggers are primarily auditory, though they can also be visual, tactile, or emotional (Barratt et al., 2017; Poerio et al., 2018). Auditory triggers tend to be low frequency, gentle and repetitive, such as whispering, softly speaking, or tapping on objects with one's fingers (see Fig. 1 & Fig. 2). In ASMR videos, these are enacted near a microphone. Visual triggers are similarly slow and repetitive which often elicit a sense of touch. Common in ASMR videos are repetitive hand movements that emulate touching the viewers' face by moving close to the camera. Similarly, tactile triggers can occur by treating microphones as if they were the viewer's ears. ASMR can also occur interpersonally by being closely examined (e.g., as though the viewer were a patient in a dentist's chair; Ahuja, 2013) or when witnessing good deeds; "when a classmate did me [sic] a favour" (Smith & Snider, 2019, p. 44). These emotional elements of ASMR are invoked in ASMR videos with close personal attention towards the camera, which is treated as the first-person perspective of the viewer (Barratt et al., 2017; Poerio et al., 2018; Zappavigna, 2020). Auditory triggers are generally regarded as the primary aspect of ASMR, and other sensory elements supplemental (Barratt et al., 2017; Poerio et al., 2018). Questionnaire-driven research indicates that the most popular types of triggers include whispering, close personal attention, and crisp sounds like fingernail tapping and crinkling sounds (Barratt et al., 2017; Poerio et al., 2018).Fig. 2..

3. ASMR's therapeutic potential

The ever-increasing attention around ASMR is founded in claims that it is physiologically and psychologically beneficial (Garro, 2017; Paszkiel et al., 2017; Poerio et al., 2018). Questionnaire-based research indicates that ASMR videos are most often used for

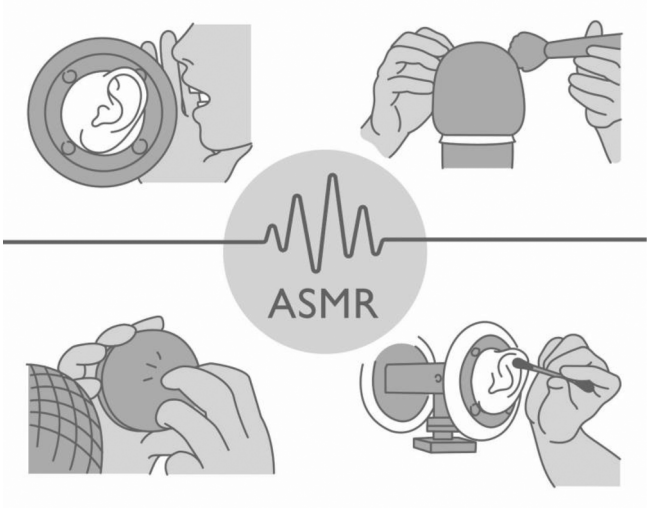

Fig. 1. Various triggers can bring about ASMR; some examples are illustrated here. Photograph sourced from Shutterstock.

Fig. 2. In most ASMR videos proximity of both the artist and objects intended to induce ASMR can be seen near the microphone. Motions such as squeezing, brushing, synchronous stroking, or repetitive movement are common in ASMR. Photographs sourced from Shutterstock.

relaxation, falling asleep, and stress relief (Barratt et al., 2017; Janik McErlean & Banissy, 2017; Roberts et al., 2020a). ASMR experiencers have reported improvement in mood after listening to ASMR to a degree that researchers found a significant main effect on mood (Barratt & Davis, 2015; Engelbregt et al., 2022). A pilot study also found that stress levels reduced faster for those who listened to ASMR content compared to a control group (Paszkiel et al., 2020). Some respondents also claim ASMR assists with managing chronic pain (Barratt & Davis, 2015), although there are no data to support this. Considering the stimuli are self-accessible, pose minimal psychological/physiological risk, and are relatively short in duration, some proponents of ASMR argue that these benefits outweigh disadvantages from a therapeutic vantage point (Garro, 2017; Smith & Snider, 2019; Swart et al., 2022). Research also indicates that electrophysiological decay effects lasting up to 45 minutes can persist after ASMR experiences have ended, suggesting that ASMR may provide lasting positive impacts on well-being (Swart et al., 2022).

While strides have been made over the last decade in researching ASMR, little progress has been made in observing its benefits under experimental conditions. Most of the research thus far has compared self-report data of ASMR experiencers versus that of non-experiencers to identify unique characteristics associated with the sensation: Very few randomised control trials have been implemented. These trials typically examine ASMR's role on mood and sleep. In a review of external stimuli as auditory sleep aids, only three studies were found that utilised experimental conditions to examine the effects of ASMR on sleep (Yoon & Baek, 2022). Two of these studies utilised nature sounds such as rain, ocean waves and waterfalls instead of conventional ASMR triggers and one was conducted before the term ASMR was coined (see Williamson, 1992). This study's results showed a significant improvement in sleep depth, return to sleep, awakening, and quality of sleep for those exposed to the ocean sounds compared to the control group, who were not exposed to any sounds (Williamson, 1992).

Another study utilising rain sounds found significantly decreased scores on the Pittsburgh Sleep Quality Index (PSQI; Smith & Wegener, 2003), indicating overall improvement in subjective sleep quality. The PSQI measures multiple facets of sleep, such as subjective sleep quality and latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The study also showed improvements to sleep latency and quality of sleep. Sleep latency refers to the time it takes to fall asleep, and sleep latency under 30 minutes is considered a good indicator of sleep quality and effectiveness of sleep related interventions (Lichstein et al., 2003; Yoon & Baek, 2022). A more recent study categorising rain sounds as ASMR found that after 30 days, listening to rain for 1 hour each night decreased PSQI scores and increased subjective quality of sleep significantly (Umbas et al., 2021). These studies support the notion that external auditory stimuli can be used as a sleep aid; however, they do not utilise conventional ASMR videos and triggers, instead using natural sounds, which belong to the white noise family (Yoon & Baek, 2022). ASMR triggers exhibit commonalities with white noise and nature sounds (Yoon & Baek, 2022), such as the low frequency and lowered volume (Barratt & Davis, 2015; Kovacevich & Huron, 2019). However, typical ASMR videos involve a greater variance of sound, including inconsistent sounds such as whispering and tapping. Additionally, there is also an increased sense of proximity in ASMR videos compared to control talking head style videos (Kovacevich & Huron, 2019; Zappavigna, 2020), further differentiating it from expansive natural sounds and white noise. In the studies that conflate ASMR and nature sounds, the sleep aid is primarily a masking tool to extraneous noise, much like white noise (Yoon & Baek, 2022), not something that the listener derives relaxation and pleasure from. This is another differentiation from ASMR, though ASMR likely also works as a masking tool. Therefore, to veraciously assess the impact of ASMR, specific ASMR triggers must be incorporated into experimental designs.

Currently, two interventions using ASMR stimuli as a sleep aid exist. A randomised control intervention using ASMR roleplay videos showed similar results to the interventions that used natural sounds, with improved scores on the PSQI and subjective sleep quality (Hardian et al., 2020). However, this intervention did not measure sleep latency. More recently, a study using ASMR as a sleep aid in conjunction with a pillow resulted in 66 % of participants reporting good night sleeps after 7 days. The intervention also decreased the number of participants who could not sleep steadily from 56 % to 11 % (Wang & Li, 2020). These findings are largely promising for ASMR as a therapeutically beneficial intervention, although more experimental research within this domain is warranted. Separating participants into control, ASMR and nature sounds group could aid in assessing any differences between naturalistic triggers and conventional ASMR triggers.

4. Related sensations

The tingling sensation, particularly as it results from external stimuli, has been compared to similar, previously identified

sensations, including paresthesia, frisson, synaesthesia, and misophonia (Barratt & Davis, 2015; Janik McErlean & Banissy, 2018; Kovacevich & Huron, 2019; Roberts et al., 2019; see Fig. 3). Paresthesia is an umbrella term for abnormal tingling, prickling or itching sensations on the skin (National Institute of Neurological Disorders and Stroke, 2019). Common transient forms of paresthesia include the tingling sensation that occurs after obdormition (after one's limb 'falls asleep') or tweaking the ulnar nerve (hitting one's funny bone; Sharif-Alhoseini et al., 2012). Chronic paresthesia is typically the result of neurological conditions affecting the central nervous system, like multiple sclerosis, or nerve entrapment syndromes like carpal tunnel (National Institute of Neurological Disorders and Stroke, 2019). While ASMR arguably fits under the umbrella of paresthesia, considering it as such carries medical connotations that do not align with ASMR's characteristics. ASMR is a non-medical and somatosensory experience which is typically positively valenced, unlike the discomfort associated with forms of medically induced paresthesia caused by medical conditions. Other related sensations are discussed.

4.1. Frisson

A comparison has been drawn with frisson, colloquially termed 'aesthetic chills' (Colver & El-Alayli, 2016; Harrison & Loui, 2014). Frisson is a similarly spontaneous and satisfying tingling sensation that occurs as a result of intense aesthetic appreciation, often accompanied by pilomotor activation and feelings of awe, absorption, thrill, or subverted expectations (Blood & Zatorre, 2001; Panksepp, 1995; Sloboda, 1991). This moment of "peak pleasure" is accompanied by a transient rush of tingles or chills (Bannister, 2019, p. 2). Most commonly, frisson is experienced when listening to music, often during climactic moments such as key changes, transitions into chorus', rapid increases in volume, or poignant lyrics (Harrison & Loui, 2014; Panksepp, 1995; Sloboda, 1991). Frisson can also occur in other contexts that are visual and emotional, such as witnessing a beautiful natural scene (Goldstein, 1980), or getting chills while watching a frightening film (Sumpf et al., 2015). Frisson is accompanied by physiological changes such as cutis anserina (i.e., goosebumps; Harrison & Loui, 2014), activation of reward systems (Mori & Iwanaga, 2017) and pupil dilation (Laeng et al., 2016); the latter of which has also shown to occur when experiencing ASMR (Lochte et al., 2018; Valtakari et al., 2019).

While these sensations share commonalities, the overall experience and induction of tingling is markedly different (Collins, 2012; Higham, 2014). One distinction is that frisson is typically induced by musical stimuli while ASMR is induced by non-musical stimuli, with survey data indicating music is non-conducive to experiencing ASMR (Barratt et al., 2017). Content analyses of ASMR videos identify that ASMR stimuli is typically quieter, more proximate, with spoken audio typically whispered, with greater oral wetness and

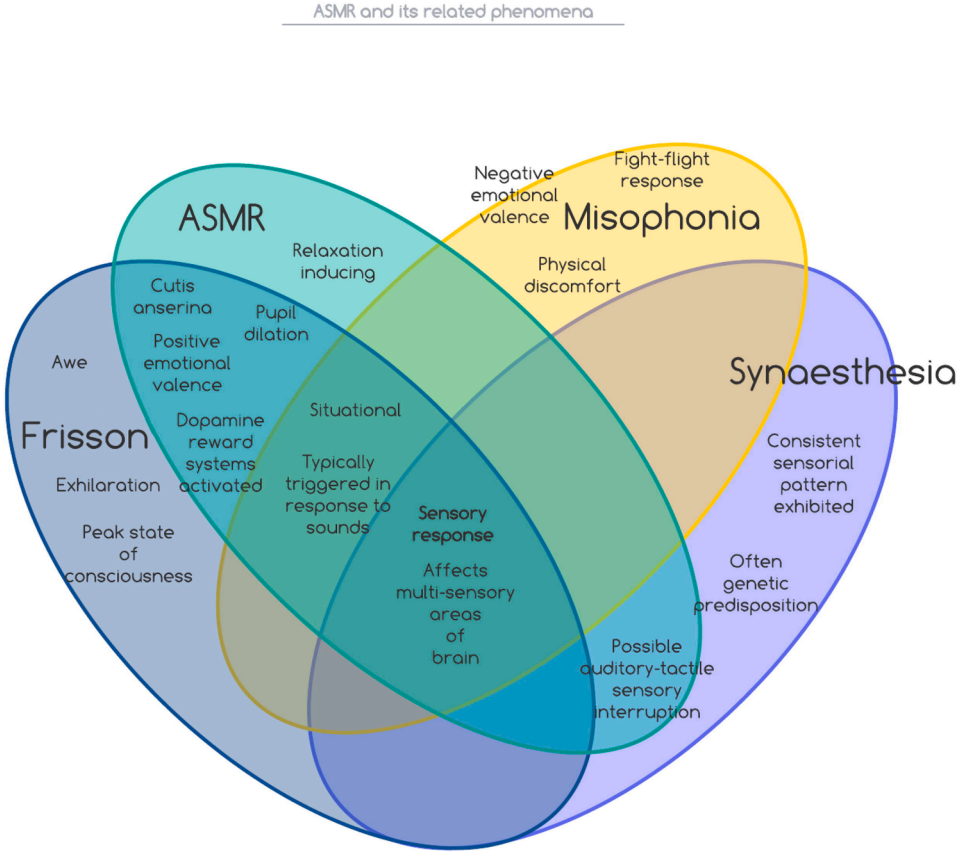

Fig. 3. Comparison of ASMR with misophonia, frisson, and synaesthesia.

audio roaming as well as less voicing, syllable rate, and vocal energy in comparison to control videos (Barratt et al., 2017; Kovacevich & Huron, 2019). This is antithetical to the excitatory process of frisson (Grewe et al., 2011), which is often elicited by increases in volume and broadening of the audio frequency range (Panksepp, 1995). The tingling sensation is transient, described as waves that rapidly propagate through the spine, neck, and arms (Huron, 2000; Mori & Iwanaga, 2017), which is usually deemed exhilarating. ASMR, conversely, is distinctly relaxing, and tingles tend to radiate throughout one's body in a slower and subdued manner (Barratt & Davis, 2015; Collins, 2012; del Campo & Kehle, 2016). In designing an ASMR assessment tool, Roberts et al. (2019) found a weak positive correlation between responses on their ASMR assessment tool and a frisson subscale ($r = 0.25$, $p < .001$). They also found a weak positive correlation between frisson and the ASMR subfactor labelled movement ($r = 0.20$, $p < .001$), indicating both tingling sensations travel through the body.

Some forms of ASMR video, often titled as 'satisfying', support the notion of aesthetic appreciation, where ASMR triggers are presented in a visually appealing way, such as systematically cutting up objects, popping bubble wrap, and playing with slime. These ASMR triggers focus more on visual and simulated tactile stimulation, and do not have the typical characteristics of triggers: they often contain high frequency popping sounds, in contrast to the general low frequency of ASMR triggers, and often lack the slow, gentle quality distinctive in ASMR content (Barratt et al., 2017; Kovacevich & Huron, 2019). Tingling resulting from these videos could be interpreted as frisson, ASMR, or a combination of both. Therefore, the demarcating factor between ASMR and frisson may not be physiological, but rather how the event is framed by the individual in a top-down manner via cognitive contextual cues. Tingling considered to be thrilling or exciting may be embodied as frisson, while relaxing tingling is perceived as ASMR. Kovacevich and Huron (2019) suggested that the self-reported divergence between ASMR and frisson may be due to misattribution. Because stimuli are more cognitively identifiable than affective states or responses, individuals may interpret the same response as different if it is induced by contrasting stimuli. Dutton and Aron (1974) famously illustrated this as men experiencing vertigo attributed their feelings to infatuation due to the presence of an attractive woman, rather than their fear of heights. This may be the case with ASMR and frisson, where the stimuli is vastly different, and thus the resulting response is interpreted as different.

Kovacevich and Huron (2019) theorise that frisson and ASMR may both arise from the suppression of a fear response. Based in previous research (Huron, 2006; McGraw, 1999; McGraw & Warren, 2010), they propose that the emotional contrast from embodying a negative response like fear, to a positive response, results in an intensely pleasurable experience akin to frisson or ASMR. In musically-induced frisson, an initial subcortical fear response arises from changes in volume and pitch, which is then consciously appraised as a non-threat, resulting in the pleasurable tingling (Huron, 2006). Kovacevich and Huron (2019) suggest that ASMR videos induce a similar unconscious fear response through an initial sense of intense proximity, which raises arousal levels much like when an insect buzzes close to one's face, or someone whispers closely into one's ear. They note that pilomotor activation is a common fear response, and ASMR users typically have high neuroticism (Fredborg et al., 2017; see Section 5), which predispose a greater sensitivity to threat.

4.2. Synaesthesia

ASMR and frisson are reminiscent of synaesthetic stimulations (Roberts et al., 2019). Synaesthesia is a condition which affects roughly 4.4 % of the population (Simner et al., 2006), wherein stimulation of one sensory domain triggers a reaction in another sensory domain, often causing an overlay and intermingling of sensory interpretations. Specific letters and numbers may be associated with colours (grapheme-colour synaesthesia; Rich & Mattingley, 2002), or musical notes may elicit experience of colour (Chromesthesia; Cytowic & Eagleman, 2011). In the case of ASMR and frisson, specific sounds elicit emotional and tactile reactions. Amongst a sample of ASMR experiencers, 5.9 % self-identified as synesthetes, though scholars have argued that this sample difference is not a significant departure from rates in the general population, nor does synaesthesia appear central to the ASMR construct (Barratt & Davis, 2015). Other scholars suggest that ASMR is a form of auditory-tactile synesthesia, in which specific auditory stimuli elicit tactile reactions in the form of tingling (Barratt & Davis, 2015; Smith et al., 2017). While there is some overlap between ASMR experiencers and synesthetes (Barratt & Davis, 2015), this likely implies an overall sensitivity to auditory stimuli, rather than a correlation between the two. Furthermore, it is important to consider the emotional well-being component of ASMR and the positive feelings which are associated, as typical synesthesia is neither positive nor negative, it is a consistent and automatic perceptual response (e.g. 'the number 2 is always red'; McGeoch & Rouw, 2020; Simner et al., 2006). Mirror touch synaesthesia, where witnessing, but not recieving, physical touch illicits touch sensations, was found to be more common in ASMR experiencers when compared to controls (Gillmeister et al., 2022)

4.3. Misophonia

Literally translating to 'hatred of sound', misophonia is a disorder in which specific sounds trigger intense negative emotional and physiological responses like rage, physical discomfort, and the fight or flight response (Brout et al., 2018; Jastreboff & Jastreboff, 2001; Rouw & Erfanian, 2018; Spence, 2020). Misophonic triggers are typically repetitive, and human-made sounds, such as chewing, loud breathing and pen clicking (Brout et al., 2018; Rouw & Erfanian, 2018). As these sounds are common ASMR triggers (Kovacevich & Huron, 2019), one might assume ASMR experiencers are characteristically unlikely to experience misophonia. Conversely, findings indicate that those who suffer with misophonia are more likely to experience ASMR (Janik McErlean & Banissy, 2018; Rouw & Erfanian, 2018), further supporting the notion that ASMR experiencers have an overall sensitivity to auditory stimuli. This suggests that the context surrounding the noise may alter an individuals' reaction to it (see Section 9.1). Indeed, the first definition of misophonia cited in literature specified that misophonic reactions occurred in specific situations or settings, rather than as a result of the loudness or frequency of the sound (Jastreboff & Jastreboff, 2001; 2014).

ASMR has been demarcated as a unique construct that is interrelated with frisson, synaesthesia and misophonia. While physiologically similar to frisson, ASMR is experientially different and ultimately occurs in complex contexts, with divergent emotions attached; namely relaxation instead of excitement and awe. ASMR, frisson, misophonia and misokinesia (hatred of repetitive or fidgety movements) could be part of a spectrum based on the intensity and pleasurability of certain sounds, but more research is needed to uncover whether this is the case. Potentially, ASMR and frisson lie on one end, as they result from extreme positive reactions to stimuli, while misophonia and misokinesia lie on the opposite end. We advocate that synaesthesia is demarcated separately from ASMR, frisson and misophonia, as it typically does not involve an emotional reaction, but rather a consistent interpretation of external stimuli that results from the engagement of multiple sensory domains. Synaesthesia presents as a perceptual phenomenon that occurs constantly, while ASMR is a stimuli-dependent sensation which only occurs situationally.

While not extensively researched in ASMR literature, context is known to be critical in ASMR, with survey research indicating individuals are less likely to experience ASMR in noisy or stressful environments (Barratt et al., 2017). Additionally, a popular discourse within the ASMR community considers how some triggers, such as mouth sounds, can be relaxing in the context of an ASMR video, but misophonic in other contexts. While misophonia refers specifically to sound-related discomfort, ASMR triggers can be auditory, visual, emotional or tactile. Counterpart/related disorders such as misokinesia and haphephobia (hatred/fear of being touched) are closely related to both misophonia and ASMR, yet distinct constructs (Jaswal et al., 2021).

5. Individual differences

Both state and trait-oriented research points to substantial variance across individual reports in ASMR-based trials. The Highly Sensitive Person Scale, (HSPS; Aron & Aron, 1997) is a self-report scale measuring Sensory Processing Sensitivity (SPS). SPS is a trait characterised by an increased sensitivity of the central nervous system (CNS), deep cognitive processing, greater sensitivity to subtle stimuli and heightened emotional reactivity (Booth et al., 2015; Boterberg & Warreyn, 2016; Greven et al., 2019). ASMR sensitivity has been correlated with greater SPS scores (Roberts et al., 2020b). ASMR sensitivity is also correlated with higher absorption (Janik McErlean & Osborne-Ford, 2020) and fantasising (Janik McErlean & Banissy, 2017), traits measuring one's propensity to immerse oneself into media one consumes, such as television shows and movies, to an extent that one loses track of time or forget about one's surroundings (Davis, 1980; see Tellegen, 1981; Tellegen & Atkinson, 1974). ASMR experiencers were also found to score higher on empathic concern (Janik McErlean & Banissy, 2017) on the Inter-Personal Reactivity Index (IPR; Davis, 1980), and a greater reactivity to interpersonal touch (Gillmeister et al., 2022). Positive correlations between ASMR sensitivity and other consciousness dimensions have also been observed via the ASMR-15 (Roberts et al., 2021):

a) Body consciousness: The tendency to focus on bodily sensations like hunger or heartbeat (Miller et al., 1981).
b) Transliminality: A lack of separation between mental processes, encompassing experiences such as lucid dreaming, absorption, mystical experiences, and increased sensitivity to external stimuli (Lange et al., 2000).
c) Unusual experiences (UE): Cognitive and sensory experiences like synaesthesia, dreams, and fantasy (Rawlings, 2002).

These results indicate a higher emotional capacity or predisposition to engage with actors in ASMR videos, and a greater sensitivity to the stimuli presented in these videos. Links between flow, absorption, mindfulness, suggestibility, and other constructs interrelated with ASMR, are discussed further on in this review (see Section 7).

ASMR experiencers have been found to have higher openness to experience (Janik McErlean & Banissy, 2017; Roberts et al., 2020b), higher neuroticism (Fredborg et al., 2017), and lower conscientiousness (Fredborg et al., 2018; Janik McErlean & Banissy, 2017; Roberts et al., 2020b), as per Costa and McCrae's (1992) five-factor model of personality, the BFI. Openness to experience refers to one's curiosity, appreciation for abstract concepts and creativity (John & Srivastava, 1999) and encapsulates the type of person who may be willing to engage in an unconventional aesthetic experience like ASMR. This relationship could be slightly skewed by the fact that the average age of ASMR experiencers is younger (Barratt & Davis, 2015), and notably openness tends to be higher in younger demographics and reduces with age (McCrae & Terracciano, 2005). Since ASMR is commonly used for stress relief (Barratt et al., 2017), those who are more prone to stress, or highly neurotic, may be more inclined to engage with ASMR. Additionally, a study of the personality inventory found the best predictor of openness was the tendency to experience chills during aesthetic experiences, akin to frisson (Costa & McCrae, 1992; McCrae, 2007). Higher openness is also common in those who experience frisson (Colver & El-Alayli, 2016). Studies have also found lower scores in conscientiousness (Fredborg et al., 2018; Janik McErlean & Banissy, 2017; Roberts et al., 2020b). Low conscientiousness has been associated with nervousness and increased reactivity to stressors (Komulainen et al., 2014; Merecz et al., 1999). As ASMR is associated with increased galvanic skin response (Poerio et al., 2018), the physiological profile of ASMR experiencers and low conscientious individuals overlaps. To this point, Engelbregt et al. (2022) found that *only* those who scored low in conscientiousness showed significant changes in skin conductance from ASMR. Low extroversion and agreeableness have also been observed in ASMR experiencers compared to non-experiencers (Fredborg et al., 2017); however, this relationship has not been supported in similar studies.

Sensory suggestibility is a trait which measures one's propensity to respond physiologically to sensory information that is covertly implied or inferred (Gheorghiu et al., 1995; Marotta et al., 2016). The Sensory Suggestibility Scale (SSS; Gheorghiu et al., 1995) measures this trait by employing exercises in which an instructor subtly implies that a specific task/s will cause a directly linked resultant physical sensation (e.g., shining a light onto a participant's face is falsely implied to create a sense of warmth on their face). In this example, those with higher sensory suggestibility will report a sense of warmth despite its physiological impossibility. ASMR experiencers score significantly higher on the SSS than control individuals (see Keizer et al., 2020). That is, ASMR experiencers are

more likely to experience illusory sensations. Suggestibility is also related to unusual experiences (Acunzo et al., 2020), traits which are common in ASMR experiencers. This may explain the popularity of tactile triggers in ASMR videos, which simulate feelings of touch. In these instances, the video performer touches microphones or the camera lens to imply a sense of touch on the viewers ears or face. For example, a performer covers the top half of the frame with their palm, encouraging the viewer to feel the presence of bodily heat on their forehead (Gentle Whispering, 2019). Alternatively, this could suggest that ASMR itself is a placebo or a perceptual suggestion effect, which occurs in those who are more prone to anomalous perceptual states in response to suggestion (see Section 9).

Taken together, the higher scores on neuroticism, sensory processing sensitivity, sensory suggestibility, body consciousness, empathy and transliminality, along with lower scores on conscientiousness, suggest that ASMR users tend to be emotionally and stimulatorily sensitive/reactive. They also tend to exhibit imaginative and creative tendencies, illustrated by higher scores in openness to experience, fantasising, absorption, observing and unusual experiences. Many of these trends co-occur in synaesthetic individuals, who have been found to have higher openness, neuroticism, fantasising and absorption, and lower conscientiousness (Banissy et al., 2012, 2013; Chun & Hupe, 2016; Janik McErlean & Banissy, 2017; Rader & Tellegen, 1987).

Sensitivities to stimuli may be explained by atypical connectivity and/or cross activations between brain regions in those who experience ASMR (Smith et al., 2017, 2019b, 2020; McGeoch & Rouw, 2020). A series of studies by Smith et al. (Smith et al., 2017, 2019b, 2020) found atypical functional connectivity in ASMR experiencers. Functional connectivity describes when neuronal firing in one brain region is statistically associated with neuronal firing in a separate brain region (Friston, 1994). Functionally connected areas of the brain form resting state networks that are often associated with particular functions (van den Heuvel & Sporns, 2013). The default mode network (DMN) is one such resting state network and is associated with internally directed thought and attention, or a disconnection from external stimuli (Buckner et al., 2008; Greicius et al., 2003; Raichle, 2015).

Smith et al. (2019b) found that ASMR listeners had reduced functional connectivity in the salience and visual networks and the DMN, as well as atypical connectivity in the central executive and sensorimotor networks. They also found increased connectivity between the occipital, frontal and temporal cortices, suggesting the brain regions of ASMR listeners are less compartmentalised than non-experiencers (Smith et al., 2017). Taken together, this indicates a de-compartmentalisation of brain networks, which may help to explain how auditory and visual stimuli result in the unique tingling sensation of ASMR. Smith et al. (2017) also suggested that ASMR may result from an inability to inhibit sensory motor experiences, producing an uncontrollable tingling sensation (Smith et al., 2017). This lack of sensory control could explain the higher absorption found in ASMR experiencers, as well as the higher sensory suggestibility Keizer et al. (2020) observed. ASMR may also impact executive function, with research finding set shifting (the ability to switch focus between mental tasks; Miyake et al., 2000; Wilson et al., 2018) and inhibitory control (ability to supress a response, feeling or action; Miyake et al., 2000) were impeded after experiencing ASMR (Wang et al., 2020). This adds credence to the theory that ASMR results from an inability to inhibit sensory motor experiences.

Using functional magnetic resonance imaging (fMRI), Smith et al. (2019a) also found greater activity in the cingulate gyrus, right paracentral lobule, and bilateral thalamus in ASMR experiencers in comparison to a control group that was presented with ASMR inducing stimuli; these brain regions are associated with emotion, behaviour regulation, alertness, and attention (Craig, 2003; Floresco, 2015; Gasquoine, 2013). A similar fMRI study found that activity in the insulae, nuclei accumbens and supplementary motor areas was associated with an experience of ASMR tingles (Locthe et al., 2018). These brain regions are associated with reward (Schultz 2000), arousal (Oliveri et al., 2003), empathy, and affiliate behaviours/social grooming (Craig, 2009).

6.1. *Model for ASMR and misophonia*

Drawing from ASMR research on misophonia, synaesthesia and functional connectedness, McGeoch and Rouw (2020) proposed that both ASMR and misophonia stem from synaesthetic cross-activations between the auditory cortex and parts of the brain related to homeostasis. They consider Craig's (2009, 2014) concept of the Global Emotional Moment, which states that inputs from various brain regions aggregate in the anterior insula cortex to form a representation of one's current emotional state. Using this model, McGeoch and Rouw (2020) contend that firings in the auditory cortex, which is housed adjacent to the insula, cross-activate with the anterior insula cortex to influence the global emotional moment. This can cause an intensely positive emotional moment, indicative of ASMR, or an intensely negative misophonic moment (McGeoch & Rouw, 2020).

As established by Smith et al. (2019b, 2020), individuals who are sensitive to ASMR tend to have less functional connectivity, which indicates that distributed neuronal networks and distinct brain regions could cross-activate to induce ASMR. McGeoch and Rouw's (2020) research team considered the valence theory of emotion; in that positive and negative emotions are lateralised to the left and right side of the brain respectively (Demaree et al., 2005). There is evidence the Autonomic Nervous System (ANS) is similarly lateralised (Craig, 2009, 2014), with the left insula implicated in parasympathetic activity, and sympathetic activity on the right (Oppenheimer et al., 1992). McGeoch and Rouw (2020) contend that, while activating both sides of the ANS (parasympathetic and sympathetic), ASMR likely involves an overall shift to the parasympathetic nervous system. Misophonia, conversely, involves an overall shift to the sympathetic nervous system.

6.2. *Electroencephalography studies*

Further neuropsychological work using electroencephalography (EEG) has expanded upon fMRI research pertaining to ASMR.

EEGs allow researchers to measure neural activity during specific cognitive functions, and track fluctuations at a greater speed (<1 s) than fMRI (Fredborg et al., 2021; Swart et al., 2022). Alpha power (8 – 13 Hz) is associated with the suppression of distractor stimuli (Foxe & Snyder, 2011; Jensen et al., 2002; Kelly et al., 2006), which, according to the alpha inhibition timing hypothesis, facilitates relaxed states by inhibiting disruptive stimuli or brain regions (Klimesch et al., 2007). Increased alpha is also associated with maintaining meditative states (Aftanas & Golocheikine, 2001) and relaxation (Niedermeyer, 1999). Alpha oscillations have been observed to increase in parietal, frontal, and temporal regions whilst viewing ASMR content (Fig. 4; Fredborg et al., 2021; Swart et al., 2022), providing support to the concept that ASMR is akin to a flow state. The inhibitory processes typical of increased alpha may also facilitate internally directed attention (Cooper et al., 2006; Magosso et al., 2019; Matsuoka et al., 2021), or the selection of relevant social cues, which may play a role in the perception of co-presence and sense of intimacy with the performers in ASMR videos (Symons et al., 2016; see Section 8 of this review). However, Engelbregt et al. (2022) found contrasting results, with EEG showing a decrease in alpha in subjects who experience tingles. Rather, they observed increases in beta oscillations (12 – 25 Hz) which they attributed to improved focused attention and immersion, as per previous research (Travis & Shear, 2010). Similarly, in addition to their findings on alpha activity Fredborg et al., (2021) also observed increased sensorimotor rhythm activity (12 – 15 Hz) specifically when participants experienced tingling sensations, which may also suggest increased focus attention. Gamma power (>30 Hz) was also observed to increase during moments of tingling.

Interpreting data on oscillatory power must be done with caution. While various studies have found that meditative states increase alpha power (Aftanas & Golocheikine, 2001; Huang & Lo, 2009; Dunn et al., 1999), some have demonstrated the opposite (Baijal & Narayanan, 2010; Cahn & Polich, 2006; Cahn et al., 2010; Travis & Wallis, 1999). When control conditions have been applied to account for general relaxation, these studies have found no changes or even decreases in alpha wave levels (Baijal & Narayanan, 2010; Cahn & Polich, 2006; Cahn et al., 2010; Travis & Wallis, 1999). Some neuroscience research has indicated that alpha waves are indicative of wakefulness, attention and task load (Klimesch, 1999; Strijkstra et al., 2000). While this may detract from Fredborg's (2021) findings, it is indicative of the complex, focused attention that is required for ASMR to be induced in participants.

7. Attentional concepts of ASMR

The relaxing and pleasurable elements of ASMR expand beyond just the transient moments of tingling. Researchers have explored whether experiencing ASMR could be considered an altered state of consciousness, wherein the individual enters a trance-like state of pleasurable absorption, which could potentially aid the induction of ASMR tingles (Roberts et al., 2019). Indeed, when making the ASMR-15, a scale assessing ASMR sensitivity, factor analysis identified a sub factor which pertained to altered states of consciousness (Roberts et al., 2019). This factor included items such as 'It feels as though I have slipped into a hypnotic, trance-like state' and 'I experience time distortions'. Various altered states of consciousness and concepts of alertness that overlap with characteristics of ASMR are discussed.

7.1. Mindfulness

Mindfulness involves a non-judgemental, present moment awareness of one's own thoughts and feelings (Bishop et al., 2004), and is known to produce positive physiological effects such as stress reduction and sleep improvement (Gu et al., 2015). With ASMR's proposed benefits including the aforementioned physiological effects (Barratt & Davis, 2015), researchers have drawn links between the two (del Campo, 2019; Fredborg et al., 2018; Scofield, 2019). The increased sensitivity to external stimuli resultant from trait mindfulness (trait mindfulness being an individual's propensity to engage in mindfulness; Harrison and Clark, 2016) may aid the induction of ASMR (del Campo, 2019). Alternatively, a present focus on external stimuli and one's sensorial response to it may induce a meditative state of relaxation (Fredborg et al., 2018; Scofield, 2019). Positive correlations have been found between ASMR sensitivity and overall mindfulness scale scores (Fredborg et al., 2018) as well as the mindfulness sub-factors, *observing* (del Campo, 2019; Scofield, 2019) and *curiosity* (Fredborg et al., 2018). Observing describes the level to which one notices and attends to experiences

Fig. 4. General areas of activation in ASMR when compared with control participants during ASMR audio. (From Freborg et al., 2021).

(Baer et al., 2006). While these correlations were significant, other aspects of mindfulness, such as a lack of judgement of one's inner experience, and non-reactivity to one's inner experience, were not significantly correlated with ASMR, and were negatively correlated with misophonia (Scofield, 2019). Additionally, Roberts et al. (2021) found a negative correlation between a mindfulness scale and the ASMR-15 scale, proposing instead that trait mindfulness is incompatible with the absorption aspects of ASMR (see Section 7.2). This indicates that ASMR tends to involve high present-moment awareness with intense observation and external curiosity, but lacks the detached, third-person perspective that often occurs in mindfulness practices.

7.2. The flow state

Other research has indicated that experiencing ASMR is much like Csikszentmihalyi's flow state (1991). The flow state is defined as a state of focus wherein someone is completely immersed in an activity (Csikszentmihalyi, 1991) and is associated with optimal performance in sport and other activities (dos Santos et al., 2018; Swann et al., 2015). Non-active aspects of flow, such as the increased state of focus, greater presence, intrinsic reward and transformation of time (Nakamura & Csikszentmihalyi, 2009), are consistent with anecdotal reports (Barratt & Davis, 2015), neurophysiological aspects and personality correlates associated with ASMR (Janik McErlean & Osborne-Ford, 2020; Scofield, 2019). Those who reported susceptibility to a wider range of ASMR triggers were more likely to report greater flow experiences (Barratt & Davis, 2015). ASMR is associated with increased absorption and observing (Janik McErlean & Osborne-Ford, 2020; Scofield, 2019), and some EEG correlates of ASMR are consistent with flow experiences (Katahira et al., 2018), namely increased frontal theta and frontocentral alpha rhythms (Swart et al., 2022). Mindfulness and flow are in many ways antithetical, as mindfulness involves a high level of self-awareness, while flow describes a lack of perception of self and surroundings (Janik McErlean & Osborne-Ford, 2020; Roberts et al., 2021). Some researchers have found reason to consider the two experientially incompatible (Sheldon et al., 2015). Fredborg et al. (2020) suggest that ASMR is a heterogeneous phenomenon. While some experience ASMR with high present-moment awareness, with a mindful focus on the sounds and visuals created in ASMR, others may find it a less engaging, more relaxing phenomenon. Perhaps those who experience ASMR mindfully do so less with the intention to emotionally connect with the stimuli, but rather focus on the sounds and their sensory effect on the body, whilst those who enter flow become engaged with the media on a personal level, where they feel connected to the ASMRtist who created the video or the goings-on within the video. Alternatively, a side-effect of the ASMR itself could induce a state of mindful observation.

7.3. Arousing relaxation

While ASMR is broadly defined as a relaxing phenomenon, research suggests it also has physiological markers of an arousal response. In addition to the sensorial tingling, findings (Poerio et al., 2018) also show that ASMR increases skin conductance and pupil dilation (Valtakari, 2019), suggesting arousal. However, concurrent findings (Engelbregt et al., 2022; Poerio et al., 2018) also show reduced heart rate, which is typically indicative of a relaxation response. This paradoxical blending of arousal and relaxation is physiologically possible (Croft et al., 2004; Crone et al., 2004) and suggests that ASMR is a unique and complex sensation that involves activations of multiple brain regions, such as the parasympathetic nervous system, sympathetic nervous system, and brain regions associated with emotion. Such observations also support McGeoch and Rouw's (2020) theory that cross-activation occurs within the brain; however, those authors posited that there is greater activity in the parasympathetic NS, producing what is overall a relaxing response. Poerio et al. (2018) argued that this arousing relaxation indicates a complex emotional response involved with ASMR (see the following section for further discussion of this point). Notably, no study has published findings on heart rate variability (HRV), which is a useful measure of ANS activity (Sztajzel, 2004; Taelman et al., 2009) that could further illuminate how ASMR interacts with both the parasympathetic and sympathetic nervous system. It is predicted that ASMR would cause a decreased HRV, as findings suggest HRV increases during stress (Kim et al., 2018). Engelbregt et al. (2022) suggest that this unique NS response could be explained by directional fractionation, which describes the phenomenon of the simultaneous increase in sympathetic and parasympathetic activation which accompanies attention to the external environment (Libby et al., 1973). As attention-interest increased in participants who were shown 30 images of varying attractivity, increased pupillary dilation and decreased heart rate was observed (Libby et al., 1973).

The attentional aspects of ASMR point to an overall increase in focused attention, as supported by EEG findings (Engelbregt et al., 2022; Fredborg et al., 2021; Swart et al., 2022) and personality correlates relating to absorption and observing (Janik McErlean & Osborne-Ford, 2020; Scofield, 2019). Curiously however, Engelbregt et al. (2022) found no significant differences on attention between ASMR and control conditions via the Eriksen Flanker Test (Eriksen & Eriksen, 1974). Researchers suspect this may have been due to a ceiling effect, as the average score was near the maximum. They suggest future research implements a more difficult test of attention.

Further research into alertness variability, such as phasic alertness and tonic alertness may aid understanding with how ASMR could involve an unusual blend of focused attention, relaxation, and arousal. Phasic alertness involves a temporary high capacity to react to stimuli and activates the sympathetic nervous system (Amihai & Kozhevnikov, 2014; Sturm et al., 1999; Weinbach & Henik, 2011). Tonic alertness describes an optimal state of vigilance which lasts for an extended period of time and is known to co-occur with relaxation (Britton et al., 2014; Posner, 2008; Sturm et al., 1999). Tonic alertness is correlated with activation of the parasympathetic nervous system and has been shown to occur during some forms of Buddhist meditation (Amihai & Kozhevnikov, 2014, Britton et al., 2014). ASMR fits the profile of tonic alertness, involving parasympathetic activity and relaxation. Alternatively, ASMR may involve a unique form of alertness that combines aspects of phasic and tonic alertness.

8. Co-presence, emotional complexity, social grooming, sexuality

ASMR content often constructs a sense of co-presence, which may help immerse viewers and increase the induction of tingles (Zappavigna, 2020). Co-presence, or social presence, refers to the sensation of being with others in physical and digital contexts (Zhao, 2003), to an extent that one relates attentionally, emotionally and behaviourally with another party (Campos-Castillo & Hitlin, 2013). In the context of digital spaces, and thus ASMR content, this relates to the feeling that one is both perceiving and being perceived by the other party, despite not actually interacting (Zappavigna, 2020).

A popular form of ASMR video is a roleplay, in which an actor plays a character that seemingly interacts with the viewer by talking directly into the camera (Ahuja, 2013). Roleplays typically occur in staged clinical settings, such as a doctor performing an examination, or a hairdresser performing a haircut (Ahuja, 2013; Ahuja & Ahuja, 2019; Zappavigna, 2020). They can also be staged as more intimate interactions, such as roleplaying as the viewer's significant other. These pre-recorded videos elicit digital intimacy and co-presence through intentional uses of language, visuals and audio that make the viewer feel involved and immersed (Zappavigna, 2020). Interactional context is produced by acknowledging the viewer's presence and greeting them, while adding in pauses for the viewer to theoretically respond. Conversational and interpersonal tones are reinforced with responses such as 'mmhmm' and 'yes'. Close personal attention is elicited by the performer standing close to the camera and interacting with microphones as if they are a part of the viewer's body. This serves to illicit mirror touch synaesthesia, which commonly occurs in ASMR users (Gillmeister et al., 2022). These videos often use binaural audio that mimics human hearing. That is, there are two microphones that are lateralised to the left and right side, and localised to each ear. This aims to bring the viewer into the environment of the video.

Its clear association with co-presence suggests that ASMR is more than an isolated physiological response and features cognitive constructs involving at least some degree of social consciousness. Lochte et al. (2018) and Poerio et al. (2018) suggested that ASMR may simulate a form of social grooming or affiliate behaviours. Social grooming occurs in animals such as birds, apes and humans, where social bonds are built by cleaning or maintaining fellow species' appearance (Dunbar, 2010; Henazi & Barrett, 1999; Kenny et al., 2017). Social grooming is an example of an affiliate behaviour, which facilitates well-being through the release of endorphins and neuropeptides (Dunbar, 2010; Feldman, 2012). Social learning theory (Bandura, 1977) may play a role in future research that is yet to examine whether the neuropeptides and endorphins released during these behaviours are also released during ASMR.

8.1. Complex emotional response

Additionally, Poerio et al. (2018) suggested that ASMR involves a mixed or complex emotional response that activates multiple parts of the brain that would not otherwise typically be active together (Berrios et al., 2015). Experiences such as nostalgia or frisson, which involve both happiness and sadness (Benedek & Kaernbach, 2011; Blood & Zatorre, 2001; Wildschut, Sedikides, Arndt, & Routledge, 2006), are examples of mixed emotional responses, and are consistent with the physiological profile of ASMR (Poerio et al., 2018). That is, these experiences are not strictly lateralised to the parasympathetic or sympathetic nervous system, but involve concurrent arousing and relaxing responses (Berrios et al., 2015).

8.2. Sexuality in ASMR

Colloquial understanding of ASMR often differs from scientific and academic work done in the field. Not only are ascribed definitions different, but so too are public perceptions. For example, a prevalent belief that ASMR is not only pseudoscientific, but also sexual in nature, persists (Brand, 2015; Waldron, 2017). This threatens the legitimisation of ASMR as a physiologically and psychologically affecting sensation. Many ASMR studies are concerned with the proliferation of myths about ASMR and report data to challenge them; for example, including questionnaire-based responses indicating that most ASMR listeners do not engage with ASMR for sexual stimulation (Barratt et al., 2017), or that most ASMR creators do not intend their work to be sexual (Starr et al., 2020). Starr et al. (2020) consider the role of 'sensuality' in ASMR, defined by pleasurable stimulation of senses that can include sexual phenomena, but more broadly encompasses non-sexual phenomena (see Heathwood, 2007). Research alternatively suggests that ASMR is typically used for stress and anxiety relief, falling asleep, and general relaxation (Barratt & Davis, 2015, Poerio et al., 2018). This is supported by data which show reductions in Beck Depression Inventory (BDI; Beck et al., 1996) scores post viewing ASMR (Barratt & Davis, 2015). ASMR has also been found to improve sleep patterns, with an intervention resulting in 66 % of participants reporting good night sleeps after 7 days (Wang & Li, 2020).

While ASMR grew in popularity on platforms such as YouTube (Google, CA, USA) with long-form content, short-form ASMR content is becoming increasingly abundant on platforms such as Instagram (Meta, USA) and, more recently, Tik Tok (ByteDance, China). Additionally, live ASMR on streaming services such as Twitch.tv has also grown in popularity, wherein sexually-charged ASMR is widespread. Much of this sexual ASMR lacks the characteristics of conventional ASMR. Rather, it involves performance of implicitly erotic acts under the guise of ASMR to circumvent many sites' terms of service, which ban sexually-explicit content (Starr et al., 2020). Such occurrence was frequent in China, with the false use of ASMR terminology applied to circumvent the nationwide ban of pornography. This resulted in the Chinese government banning ASMR in 2018 due to the rise in 'vulgar' ASMR content (SHDF, 2018). Similar scrutiny has occurred on YouTube, with some ASMR channels losing the ability to earn advertising revenue due to the videos being labelled inappropriate (Blue, 2018).

In wake of the ASMR ban in China, Starr et al. (2020) conducted a content analysis of Chinese ASMR performances. They argued that Sexual ASMR (S-ASMR), is a different medium to conventional ASMR, given the array of different production techniques, linguistic choices and affective stances employed. Visually, S-ASMR videos utilise downcast framing to highlight the performer's body,

conforming to the notion of the male gaze (see Mulvey, 1975). Performers recline in their seats to show as much of their bodies as possible or lean forward to accentuate bared cleavage. S-ASMRtist's clothing often harkens to anime culture (Galbraith, 2011), with sleeveless tops bearing cleavage and short skirts that expose legs.

S-ASMR content also lacks auditory elements common to ASMR. Starr et al. (2020) found a lack of tapping, whispering, slow hand movements and soft speaking. Much more common were mouth sounds such as kissing, eating and breathing. As established, these sounds are divisive in the ASMR community, and seemingly serve to imply oral sex more than to induce a tingling sensation (Starr et al., 2020). Licking sounds are often paired with exaggerated facial expressions evocative of *ahegao*, an expression found in Japanese anime pornography, *hentai*, showing intense pleasure. These characteristics are present in the most popular ASMR twitch streamers today, such as Amaranth, who won 'Best ASMR Streamer' award for her popular ASMR Streams in 2021 (The Streamer Awards, 2022). The existence of this S-ASMR content misrepresents what conventional ASMR involves and threatens to delegitimise it. Thus, a more formal definition and understanding of ASMR is needed. Ultimately, ASMR content offers a versatile performance medium which can be utilised for a variety of genres, ranging from clinical roleplays, relaxation videos, to intimate and sexual content, when adopted appropriately. It is important to demarcate between therapeutically-beneficial ASMR and material that appears to use (limited) elements of ASMR for the explicit sensationalisation or sextualisation of content.

As scholars have observed with emergent integrative praxis in the fields of virtual reality assisted psychotherapy, telehealth, and other burgeoning platforms that cultivate the strengths of modern telecommunications, ASMR is well-placed as a versatile, short-form, and anecdotally effective model that may either complement or supplement certain psychotherapeutic modalities. For instance, roleplay/personal attention/intimate ASMR has promising potential to aid clients struggling with intimacy, or for couples therapy. The feelings of connectedness strengthened during ASMR may counter the negative effects of loneliness and improve well-being (Holt-Lunstad et al., 2015; Poerio et al., 2018). Finally, the medium also has potential in non-related legitimate disciplines of practice, such as marketing, advertising, and teaching (Bogueva & Marinova, 2020; Chae et al., 2021; Spence, 2020).

9. The role of expectancy, placebo, and context

Because there has been little progress in clinical trials on the impact of ASMR, there is scepticism surrounding its validity (Brand, 2015; Cash et al., 2018). If ASMR experiences and frisson experiences are indeed the result of predominantly expectancy effects, or placebo, the validity of ASMR as a potentially therapeutically beneficial medium is diminished. Cash et al. (2018) conducted a study on ASMR users and non-ASMR users to determine if ASMR was elicited because of expectation. Participants were shown 3 types of clips: 1) ASMR-inducing content, denoted 'ASMR', 2) content that exhibited a passing similarity to ASMR, but lacked core characteristics, thus, should not induce ASMR, denoted 'foil', 3) a control clip of technological music, denoted 'music'. Prior to viewing, participants received instructions that aimed to skew their expectations: One group had instructions that suggested all the clips would induce ASMR (encouraging), while the other group's instructions suggested none of the clips would induce ASMR (discouraging).

The findings showed that non-ASMR users were susceptible to expectancy effects, but ASMR users were not (Cash et al., 2018). ASMR ratings did not significantly differ between encouraging and discouraging groups for ASMR users. ASMR users also reported significantly higher ASMR ratings for the ASMR clips than the music and foil clips. In ASMR sensitive individuals, ASMR clips induced ASMR regardless of the priming that was provided. Cash et al. (2018) interpreted these results by suggesting that ASMR is indeed the result of expectancy effects and is such for both naïve participants and ASMR users. They suggest that ASMR users were unaffected by the experimental manipulation because their personal expectations overrode the experimental expectations. They argue these personal expectations are evident in the uniquely low scores ASMR users reported for the music and foil clips, which were lower than the non-ASMR users. As Hostler et al. (2019) identify in their commentary on Cash et al.'s (2018) study, this is not a parsimonious explanation. The consistently low scores that ASMR users rated the foil and music clips cannot explain how high ASMR scores were caused by pre-existing expectation.

While it may be the case that ASMR users had predisposed schemas regarding what ASMR videos entail, this was not addressed in the study design, and thus such a conclusion is speculative. The expectancy manipulation—telling participants the media will or will not induce ASMR—is a poor test of the expectancy hypothesis, as this is unlikely to change the expectations of individuals who are already familiar with ASMR. This presents a difficulty with designing placebo studies on ASMR. Frequent users of ASMR are likely to have ASMR schemas, whereas those who are unfamiliar will not. Future studies could consider performing a similar study design on only naïve participants, which would remove the influence of ASMR schemas. As Hostler et al. (2019) note, this would require a thorough explanation of ASMR to these participants, to ensure they have the 'perceptual expertise' to understand and identify ASMR, and not conflate ASMR with other sensations such as frisson. A truly naïve viewing of ASMR would likely yield meaningless results, as participants would not understand what ASMR is or how it is induced. Hostler et al., (2019) instead argue that Cash et al.'s (2018) experiment speaks to the veracity of ASMR, because ASMR users consistently reported high ASMR induction from the ASMR clips, regardless of the experimental manipulation. However, this does not explain why naïve participants were influenced by the expectancy manipulations.

Certainly, when analysing the impact of digital mediums such as ASMR videos, the role of placebo is highly intwined in the experience. Ahuja and Ahuja (2019) argue that is it an impossible task to untangle ASMR from placebo. They point to definitions of placebo that describe positive health outcomes from the "identifiable healthcare paraphernalia and settings, emotional and cognitive engagement with clinicians, empathetic and intimate witnessing, and the laying on the hands", which lacks any medicinal intervention. They argue that ASMR videos, specifically medical-based roleplay videos (faux doctor visits, eye exams), inherently have these characteristics of a placebo. That is, the simulation of medical settings that exists in ASMR roleplay videos aims to reap the benefits of the medical encounter without the clinical substance. They contest that study designs that aim to create control videos, that

mimic ASMR but lack its core elements, is like 'simulating an intervention that is itself a simulation'. Ahuja and Ahuja's (2019) arguments relate specifically to ASMR videos that involve a medical roleplay, not to the broader concept of ASMR media. Numerous studies have aimed to tease apart the aesthetic and auditory qualities of ASMR videos (Daniels, 2022; Gallagher, 2016; Kovacevich & Huron, 2019; Vucic, 2020), and the specific triggers that commonly induce ASMR. To create a ASMR 'foil' for an experimental study, these aesthetic qualities could be adopted, whilst lacking specific ASMR triggers or the audio qualities, such as oral wetness, audio roaming, and low syllabic rate (Kovacevich & Huron, 2019). The question remains whether simulating an ASMR video simply leads to the creation of an ASMR video: A simulation of ASMR could still induce ASMR.

A possible solution could be the use of unintentional ASMR, a genre of ASMR video which takes scenes from television, films, and real-life recordings such as medical exams or painting tutorials that possess characteristics of ASMR. These videos are not expressly ASMR, though the characteristics (quiet speaking, proximity, close personal attention) still induce ASMR to some viewers. Unintentional ASMR could be used in addition to control and 'foil' videos in an experimental study design. These videos may be more susceptible to expectancy manipulations because they are not intended to be ASMR and would not align with some ASMR schemas. This could aid in determining if some ASMR users are more influenced by expectancy effects than others.

The discussion of placebo in ASMR is highly complex and involves numerous factors such as schemas, context, personal preference, subject bias, and the difficulty in producing 'foil' ASMR. Some studies have yielded positive results with open label placebo trials (Kaptchuk et al., 2010) – suggesting that the influence of placebo on clinical interventions should not be viewed as a detriment to effectiveness. It is likely that ASMR is impacted by expectancy and placebo in a similar way to many established medical interventions. Common interventions such as SSRIs are known to be effective in part due to placebo (Kirsch, 2014, 2019). Further research is necessary to determine what role placebo and expectancy plays in ASMR. We assert that ASMR is a physiologically effecting phenomenon with neurological underpinnings, that is augmented by factors such as placebo and expectancy.

9.1. Context

While Cash et al. (2018) were unable to parsimoniously prove that ASMR users had pre-existing expectations, this consideration should not be objected outright: There is merit to the idea that how individuals interpret external stimuli, specifically sounds, can be influenced by their expectations and conceptual understanding. Research on the restorative power of natural sounds, such as rain, chirping birds and rustling wind, is well documented (Benfield, et al., 2010; Benfield et al., 2014; Benfield et al., 2014; Ulrich, 1981, 1984; Ulrich et al., 1991; See Biophilia; Fromm, 1964), however some evidence suggests these benefits are impacted by expectancy. Van Hedger et al. (2019) observed that nature sounds were only preferred over urban sounds if they were easily associated with nature. Ambiguous nature sounds, on the other hand, were less favourable than urban sounds. Another study found ambiguous sounds were rated higher if participants were told these originated from a waterfall, as opposed to a machine (Haga et al., 2016). This suggests that a semantic judgement is involved in the interpretation of these sounds, contrary to popular belief that humans' affinity for natural sounds is innate (see Stress Reduction Theory; Ulrich, 1983). A similar case may exist with ASMR, wherein the triggers that are intentionally produced in an ASMR video are judged differently than similar sounds that occur naturalistically in real life. A classic example of this is chewing or mouth sounds, such as lip smacking, loud swallowing or heavy breathing, which are relaxing when observed in an ASMR video, but misophonic when heard in real life.

Knowledge that the triggers are being produced intentionally from a video, as opposed to naturally in real life, may change one's interpretation. Similar instances of contextual information changing aesthetic judgement exist in music and visual art, such as unpleasant sounds being perceived positively in the context of contemporary music (Reuter & Oehler, 2011), or a painting gaining poignancy upon learning about the artist's circumstances at the time (Berger et al., 1972). Alternatively, the lack of control that a listener possesses when a trigger occurs naturalistically may result in frustration or discomfort. When an ASMR video is experienced, the type of triggers and the volume is decided by the viewer, thus a level of control and active participation is maintained, which may aid the induction of ASMR tingles. Additionally, findings suggest that loud environments such as bars are not conducive to experiencing ASMR, supporting the concept that context is an important factor (Barratt et al., 2017). Such contexts may preclude the ability to enter a state of immersion and focused attention which aids ASMR induction (Janik McErlean & Osborne-Ford, 2020).

The role of context could be explained by McGeoch and Rouw's (2020; see Section 6.1) theory that cross activations between the auditory cortex and the insula cause an intense emotional moment. Perhaps context influences whether the global emotional moment is perceived positively (ASMR) or negatively (misophonia). Potentially too, a state of mind akin to flow, immersion, or focused attention, may act as a precursor that allows cross activations to be interpreted positively, thus inducing ASMR rather than misophonia. This could explain why stimuli occurring in naturalistic contexts cause misophonia, where a state of flow is non-existent, but the same stimuli can induce ASMR when an individual is immersed in an ASMR video.

Furthermore, a positive correlation between preference for natural scenes and the perceived benefit of that environment has been observed. That is, those who think nature is restorative tend to enjoy it more (Purcell et al., 2001). This suggests that there is an element of expectation when interpreting sounds that are typically considered to be calming or restorative. This may too be the case with ASMR videos, which are typically interpreted as a therapeutic by regular listeners. These factors may also play into a sense of willingness to experience the sensation, as one may not experience ASMR tingles if they are not engaged or invested in the video and its potentially positive outcomes.

10. ASMR criteria

Having applied Roberts et al.'s (2019) insights that they applied to derive an ASMR-15 scale, we consider the following features

characteristic of all ASMR: 1) Sensation (Tingling), 2) Altered Consciousness, 3) Relaxation, 4) Positive Feelings; in addition to these, we also introduce the following two considerations based on this review, 5) Context, 6) Willingness to Experience Sensation.

First, sensation (tingling) corresponds to a pleasant tingling sensation which is present in all ASMR accounts. It often occurs around the spine but has been reported in other areas (Barratt & Davis, 2015; Roberts et al., 2019). Secondly, altered consciousness, which captures the propensity to deviate from regular waking function when experiencing ASMR, including shifts in awareness and perception such as time distortion (Roberts et al., 2019). Studies have indicated this is likely a flow state, although such a state may vary between individuals, potentially being more like a mindfulness state; as mentioned earlier, a combination of different states might come about. Next, a marked presence of relaxation and change in affect (positive feelings). ASMR characteristically results in positive feelings (Ahuja, 2013), whether a sense of calm, satisfaction, aesthetic pleasure, or engagement. Without these positive feelings, ASMR may be miscategorised as a form of paraesthesia.

Although no scientific research has been conducted as of writing, we believe context and willingness is key in experiencing ASMR. Survey research has indicated individuals are less likely to experience ASMR in noisy or stressful environments (Barratt et al., 2017), which may impact the ability to enter an altered state of consciousness demarcated by focused attention and immersion (see Appendix 1). Additionally, the common discourse within the ASMR community that some triggers, such as mouth sounds, can be relaxing in the context of an ASMR video, but misophonic in other contexts indicates that context influences ASMR induction. Drawing from findings on ambigious nature sounds (Purcell et al., 2001; Van Hedger et al., 2019), we assert that predisposed beliefs influence how individuals experience external stimuli, and thus how ASMR is induced. The willingness to experience ASMR and the belief in its veracity may also influence how affective and effective it is for individuals.

ASMR represents a unique sensory experience that entails a blend of arousal, relaxation, alertness and emotional connection, which can produce positive feelings, increases in alpha brain activity, reduced heart rate, increased skin conductance and pupil dilation (Barratt & Davis, 2015; Engelbregt et al., 2022; Fredborg et al., 2021; Poerio et al., 2018; Valtakari, 2019). Those who experience the sensation tend to have reduced functional connectivity within resting state networks, suggesting less compartmentalisation within the brain. This may result in cross activations between typically disconnected brain regions (Smith et al., 2019b). Theories posit that the pleasant sensation and positive feelings associated with ASMR may result from a cross-activation between the auditory cortex and the autonomous nervous system, producing a positively valanced homeostatic reaction (McGeoch & Rouw, 2020).

While ASMR is broadly considered a relaxing phenomenon, research indicates it is a more complex and engaging sensation, involving emotional compartments of the brain, and engaging brain regions associated with arousal as well as relaxation. That unique combination of factors illustrates that ASMR involves a level of focused attention, sympathetic activation, and emotional connectedness not found in a typical relaxation response. The core aspects involved in an ASMR response have been extensively canvassed here, and avenues for future research have been put forth, especially the role of context in experiencing ASMR and/or interrelated sensory phenomena. Future research may also examine the release of social grooming neuropeptides during ASMR. ASMR content as performance medium shows promise in a therapeutic setting, with potential use for building emotional connection, loneliness treatment, and couples' therapy. Considering this early work, it would be interesting for the academic community to validate ASMR as a scientifically based sensation with a broad range of potential implications in psychotherapy and social cognition.

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There is no direct/original data used in this theoretical work

Comments Regarding the Importance of Context in ASMR.

Diya (2021). *When my cousin does this mouth sounds.. Me: Eyy stop it disgustin.. Frivolous fox: nom nom nomm. Me: oo it s Satisfying.* [Comment on the video ASMR Ear Licking ~ Extreme Mouth Sounds for Tingle Immunity]. YouTube. https://www.youtube.com/watch?vˆ -BdSCcmJKJk.

Orfgorf. (2020, January 28). *I HATE mouth sounds, chewing ect… but for some reason ASMR is enjoyable.* Reddit. https://www.reddit.com/r/misophonia/comments/ev515f/i_hate_mouth_sounds_chewing_ect_but_for_some/.

perk1444. (2020, January 29). *Just as another someone else mentioned, I think context matters a lot.* [Comment on forum post I HATE mouth sounds, chewing ect… but for some reason ASMR is enjoyable]. Reddit. https://www.reddit.com/r/misophonia/comments/ev515f/i_hate_mouth_sounds_chewing_ect_but_for_some/.

Tyla Mchugh (2019). *It s weird that I can t stand people chewing loudly irl but when I m trying to sleep I m like haha yes more more.* [Comment on the video [ASMR] Sensitive, Breathy & Wet Mouth (smiley)1F61B Sounds ~]. Youtube. https://www.youtube.com/watch?vˆ 4CyDFA5IO9U.

Acunzo, D., Cardena, E., & Terhune, D. B. (2020). Anomalous experiences are more prevalent among highly suggestible individuals who are also highly dissociative. *Cognitive Neuropsychiatry, 25*(3), 179–189. https://doi.org/10.1080/13546805.2020.1715932
Aftanas, L. I., & Golocheikine, S. A. (2001). Human anterior and frontal midline theta and lower alpha reflect emotionally positive state and internalized attention: High-resolution EEG investigation of meditation. *Neuroscience Letters, 310*, 57–60. https://doi.org/10.1016/s0304-3940(01)02094-8
Ahuja, N. K. (2013). It feels good to be measured: Clinical role-play, Walker Percy, and the tingles. *Perspectives in Biology and Medicine, 56*, 442–451.
Ahuja, A., & Ahuja, N. K. (2019). Clinical role-play in autonomous sensory meridian response (ASMR) videos: Performance and placebo in the digital era. *Jama, 321* (14), 1336–1337. https://doi.org/10.1001/jama.2019.2302
Amihai, I., & Kozhevnikov, M. (2014). Arousal vs. relaxation: A comparison of the neurophysiological and cognitive correlates of Vajrayana and Theravada meditative practices. *PloS one, 9*(7), e102990.
Andersen, J. (2014). Now you've got the shiveries: Affect, intimacy, and the ASMR whisper community. *Television New Media, 16*(8), 683–700. https://doi.org/10.1177/1527476414556184
Aron, E. N., & Aron, A. (1997). Sensory-processing sensitivity and its relation to introversion and emotionality. *Journal of personality and social psychology, 73*(2), 345. DOI: 0022-3514/97/S3.00.
Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*(1), 27–45. https://doi.org/10.1177/1073191105283504
Baijal, S., & Srinivasan, N. (2010). Theta activity and meditative states: Spectral changes during concentrative meditation. *Cognitive processing, 11*(1), 31–38. https://doi.org/10.1007/s10339-009-0272-0
Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.
Banissy, M. J., Cassell, J. E., Fitzpatrick, S., Ward, J., Walsh, V. X., & Muggleton, N. G. (2012). Increased positive and disorganised schizotypy in synaesthetes who experience colour from letters and tones. *Cortex, 48*(8), 1085–1087. https://doi.org/10.1016/j.cortex.2011.06.009
Banissy, M. J., Holle, H., Cassell, J., Annett, L., Tsakanikos, E., Walsh, V., et al. (2013). Personality traits in people with synaesthesia: Do synaesthetes have an atypical personality profile? *Personality and Individual Differences, 54*(7), 828–831. https://doi.org/10.1016/j.paid.2012.12.018
Bannister, S. (2019). Distinct varieties of aesthetic chills in response to multimedia. *PloS one, 14*(11), e0224974.
Barratt, E. L., & Davis, N. J. (2015). Autonomous Sensory Meridian Response (ASMR): A flow-like mental state (No. e719v1). *PeerJ, 3*, e851.
Barratt, E. L., Spence, C., & Davis, N. J. (2017). Sensory determinants of the autonomous sensory meridian response (ASMR): Understanding the triggers. *PeerJ, 5,* Article e3846. https://doi.org/10.7717/peerj.3846.
Beck, A. T., Steer, R. A., & Brown, G. (1996). Beck depression inventory–II. *Psychological Assessment*.
Benedek, M., & Kaernbach, C. (2011). Physiological correlates and emotional specificity of human piloerection. *Biological psychology, 86*(3), 320–329. https://doi.org/10.1016/j.biopsycho.2010.12.012
Benfield, J. A., Bell, P. A., Troup, L. J., & Soderstrom, N. C. (2010). Does anthropogenic noise in national parks impair memory? *Environment and Behavior, 42*, 693–706. https://doi-org.ezproxy.lib.rmit.edu.au/10.1177/0013916509351219.
Benfield, J. A., Taff, B. D., Newman, P., & Smyth, J. (2014). *Natural sound facilitates mood recovery. Ecopsychology, 6*(3), 183–188. https://doi.org/10.1089/eco.2014.0028
Benfield, J. A., Rainbolt, G. A., Bell, P. A., & Donovan, G. (2014). Classrooms with nature views: Evidence of differing student perceptions and behaviors. *Environment and Behavior, 47*(2), 140–157. https://doi.org/10.1177/0013916513499583
Berger, J., Blomberg, S., Fox, C., Dibb, M., & Hollis, R. (1972). *Ways of Seeing*. British Broadcasting Corporation and Penguin Books.
Berrios, R., Totterdell, P., & Kellett, S. (2015). Eliciting mixed emotions: A meta-analysis comparing models, types, and measures. *Frontiers in psychology, 6*, 428. https://doi.org/10.3389/fpsyg.2015.00428
Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., et al. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*, 230–241. https://doi.org/10.1093/clipsy.bph077
Blood, A. J., & Zatorre, R. J. (2001). Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. *Proceedings of the National Academy of Sciences, 98*, 11818–11823. https://doi.org/10.1073/pnas.191355898
Blue, V. (2018). Why PayPal's crackdown on ASMR creators should worry you. *Engadget*. https://www.engadget.com/2018-09-14-paypal-ban-asmr-sound-art-therapy.html.
Bogueva, D., & Marinova, D. (2020). Autonomous Sensory Meridian Response (ASMR) for Responding to Climate Change. *Sustainability, 12*(17), 6947. https://doi.org/10.3390/su12176947
Booth, C., Standage, H., & Fox, E. (2015). Sensory-processing sensitivity moderates the association between childhood experiences and adult life satisfaction. *Personality and individual differences, 87*, 24–29. https://doi.org/10.1016/j.paid.2015.07.020
Boterberg, S., & Warreyn, P. (2016). Making sense of it all: The impact of sensory processing sensitivity on daily functioning of children. *Personality and Individual Differences, 92*, 80–86. https://doi.org/10.1016/j.paid.2015.12.022
Brand R. (2015, April 15) *Is ASMR Just Female Porn? Russell Brand The Trews (E298)* [Video] YouTube. https://www.youtube.com/watch?vˆ 0wUFCyjsNGk www.russellbrand.com.
Britton, W. B., Lindahl, J. R., Cahn, B. R., Davis, J. H., & Goldman, R. E. (2014). Awakening is not a metaphor: The effects of Buddhist meditation practices on basic wakefulness. *Annals of the New York Academy of Sciences, 1307*(1), 64–81. https://doi.org/10.1111/nyas.12279
Brout, J. J., Edelstein, M., Erfanian, M., Mannino, M., Miller, L. J., Rouw, R., et al. (2018). Investigating misophonia: A review of the empirical literature, clinical implications, and a research agenda. *Frontiers in Neuroscience, 36*. https://doi.org/10.3389/fnins.2018.00036
Buckner, R., Andrews-Hanna, J., & Schacter, D. (2008). The Brain's Default Network: Anatomy, Function, and Relevance to Disease. *Annals of the New York Academy of Sciences, 1124*(1), 1–38. https://doi.org/10.1196/annals.1440.011
Cahn, B. R., & Polich, J. (2006). Meditation states and traits: EEG, ERP, and neuroimaging studies. *Psychological bulletin, 132*(2), 180. https://doi.org/10.1037/0033-2909.132.2.180
Cahn, B. R., Delorme, A., & Polich, J. (2010). Occipital gamma activation during Vipassana meditation. *Cogn Process, 11*, 39–56. https://doi.org/10.1007/s10339-009-0352-1
Campos-Castillo, C., & Hitlin, S. (2013). Copresence: Revisiting a building block for social interaction theories. *Sociological Theory, 31*(2), 168–192. https://doi.org/10.1177/0735275113489811
Cash, D. K., Heisick, L. L., & Papesh, M. H. (2018). Expectancy effects in the autonomous sensory meridian response. *PeerJ, 6*, e5229.
Chae, H., Baek, M., Jang, H., & Sung, S. (2021). Storyscaping in fashion brand using commitment and nostalgia based on ASMR marketing. *Journal of Business Research, 130*, 462–472. https://doi.org/10.1016/j.jbusres.2020.01.004
Chun, C. A., & Hupe, J. M. (2016). Are synesthetes exceptional beyond their synesthetic associations? A systematic comparison of creativity, personality, cognition, and mental imagery in synesthetes and controls. *British Journal of Psychology, 107*(3), 397–418. https://doi.org/10.1111/bjop.12146
Collins, S. T. (2012). *September 10)*. Buzzfeed: Why music gives you the chills. http://www.buzzfeed.com/theseantcollins/why-music-gives-you-the-chills-7ahd.
Colver, M. C., & El-Alayli, A. (2016). Getting aesthetic chills from music: The connection between openness to experience and frisson. *Psychology of Music, 44*(3), 413–427. https://doi.org/10.1177/0305735615572358
Cooper, N. R., Burgess, A. P., Croft, R. J., & Gruzelier, J. H. (2006). Investigating evoked and induced electroencephalogram activity in task-related alpha power increases during an internally directed attention task. *Neuroreport, 17*(2), 205e208.
Costa, P. T., & McCrae, R. R. (1992). The five-factor model of personality and its relevance to personality disorders. *Journal of Personality Disorders, 6*(4), 343–359. https://doi.org/10.1521/pedi.1992.6.4.343

Craig, A. D. (2003). Interoception: The sense of the physiological condition of the body. *Current opinion in neurobiology, 13*(4), 500–505. https://doi.org/10.1016/S0959-4388(03)00090-4
Craig, A. D. (2009). How do you feel—now? The anterior insula and human awareness. *Nature reviews neuroscience, 10*(1), 59–70. https://doi.org/10.1038/nrn2555
Craig, A. D. (2014). *How Do You Feel? An interoceptive moment with your neurobiological self*. Princeton: Princeton University Press.
Croft, R. J., Gonsalvez, C. J., Gander, J., Lechem, L., & Barry, R. J. (2004). Differential relations between heart rate and skin conductance, and public speaking anxiety. *Journal of behavior therapy and experimental psychiatry, 35*(3), 259–271. https://doi.org/10.1016/j.jbtep.2004.04.012
Crone, E. A., Somsen, R. J., Beek, B. V., & Van Der Molen, M. W. (2004). Heart rate and skin conductance analysis of antecendents and consequences of decision making. *Psychophysiology, 41*(4), 531–540. https://doi.org/10.1111/j.1469-8986.2004.00197.x
Csikszentmihalyi, M. (1991). *Flow: The psychology of optimal experience In*. New York: HarperPerennial.
Cytowic, R. E., & Eagleman, D. M. (2011). *Wednesday is indigo blue: Discovering the brain of synesthesia*. Mit Press.
Daniels, A. (2022). No Tingles for You: An Investigation of the Auditory Stimulus Qualities that Elicit AVES (ASMR).
Davis, M. H. (1980). A multi-dimensional approach to individual differences in empathy. *JCAS Catalog of Selected Documents in Psychology, 75*, 989–1015.
del Campo, M. A., & Kehle, T. J. (2016). Autonomous Sensory Meridian Response (ASMR) and Frisson: Mindfully Induced Sensory Phenomena That Promote Happiness. *International Journal of School Educational Psychology, 4*(2), 99–105. https://doi.org/10.1080/21683603.2016.1130582
del Campo, M. A. (2019). An Examination of Relationships between Autonomous Sensory Meridian Response (ASMR) and Facets of Mindfulness. *Doctoral Dissertations, 2351*. https://opencommons.uconn.edu/dissertations/2351.
Demaree, H. A., Everhart, D. E., Youngstrom, E. A., & Harrison, D. W. (2005). Brain lateralization of emotional processing: Historical roots and a future incorporating "dominance". *Behavioral and cognitive neuroscience reviews, 4*(1), 3–20. https://doi.org/10.1177/1534582305276837
Diya. (2021). *When my cousin does this mouth sounds.. Me: Eyy stop it disgustin.. Frivolous fox: nom nom nomm. Me: oo it s Satisfying.* [Comment on the video ASMR Ear Licking ~ Extreme Mouth Sounds for Tingle Immunity]. YouTube. https://www.youtube.com/watch?v=-BdSCcmJKJk.
Dutton, D. G., & Aron, A. P. (1974). Some evidence for heightened sexual attraction under conditions of high anxiety. *Journal of Personality and Social Psychology, 30*(4), 510–517. https://doi.org/10.1037/h0037031
Dunbar, R. I. (2010). The social role of touch in humans and primates: Behavioural function and neurobiological mechanisms. *Neuroscience Biobehavioral Reviews, 34*(2), 260–268. https://doi.org/10.1016/j.neubiorev.2008.07.001
Dunn, B. R., Hartigan, J. A., & Mikulas, W. L. (1999). Concentration and mindfulness meditations: Unique forms of consciousness? *Applied psychophysiology and biofeedback, 24*(3), 147–165. https://doi.org/10.1023/A:1023498629385
dos Santos, W. O., Bittencourt, I. I., Isotani, S., Dermeval, D., Marques, L. B., & Silveira, I. F. (2018). Flow theory to promote learning in educational systems: Is it really relevant? *Revista Brasileira de Informatica na Educaçao, 26*(02), 29. http://br-ie.org/pub/index.php/rbie.
Engelbregt, H. J., Brinkman, K., van Geest, C. C. E., Irrmischer, M., & Deijen, J. B. (2022). The effects of autonomous sensory meridian response (ASMR) on mood, attention, heart rate, skin conductance and EEG in healthy young adults. *Experimental Brain Research, 240*(6), 1727–1742.
Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception Psychophysics, 16*, 143–149. https://doi.org/10.3758/BF03203267
Feldman, R. (2012). Oxytocin and social affiliation in humans. *Hormones and behavior, 61*(3), 380–391. https://doi.org/10.1016/j.yhbeh.2012.01.008
Floresco, S. B. (2015). The nucleus accumbens: An interface between cognition, emotion, and action. *Annual Review Psychology, 66*(1), 25–52. https://doi.org/10.1146/annurev-psych-010213-115159
Foxe, J. J., & Snyder, A. C. (2011). The role of alpha-band brain oscillations as a sensory suppression mechanism during selective attention. *Frontiers in psychology, 2*, 154. https://doi.org/10.3389/fpsyg.2011.00154
Fredborg, B. K., Clark, J., & Smith, S. D. (2017). The big five personality traits and Autonomous Sensory Meridian Response (ASMR). *Frontiers in Psychology, 8*, 247. https://doi.org/10.3389/fpsyg.2017.00247
Fredborg, B. K., Clark, J., & Smith, S. D. (2018). Mindfulness and Autonomous Sensory Meridian Response (ASMR). *PeerJ, 6, Article e5414*. https://doi.org/10.7717/peerj.5414
Fredborg, B. K., Champagne-Jorgensen, K., Desroches, A. S., & Smith, S. D. (2021). An electroencephalographic examination of the autonomous sensory meridian response (ASMR). *Consciousness and Cognition, 87*, Article 103053. https://doi.org/10.1016/j.concog.2020.103053
Friston, K. J. (1994). Functional and effective connectivity in neuroimaging: A synthesis. *Human brain mapping, 2*(1–2), 56–78. https://doi.org/10.1002/hbm.460020107
Fromm, E. (1964). *The Heart of Man*. Harper & Row.
Galbraith, P. W. (2011). Maid in Japan: An ethnographic account of alternative intimacy. *Intersections: Gender and sexuality in Asia and the Pacific, 1*(25). http://intersections.anu.edu.au/issue25/galbraith.htm.
Gallagher, R. (2016). Eliciting euphoria online: The aesthetics of "ASMR" video culture. *Film. Criticism, 40*(2). https://doi.org/10.3998/fc.13761232.0040.202
Garro, D. (2017). Autonomous Meridian Sensory Response: from Internet subculture to audiovisual therapy. *Proceedings of the Electronic Visualisation and the Art Conference (EVA London 2017)* (395-402). BCS, The Chartered Institute for IT.
Gasquoine, P. G. (2013). Localization of function in anterior cingulate cortex: From psychosurgery to functional neuroimaging. *Neuroscience Biobehavioral Reviews, 37*(3), 340–348. https://doi.org/10.1016/j.neubiorev.2013.01.002
Gentle Whispering ASMR. (2019, April 30). *Slow Hand Movements and Blissful Whispers ASMR* [Video]. YouTube. https://www.youtube.com/watch?v=pBHCvp57rf4.
Gheorghiu, V. A., Koch, E., & Hubner, M. (1995). A group scale for the influence of suggestion on sensory judgments. *Hypnos, 21*(1), 38–49.
Gillmeister, H., Succi, A., Romei, V., & Poerio, G. L. (2022). Touching you, touching me: Higher incidence of mirror-touch synaesthesia and positive (but not negative) reactions to social touch in Autonomous Sensory Meridian Response. *Consciousness and Cognition, 103*, Article 103380. https://doi.org/10.1016/j.concog.2022.103380
Goldstein, A. (1980). Thrills in response to music and other stimuli. *Physiological psychology, 8*(1), 126–129. https://doi.org/10.3758/BF03326460
Greicius, M. D., Krasnow, B., Reiss, A. L., & Menon, V. (2003). Functional connectivity in the resting brain: a network analysis of the default mode hypothesis. *Proceedings of the National Academy of Sciences, 100*(1), 253–258. https://doi.org/10.1073/pnas.0135058100
Greven, C. U., Lionetti, F., Booth, C., Aron, E. N., Fox, E., Schendan, H. E., … Homberg, J. (2019). Sensory processing sensitivity in the context of environmental sensitivity: A critical review and development of research agenda. *Neuroscience Biobehavioral Reviews, 98*, 287–305. https://doi.org/10.1016/j.neubiorev.2019.01.009v
Grewe, O., Katzur, B., Kopiez, R., & Altenmüller, E. (2011). Chills in different sensory domains: Frisson elicited by acoustical, visual, tactile and gustatory stimuli. *Psychology of Music, 39*(2), 220–239.
Gu, J., Strauss, C., Bond, R., & Cavanagh, K. (2015). How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clinical psychology review, 37*, 1–12. https://doi.org/10.1016/j.cpr.2015.01.006
Haga, A., Halin, N., Holmgren, M., & S€orqvist, P. (2016). Psychological restoration can depend on stimulus-source attribution: A challenge for the evolutionary account*? Frontiers in Psychology, 7*, 1–8. https://doi.org/10.3389/fpsyg.2016.01831
Hardian, H., Febriani, S. S., Sumekar, T. A., Muniroh, M., Indraswari, D. A., Purwoko, Y., et al. (2020). Improvement of Sleep Quality by Autonomous Sensory Meridian Response (ASMR) Stimulation Among Medical Students. *Malaysian Journal of Medicine and Health Sciences, 16*, 81–85.
Harrison, N. R., & Clark, D. (2016). The observing facet of trait mindfulness predicts frequency of aesthetic experiences evoked by the arts. *Mindfulness, 7*(4), 971–978. https://doi.org/10.1007/s12671-016-0536-6
Harrison, L., & Loui, P. (2014). Thrills, chills, frissons, and skin orgasms: Toward an integrative model of transcendent psychophysiological experiences in music. *Frontiers in Psychology, 5*, 790. https://doi.org/10.3389/fpsyg.2014.00790
Heathwood, C. (2007). The reduction of sensory pleasure to desire. *Philosophical Studies, 133*(1), 23–44. https://doi.org/10.1007/s11098-006-9004-9
Henazi, S. P., & Barrett, L. (1999). The value of grooming to female primates. *Primates, 40*(1), 47–59. https://doi.org/10.1007/BF02557701

Higham, N. (2014, December 11). *ASMR: The videos which claim to make their viewers 'tingle* . BBC. http://www.bbc.com/news/magazine30412358.
Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on psychological science, 10*(2), 227–237. https://doi.org/10.1177/1745691614568352
Hostler, T. J., Poerio, G. L., & Blakey, E. (2019). Still more than a feeling: Commentary on Cash et al., "expectancy effects in the autonomous sensory meridian response" and recommendations for measurement in future ASMR research. *Multisensory Research, 32*(6), 521–531. https://doi.org/10.1163/22134808-20191366
Huang, H. Y., & Lo, P. C. (2009). EEG dynamics of experienced Zen meditation practitioners probed by complexity index and spectral measure. *Journal of medical engineering technology, 33*(4), 314–321. https://doi.org/10.1080/03091900802602677
Huron, D. (2000). Music Cognition Handbook: A Glossary of Concepts.
Huron, D. (2006). *Sweet anticipation: Music and the psychology of expectation*. Cambridge, MA: MIT Press. https://doi.org/10.7551/mitpress/6575.001.0001.
Janik McErlean, A. B., & Banissy, M. J. (2017). Assessing individual variation in personality and empathy traits in self-reported autonomous sensory meridian response. *Multisensory Research, 30*(6), 601–613. https://doi.org/10.1163/22134808-00002571
Janik McErlean, A. B., & Banissy, M. J. (2018). Increased misophonia in self-reported autonomous sensory meridian response. *PeerJ, 6*, e5351.
Janik McErlean, A. B., & Osborne-Ford, E. J. (2020). Increased absorption in autonomous sensory meridian response. *PeerJ, 8*, e8588.
Jastreboff, M. M., & Jastreboff, P. J. (2001). Components of decreased sound tolerance: Hyperacusis, misophonia, phonophobia. *ITHS News Lett, 2*(5–7), 1–5. http://tinnitus.org/DST_NL2_PJMJ.pdf.
Jastreboff, P. J., & Jastreboff, M. M. (2014, May). Treatments for decreased sound tolerance (hyperacusis and misophonia). *Seminars in Hearing, 35*(2) 105-120). Thieme Medical Publishers. DOI: 10.1055/s-0034-1372527.
Jaswal, S. M., De Bleser, A. K., & Handy, T. C. (2021). Misokinesia is a sensitivity to seeing others fidget that is prevalent in the general population. *Scientific Reports, 11*(1), 1–12. https://doi.org/10.1038/s41598-021-96430-4
Jensen, O., Gelfand, J., Kounios, J., & Lisman, J. E. (2002). Oscillations in the alpha band (9e12 Hz) increase with memory load during retention in a short-term memory task. *Cerebral Cortex, 12*(8), 877e882. https://doi.org/10.1093/cercor/12.8.877
John, O. P., & Srivastava, S. (1999). The Big Five Trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin, & O. P. John (Eds.), *Handbook of personality: Theory and research* (pp. 102–138). Guilford Press.
Kaptchuk, T. J., Friedlander, E., Kelley, J. M., Sanchez, M. N., Kokkotou, E., Singer, J. P., et al. (2010). Placebos without deception: A randomized controlled trial in irritable bowel syndrome. *PloS one, 5*(12), e15591.
Katahira, K., Yamazaki, Y., Yamaoka, C., Ozaki, H., Nakagawa, S., & Nagata, N. (2018). EEG correlates of the flow state: A combination of increased frontal theta and moderate frontocentral alpha rhythm in the mental arithmetic task. *Frontiers in Psychology, 9*, 300. https://doi.org/10.3389/fpsyg.2018.00300
Keizer, A., Chang, T. H., O'Mahony, C. J., Schaap, N. S., & Stone, K. D. (2020). Individuals who experience autonomous sensory meridian response have higher levels of sensory suggestibility. *Perception, 49*(1), 113–116. https://doi.org/10.1177/0301006619891913
Kelly, S. P., Lalor, E. C., Reilly, R. B., & Foxe, J. J. (2006). Increases in alpha oscillatory power reflect an active retinotopic mechanism for distracter suppression during sustained visuospatial attention. *Journal of neurophysiology, 95*(6), 3844–3851. https://doi.org/10.1152/jn.01234.2005
Kenny, E., Birkhead, T. R., & Green, J. P. (2017). Allopreening in birds is associated with parental cooperation over offspring care and stable pair bonds across years. *Behavioral Ecology, 28*(4), 1142–1148. https://doi.org/10.1093/beheco/arx078
Kim, H. G., Cheon, E. J., Bai, D. S., Lee, Y. H., & Koo, B. H. (2018). Stress and heart rate variability: a meta-analysis and review of the literature. *Psychiatry Investigation, 15*(3), 235. https://doi.org/10.30773/pi.2017.08.17
Kirsch, I. (2014). Antidepressants and the Placebo Effect. *Zeitschrift fur Psychologie, 222*(3), 128–134. https://doi.org/10.1027/2151-2604/a000176
Kirsch, I. (2019). Placebo effect in the treatment of depression and anxiety. *Frontiers in Psychiatry, 10*, 407. https://doi.org/10.3389/fpsyt.2019.00407
Klimesch, W. (1999). EEG alpha and theta oscillations reflect cognitive and memory performance: A review and analysis. *Brain research reviews, 29*(2–3), 169–195. https://doi.org/10.1016/S0165-0173(98)00056-3
Klimesch, W., Sauseng, P., & Hanslmayr, S. (2007). EEG alpha oscillations: The inhibitionetiming hypothesis. *Brain Research Reviews, 53*(1), 63e88. https://doi.org/10.1016/j.brainresrev.2006.06.003
Komulainen, E., Meskanen, K., Lipsanen, J., Lahti, J. M., Jylhä, P., Melartin, T., et al. (2014). The effect of personality on daily life emotional processes. *PloS one, 9*(10), e110907.
Kovacevich, A., & Huron, D. (2019). Two studies of autonomous sensory meridian response (ASMR): The relationship between ASMR and music-induced frisson. *Empirical musicology review, 13*(1–2), 39–63. https://doi.org/10.18061/emr.v13i1-2.6012.
Laeng, B., Eidet, L. M., Sulutvedt, U., & Panksepp, J. (2016). Music chills: The eye pupil as a mirror to music's soul. *Consciousness and cognition, 44*, 161–178. https://doi.org/10.1016/j.concog.2016.07.009
Lange, R., Thalbourne, M. A., Houran, J., & Storm, L. (2000). The Revised Transliminality Scale: Reliability and validity data from a Rasch top-down purification procedure. *Consciousness and cognition, 9*(4), 591–617. https://doi.org/10.1006/ccog.2000.0472
Libby, W. L., Jr, Lacey, B. C., & Lacey, J. I. (1973). Pupillary and cardiac activity during visual attention. *Psychophysiology, 10*(3), 270–294. https://doi.org/10.1111/j.1469-8986.1973.tb00526.x
Lichstein, K. L., Durrence, H. H., Taylor, D. J., Bush, A. J., & Riedel, B. W. (2003). Quantitative criteria for insomnia. *Behaviour research and therapy, 41*(4), 427–445. https://doi.org/10.1016/S0005-7967(02)00023-2
Lochte, B. C., Guillory, S. A., Richard, C. A., & Kelley, W. M. (2018). An fMRI investigation of the neural correlates underlying the autonomous sensory meridian response (ASMR). *BioImpacts: BI, 8*(4), 295. https://doi.org/10.15171/bi.2018.32
Magosso, E., De Crescenzio, F., Ricci, G., Piastra, S., & Ursino, M. (2019). EEG alpha power is modulated by attentional changes during cognitive tasks and virtual reality immersion. *Computational Intelligence and Neuroscience, 2019*. https://doi.org/10.1155/2019/7051079
Marotta, A., Tinazzi, M., Cavedini, C., Zampini, M., & Fiorio, M. (2016). Individual differences in the rubber hand illusion are related to sensory suggestibility. *PloS one, 11*(12), e0168489.
Matsuoka, T., Shimode, T., Ota, T., & Matsuo, K. (2021). Eventrelated alpha-band power changes during self-reflection and working memory tasks in healthy individuals. *Frontiers in Human Neuroscience, 14*. https://doi.org/10.3389/fnhum.2020.570279
McCrae, R. R., & Terracciano, A. (2005). Universal features of personality traits from the observer's perspective: Data from 50 cultures. *Journal of personality and social psychology, 88*(3), 547–561. https://doi.org/10.1037/0022-3514.88.3.547
McCrae, R. R. (2007). Aesthetic chills as a universal marker of openness to experience. *Motivation and Emotion, 31*(1), 5–11. https://doi.org/10.1007/s11031-007-9053-1
McGeoch, P. D., & Rouw, R. (2020). How everyday sounds can trigger strong emotions: ASMR, misophonia and the feeling of wellbeing. *BioEssays, 42*(12), 2000099. https://doi.org/10.1002/bies.202000099
McGraw, A. P. (1999). *Expectations and emotions in sports*. Ohio State University: Psychology Department. Masters thesis.
McGraw, A. P., & Warren, C. (2010). Benign violations: Making immoral behavior funny. *Psychological Science, 21*(8), 1141–1149. https://doi.org/10.1177/0956797610376073
Merecz, D., Makowska, Z., & Makowiec-Dabrowska, T. (1999). The assessment of Big Five Personality Factors and Temperament Domains as modifiers of cardiovascular response to occupational stress. *International Journal of Occupational Medicine and Environmental Health, 12*(3), 273–284.
Miller, L. C., Murphy, R., & Buss, A. H. (1981). Consciousness of body: Private and public. *Journal of personality and social psychology, 41*(2), 397. https://doi.org/10.1037/0022-3514.41.2.397
Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive psychology, 41*(1), 49–100. https://doi.org/10.1006/cogp.1999.0734
Mori, K., & Iwanaga, M. (2017). Two types of peak emotional responses to music: The psychophysiology of chills and tears. *Scientific reports, 7*, 46063. https://doi.org/10.1038/srep46063

Mulvey, L. (1975). Visual pleasure and narrative cinema. *Screen, 16*(3), 6–18. https://doi.org/10.1007/978-1-349-19798-9_3
Nakamura, J., & Csikszentmihalyi, M. (2009). Flow theory and research. *Handbook of positive psychology, 195*, 206.
National Institute of Neurological Disorders and Stroke. (2019). *Parasthesia.* https://www.ninds.nih.gov/health-information/disorders/paresthesia.
Niedermeyer, E. (1999). The normal EEG of the waking adult. In E Niedermeyer, & F Lopes da Silva (Eds.), *Electroencephalography: Basic principles, Clinical Applications and Related Fields* (4th ed., pp. 149e173). Philadelphia, PA: Williams and Wilkins.
Niven, E. C., & Scott, S. K. (2021). Careful whispers: When sounds feel like a touch. *Trends in Cognitive Sciences, 25*(8), 645–647. https://doi.org/10.1016/j.tics.2021.05.006
Oliveri, M., Babiloni, C., Filippi, M. M., Caltagirone, C., Babiloni, F., Cicinelli, P., et al. (2003). Influence of the supplementary motor area on primary motor cortex excitability during movements triggered by neutral or emotionally unpleasant visual cues. *Experimental brain research, 149*(2), 214–221. https://doi.org/10.1007/s00221-002-1346-8
Oppenheimer, S. M., Gelb, A., Girvin, J. P., & Hachinski, V. C. (1992). Cardiovascular effects of human insular cortex stimulation. *Neurology, 42*(9), 1727. https://doi.org/10.1212/WNL.42.9.1727
Orfgorf.. (2020). January 28*). I HATE mouth sounds, chewing ect... but for some reason ASMR is enjoyable. Reddit.* https://www.reddit.com/r/misophonia/comments/ev515f/i_hate_mouth_sounds_chewing_ect_but_for_some/.
Panksepp, J. (1995). The emotional sources of 'chills' induced by music. *Music Perception, 13*, 171–207. https://doi.org/10.2307/40285693
Paszkiel, S., Dobrakowski, P., & Łysiak, A. (2020). The impact of different sounds on stress level in the context of EEG, cardiac measures and subjective stress level: A pilot study. *Brain Sciences, 10*(10), 728. https://doi.org/10.3390/brainsci10100728
perk1444.. (2020). January 29). *Just as another someone else mentioned, I think context matters a lot.* [Comment on the post I HATE mouth sounds, chewing ect... but for some reason ASMR is enjoyable]. *Reddit.* https://www.reddit.com/r/misophonia/comments/ev515f/i_hate_mouth_sounds_chewing_ect_but_for_some/.
Poerio, G. L., Blakey, E., Hostler, T. J., & Veltri, T. (2018). More than a feeling: Autonomous sensory meridian response (ASMR) is characterized by reliable changes in affect and physiology. *PLoS ONE, 13*, Article e0196645.https://doi.org/10.1371/journal.pone.0196645.
Posner, M. I. (2008). Measuring alertness. *Annals of the New York Academy of Sciences, 1129*(1), 193–199. https://doi.org/10.1196/annals.1417.011
Purcell, T., Peron, E., & Berto, R. (2001). Why do preferences differ between scene types? *Environment and Behavior, 33*(1), 93–106. https://doi.org/10.1177/00139160121972882
Rader, C. M., & Tellegen, A. (1987). An investigation of synesthesia. *Journal of Personality and Social Psychology, 52*(5), 981. https://doi.org/10.1037/0022-3514.52.5.981
Raichle, M. E. (2015). The brain's default mode network. *Annual Review of Neuroscience, 38*, 433–447. https://doi.org/10.1146/annurev-neuro-071013-014030
Rawlings, D. (2002). An exploratory factor analysis of Hartmann's boundary questionnaire and an empirically-derived short version. *Imagination, Cognition and Personality, 21*, 131–144. https://doi.org/10.2190/3XM9-LGA6-MJ76-X658
Reddy, N. V., & Mohabbat, A. B. (2020). Autonomous sensory meridian response: Your patients already know, do you? *Cleveland Clinic journal of medicine, 87*(12), 751–754. https://doi.org/10.3949/ccjm.87a.20005
Reuter, C., & Oehler, M. (2011). Psychoacoustics of chalkboard squeaking. *The Journal of the Acoustical Society of America, 130*(4), 2545. https://doi.org/10.1121/1.3655174
Rich, A. N., & Mattingley, J. B. (2002). Anomalous perception in synaesthesia: A cognitive neuroscience perspective. *Nature Reviews Neuroscience, 3*(1), 43–52. https://doi.org/10.1038/nrn702
Roberts, N., Beath, A., & Boag, S. (2019). Autonomous sensory meridian response: Scale development and personality correlates. *Psychology of Consciousness: Theory, Research, and Practice, 6*(1), 22. https://doi.org/10.1037/cns0000168
Roberts, N., Beath, A., & Boag, S. (2020a). A mixed-methods examination of autonomous sensory meridian response: Comparison to frisson. *Consciousness and cognition, 86*, Article 103046. https://doi.org/10.1016/j.concog.2020.103046
Roberts, N., Beath, A., & Boag, S. (2021). Autonomous sensory meridian response: Individual differences and consciousness correlates. *Psychology of Consciousness: Theory, Research, and Practice, 8*(1), 27. https://doi.org/10.1037/cns0000243
Roberts, N., Beath, A., & Boag, S. (2020b). Autonomous sensory meridian response: Sensitivity and personality correlates. *Journal of Individual Differences, 42*(3), 124. https://doi.org/10.1027/1614-0001/a000337Rouw, R., & Erfanian, M. (2018). A large-scale study of misophonia. Journal of clinical psychology, 74(3), 453-479. DOI: 10.1002/jclp.22500
Rouw, R., & Scholte, H. S. (2016). Personality and cognitive profiles of a general synesthetic trait. *Neuropsychologia, 88*, 35–48. https://doi.org/10.1016/j.neuropsychologia.2016.01.006
Schultz, W. (2000). Multiple reward signals in the brain. *Nature reviews neuroscience, 1*(3), 199–207. https://doi.org/10.1038/35044563
Scofield, E. (2019). A Quantitative Study Investigating the Relationship between Autonomous Sensory Meridian Response (ASMR). *Misophonia and Mindfulness.* https://e-space.mmu.ac.uk/id/eprint/623904.
Sharif-Alhoseini, M., Rahimi-Movaghar, V., & Vaccaro, A. R. (2012). *Underlying causes of paresthesia* (pp. 71–90). InTech: Paresthesia. Croatia.
SHDF. (2018). *, 5B JŠ·•Jg« . , >S}{—M8³>z}÷u?'²[ŸßÐ. ^`i]Œ„•G"(Z)9¯]¬ÿ ASMR,;>• (The national'Anti-Vice and Pornography office has informed a number of websites of the necessity of vigorously cleaning up ASMR content due to pornographic vulgarity).* http://www.shdf.gov.cn/shdf/contents/767/379649.html.
Sheldon, K. M., Prentice, M., & Halusic, M. (2015). The experiential incompatibility of mindfulness and flow absorption. *Social Psychological Personality Science, 6*, 276–283. https://doi.org/10.1177/1948550614555028
Simner, J., Mulvenna, C., Sagiv, N., Tsakanikos, E., Witherby, S. A., Fraser, C., et al. (2006). Synaesthesia: The prevalence of atypical cross-modal experiences. *Perception, 35*(8), 1024–1033. https://doi.org/10.1068/p5469
Sloboda, J. A. (1991). Music structure and emotional response: Some empirical findings. *Psychology of music, 19*(2), 110–120.
Smith, S. D., Fredborg, B. K., & Kornelsen, J. (2017). An examination of the default mode network in individuals with autonomous sensory meridian response (ASMR). *Social neuroscience, 12*(4), 361–365. https://doi.org/10.1080/17470919.2016.1188851
Smith, S. D., Fredborg, B. K., & Kornelsen, J. (2019a). A functional magnetic resonance imaging investigation of the autonomous sensory meridian response. *PeerJ, 7*, e7122.
Smith, S. D., Fredborg, B. K., & Kornelsen, J. (2019b). Atypical functional connectivity associated with autonomous sensory meridian response: An examination of five resting-state networks. *Brain connectivity, 9*(6), 508–518. https://doi.org/10.1089/brain.2018.0618
Smith, S. D., Fredborg, B. K., & Kornelsen, J. (2020). Functional connectivity associated with five different categories of Autonomous Sensory Meridian Response (ASMR) triggers. *Consciousness and Cognition, 85*, Article 103021. https://doi.org/10.1016/j.concog.2020.103021
Smith, N., & Snider, A. M. (2019). ASMR, affect and digitally-mediated intimacy. *Emotion, Space and Society, 30*, 41–48. https://doi.org/10.1016/j.emospa.2018.11.002
Smith, M. T., & Wegener, S. T. (2003). Measures of sleep: The insomnia severity index, medical outcomes study (MOS) sleep scale, Pittsburgh sleep diary (PSD), and Pittsburgh sleep quality index (PSQI). *Arthritis Care Research: Official Journal of the American College of Rheumatology, 49*(S5), S184–S196. https://doi.org/10.1002/art.11409
Spence, C. (2020). Extraordinary emotional responses elicited by auditory stimuli linked to the consumption of food and drink. *Acoustical science and Technology, 41*(1), 28–36. https://doi.org/10.1250/ast.41.28
Starr, R. L., Wang, T., & Go, C. (2020). Sexuality vs. sensuality: The multimodal construction of affective stance in Chinese ASMR performances. *Journal of Sociolinguistics, 24*(4), 492–513. https://doi.org/10.1111/josl.12410
Strijkstra, A. M., Beersma, D. G., Drayer, B., Halbesma, N., & Daan, S. (2003). Subjective sleepiness correlates negatively with global alpha (8–12 Hz) and positively with central frontal theta (4–8 Hz) frequencies in the human resting awake electroencephalogram. *Neuroscience letters, 340*(1), 17–20. https://doi.org/10.1016/S0304-3940(03)00033-8
Sturm, W., De Simone, A., Krause, B. J., Specht, K., Hesselmann, V., Radermacher, I., et al. (1999). Functional anatomy of intrinsic alertness: Evidence for a fronto-parietal-thalamic-brainstem network in the right hemisphere. *Neuropsychologia, 37*(7), 797–805. https://doi.org/10.1016/S0028-3932(98)00141-9

Sumpf, M., Jentschke, S., & Koelsch, S. (2015). Effects of aesthetic chills on a cardiac signature of emotionality. *PLoS One, 10*(6), e0130117.
Swann, C., Crust, L., Keegan, R., Piggott, D., & Hemmings, B. (2015). An inductive exploration into the flow experiences of European Tour golfers. *Qualitative Research in Sport, Exercise and Health, 7*(2), 210–234. https://doi.org/10.1080/2159676X.2014.926969
Swart, T. R., Banissy, M. J., Hein, T. P., Bruna, R., Pereda, E., & Bhattacharya, J. (2022). ASMR amplifies low frequency and reduces high frequency oscillations. *Cortex, 149*, 85–100. https://doi.org/10.1016/j.cortex.2022.01.004
Symons, A. E., El-Deredy, W., Schwartze, M., & Kotz, S. A. (2016). The functional role of neural oscillations in non-verbal emotional communication. *Frontiers in Human Neuroscience, 10*. https://doi.org/10.3389/fnhum.2016.00239
Sztajzel, J. (2004). Heart rate variability: A noninvasive electrocardiographic method to measure the autonomic nervous system. *Swiss medical weekly, 134*(35–36), 514–522.
Taelman, J., Vandeput, S., Spaepen, A., & Huffel, S. V. (2009). Influence of mental stress on heart rate and heart rate variability. In *In 4th European conference of the international federation for medical and biological engineering* (pp. 1366–1369). Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-540-89208-3_324.
Tellegen, A. (1981). Practicing the two disciplines for relaxation and enlightenment: Comment on "Role of the feedback signal in electromyograph biofeedback: The relevance of attention" by Qualls and Sheehan. *Journal of Experimental Psychology: General, 110*(2), 217–226. https://doi.org/10.1037/0096-3445.110.2.217
Tellegen, A., & Atkinson, G. (1974). Openness to absorbing and self-altering experiences (''absorption''), a trait related to hypnotic susceptibility. *Journal of Abnormal Psychology, 83*, 268–277. https://doi.org/10.1037/h0036681
The Streamer Awards. (2022). *Winners*. https://thestreamerawards.com/winners.
Travis, F., & Shear, J. (2010). Focused attention, open monitoring and automatic self-transcending: Categories to organize meditations from Vedic, Buddhist and Chinese traditions. *Consciousness and cognition, 19*(4), 1110–1118. https://doi.org/10.1016/j.concog.2010.01.007
Travis, F., & Wallace, R. K. (1999). Autonomic and EEG patterns during eyes-closed rest and transcendental meditation (TM) practice: The basis for a neural model of TM practice. *Consciousness and cognition, 8*(3), 302–318. https://doi.org/10.1006/ccog.1999.0403
Tyla Mchugh (2019). *It s weird that I can t stand people chewing loudly irl but when I m trying to sleep I m like haha yes more more.* [Comment on the video [ASMR] Sensitive, Breathy & Wet Mouth Sounds ~]. Youtube. https://www.youtube.com/watch?v^ 4CyDFA5IO9U.
Ulrich, R. S. (1981). Natural Versus Urban Scenes: Some Psychophysiological Effects. *Environment and Behavior, 13*(5), 523–556. https://doi.org/10.1177/0013916581135001
Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. *Behavior and the Natural Environment*, 85–125. https://doi.org/10.1007/978-1-4613-3539-9_4
Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science, 224*(4647), 420–421. https://doi.org/10.1126/science.6143402
Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology, 11*(3), 201–230. https://doi.org/10.1016/S0272-4944(05)80184-7
Umbas, J. C. G., Bintang, A. K., Aulina, S., Bahar, A., & Akbar, M. (2021). The effect of white noise on high school students' sleep quality at Unit B of Rajawali Girls Dormitory Makassar. *Medicina Clínica Practica, 4*, Article 100209. https://doi.org/10.1016/j.mcpsp.2021.100209
Valanciute, A., & Thampy, L. A. (2011). Physio Kundalini syndrome and mental health. *Mental Health, Religion Culture, 14*(8), 839–842. https://doi.org/10.1080/13674676.2010.530648
Valtakari, N. V., Hooge, I. T., Benjamins, J. S., & Keizer, A. (2019). An eye-tracking approach to Autonomous sensory meridian response (ASMR): The physiology and nature of tingles in relation to the pupil. *PloS one, 14*(12), e0226692.
Van den Heuvel, M. P., & Sporns, O. (2013). An anatomical substrate for integration among functional networks in human cortex. *Journal of Neuroscience, 33*(36), 14489–14500. https://doi.org/10.2478/jaiscr-2021-0001
Van Hedger, S. C., Nusbaum, H. C., Heald, S. L., Huang, A., Kotabe, H. P., & Berman, M. G. (2019). The aesthetic preference for nature sounds depends on sound object recognition. *Cognitive science, 43*(5), e12734.
Vucic, D. (2020). Digital intimacy and the aestheticisation of sound. *Meanjin, 79*(1), 105–113. https://doi.org/10.3316/informit.119437364391514
Waldron, E. L. (2017). "This FEELS SO REAL!" Sense and sexuality in ASMR videos. *First Monday, 22*(1). https://doi.org/10.5210/fm.v22i1.7282
Wang, M., & Li, B. (2020). Research on the Application of ASMR in the Development and Design of Sleeping Products. *E3S Web of Conferences, 179*(1), 02061. https://doi.org/10.1051/e3sconf/202017902061
Wang, X., Yang, X., Sun, Y., & Su, Y. (2020). The influence of autonomous sensory meridian response on individual's executive function. *Quarterly Journal of Experimental Psychology, 73*(10), 1587–1595. https://doi.org/10.1177/1747021820922954
Weinbach, N., & Henik, A. (2011). Phasic alertness can modulate executive control by enhancing global processing of visual stimuli. *Cognition, 121*(3), 454–458. https://doi.org/10.1016/j.cognition.2011.08.010
Wildschut, T., Sedikides, C., Arndt, J., & Routledge, C. (2006). Nostalgia: Content, triggers, functions. *Journal of personality and social psychology, 91*(5), 975. https://doi.org/10.1037/0022-3514.91.5.975
Williamson, J. W. (1992). The effects of ocean sounds on sleep after coronary artery bypass graft surgery. *American Journal of Critical Care, 1*(1), 91–97. https://doi.org/10.4037/ajcc1992.1.1.91
Wilson, J., Andrews, G., Hogan, C., Wang, S., & Shum, D. H. K. (2018). Executive function in middle childhood and the relationship with theory of mind. *Developmental Neuropsychology, 43*(3), 163–182. https://doi.org/10.1080/87565641.2018.144029
Yoon, H., & Baek, H. J. (2022). External Auditory Stimulation as a Non-Pharmacological Sleep Aid. *Sensors, 22*(3), 1264. https://doi.org/10.3390/s22031264
Zappavigna, M. (2020). Digital intimacy and ambient embodied copresence in YouTube videos: Construing visual and aural perspective in ASMR role play videos. *Visual Communication, 1470357220928102*. https://doi.org/10.1177/1470357220928102
Zhao, S. (2003). Toward a taxonomy of copresence. *Presence: Teleoperators Virtual Environments, 12*(5), 445–455. https://doi.org/10.1162/105474603322761261