The role of perception in audiovisual elicitation of somatosensation (AVES) – an investigation of somatic distribution and individual differences

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Signed Declaration

I confirm that the work presented in this doctoral thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis, particularly via citation throughout the thesis (and their respective references in the bibliography) and statement of contribution in relevant sections (4.3.1., 5.3.1., and 5.6.1.).

Abstract

Cortical auditory modelling has gained traction in the past few years. Particularly, the caudal auditory fields have been theorised to play a role in auditory-somatosensory and auditory-spatial convergence in humans but is yet to be tested empirically. The challenge is identifying a viable medium to investigate such cross-modal interactions. To this end, a relatively recent perceptual phenomenon known as the autonomous sensory meridian response (ASMR) was theorised as a candidate to explore these neural cross-modal relationships. ASMR is described as a pleasant experience encompassing a somatosensory tingling sensation and feeling of relaxation characteristically reported to be emotionally positive and triggered via audiovisual stimulation. Despite a growing literature that has attributed the response with phenomenological characteristics, as well as personality and empathic, physiological, and neural profiles, there is still no mechanistic account of ASMR. There is also a comparison between ASMR and other similar perceptual phenomena including synaesthesia, frisson, and misophonia. With ASMR research on the rise, it is surprising to find no literature review to cover and bridge the present understandings of the phenomenon.

This thesis introduces the theory behind auditory cross-modal integration followed by two literature reviews encompassing all aspects of ASMR covered within the literature and beyond. Proceeding this is a collection of studies that have explored the phenomenology of, and association between ASMR and other perceptual phenomena including mirror-touch synaesthesia (MTS) and misophonia. The thesis will end with an overall conclusion and future research.

Impact Statement

The present thesis sought to review a relatively recent theory of cortical auditory modelling which considers cross-modal interactions of non-auditory sensory influences on audition. The autonomous sensory meridian response (ASMR) was introduced as a possible investigatory candidate. To this end, the thesis thoroughly collated and synthesised the available literature and empirical findings centred on and around the phenomenon (including interdisciplinary research areas) as well as introducing novel ideas of relevance and suggestions for future research (especially functional imaging). In the event of publication, it would provide an overview of the research areas that have come into fruition since its coining, while also producing a foundation for the advancement of knowledge and the facilitation of theory development.

Considering the research studies conducted and outlined in this thesis, they have addressed not only ASMR but also mirror-touch synaesthesia (MTS), and misophonia as well as their association with ASMR. Novel findings were reported on all accounts. Regarding the research on ASMR and MTS, this was the first study to jointly investigate the personality and empathic profiles of both phenomena. Moreover, the joint research on ASMR and misophonia built on previous iterations and led to deepening current understandings of the phenomenological characteristics attributable to both phenomena, the formulation of preliminary prevalence rates for ASMR and misophonia in the general population (and ASMR-sensitive individuals) and mapping the somatic distribution of the somatosensation of both phenomena. Within this, the ASMR and misophonic stimuli presented in this study which successfully elicited the respective responses were developed in the lab. The methodology thus, may be applicable to those looking to develop their own effective stimuli including other researchers, people in industry looking to commercialise ASMR (e.g., in advertisement), and/or individuals who make their own ASMR media online who are looking to better its effectiveness. Further, in both studies, novel measures of ASMR (and another on misophonia) were developed. These have the potential to be adapted to not only measure the characteristic properties of the response but may be useful in screening for response sensitivity. This is a recurring issue within ASMR research, that the development of standardised and independent screening protocol has mostly been overlooked thereby questioning current recruitment practises and even study findings.

ASMR research has a practical application in the real world, the potential ability to attenuate the symptomology of conditions such as depression and insomnia. Anecdotally, it has been utilised this way and its popularity in online communities is continually on the rise. In fact, research has begun to discuss and test this within clinical settings. To ensure ASMR investigations are appropriate, understanding the phenomenological characteristics, the factors underlying the phenomenon (e.g., personality and empathic traits, physiology, neural aetiology), how it differs from other similar perceptual phenomena, having effective or the knowledge to develop effective ASMR stimuli to elicit the response, and having effective screening protocol to gauge ASMR-sensitivity is vital. Throughout this thesis, all such matters and how to achieve them has been discussed both in the reviews and studies.

Acknowledgements

The path toward writing a thesis, let alone a doctoral thesis is arduous and certainly not linear. Adding another variable in the form of an unprecedented Covid-19 pandemic only amps up the difficulty. Despite uncertainty and interruptions throughout, one factor remained certain, the process of attaining a doctorate is and was not a singlehanded feat. Thus, there are many people I would like to express my gratitude for making this journey that little bit easier and their contribution toward this thesis, both directly and indirectly.

First, I would like to thank my supervisor of the last four years, Prof Sophie Scott. From my MRes to my PhD, Prof Scott has been unfailingly supportive, continually making time in her exceedingly busy schedule to discuss all aspects of my degree and providing academic support throughout. It is truly a credit to Prof Scott that this thesis was possible.

I would be remiss to not pass my thanks to the master's students, Gina Gilpin, Marina Rodríguez López, and Alex Griffin who joined and aided in the research projects that now make up this thesis. Often having to adapt and rush to complete the projects for various reasons, namely the pandemic but especially in time for master's deadlines, I can say with an air of complete certainty that these projects would not be, without you. It has been a true joy getting to know and work with you all. I would also like to extend my thanks to the rest of my colleagues, past and present, in the speech and communication lab in the ICN.

Another academic I must thank is Dr Roger Moore who introduced me to the field of neuroscience and supervised my research project on the personality and physiological basis of ASMR during my undergraduate degree.

More so, I would like to extend my thanks to the ASMR community, both the online content creators and the researchers. Without the existence of this community, this perceptual phenomenon would remain in obscurity and the researchers who are now exploring it would be spending their time elsewhere.

Last but certainly not least, I pass my appreciation to my family for their counsel and sympathetic ear, and to my friends, who, many a time, helped me take my mind off my studies even if it was for a brief moment. Thank you.

Covid-19 Impact Statement

To note, this text is the same as the 'Covid-19 Impact Form' submitted alongside this thesis.

It is best to begin with some context – my plan for my doctoral thesis prior to the pandemic. Originally, I had planned to conduct a functional MRI (fMRI) investigation – specifically an investigation of the spatial and somatosensory properties of the caudal auditory fields through the autonomous sensory meridian response (ASMR). Instead, less than six months into my PhD, the pandemic struck, and the first lockdown was enforced. Essentially, I had to completely re-work my thesis plan, as I am sure, did many others regrettably finding themselves in such a precarious position. This meant dropping the proposed fMRI methodology, especially since the scanners in BUCNI were quenched and again, with no end in sight to life under lockdown. Of course, other potential methods of study such as physiology were also halted with the lockdown in play, and even when things seemed to somewhat be returning to normality, there was a clear and understandable hesitancy of people returning to the universities, let alone those who wished to participate in research. This, as I am sure many other academics became aware, meant adapting to online research as the only way forward for the then foreseeable future with the ever-looming additional pressure of not knowing when normality would truly be, if ever.

My first year thus consisted of undertaking the write-up of a comprehensive literature review on my area of focus, ASMR, whose literature was and still is devoid of such a review. To compensate for how the pandemic destroyed my ability to collect in-person data, the length of this literature review was increased and now makes up a significant portion of my thesis. Alongside this review, with the help of a master's student, I conducted my first study which was purely online. Other than a small learning curve, there was not a problem per se in adapting to online studies, the issue lied more in the fact that auditory-based studies, let alone those that investigate perceptual phenomena (i.e., presenting solely auditory stimuli online, and to trigger a perceptual condition) are difficult to conduct online such as ear/headphone screening which was echoed in my second research project.

This continued into the following two years where I conducted two further online behavioural experiments, each with the help of a master's student. This was essentially a learning process with each study being adapted from the previous iteration. There was also another learning process in having to learn and carry out non-traditional forms of data analyses such as using non-parametric statistics which I had zero familiarity with as well as exploratory analysis such as developing and utilising heat maps and analysing heat map data. While the collective results did indeed lead to interesting and much-needed findings on the phenomenological characteristics of ASMR (such as preliminary prevalence rates and mapping the somatic distribution of ASMR somatosensation) but also on its comparison with other similar perceptual phenomena including mirror-touch synaesthesia and misophonia, it is far from my original expectation of neuroimaging research on what is really an up-and-coming field in ASMR as well as cortical auditory processing and modelling. While it is true that fMRI testing did somewhat resume in my final year of study, it seemed like a near impossible task to get this running and recruit an adequate sample with possible participants essentially still favouring online versus in-person participation – as I have come to understand from a colleague in a similar position.

Although I cannot help but feel that not following the original fMRI plan has been a missed opportunity, in retrospect, if anything good has come out of completing a PhD under the pandemic, I would say it was writing my initial review that covered close to all aspects of ASMR; writing, submitting, then publishing an opinion article on the topic; learning new data analysis methodologies; the discoveries made from conducting the online studies; and generally, adapting to such a situation.

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CHAPTER 1: Somatosensory Interactions with Auditory Processing

One can trace back the establishment of knowledge surrounding the key brain areas for speech (production and perception) to the nineteenth century (Rauschecker & Scott, 2009). Expectedly, understandings of speech processing have progressed substantially since such earlier, rudimentary reports. Yet, arguably, contrary to vision, neuroscientific investigation into audition has been rather lacking, attributed to factors such as the dominance of vision, as well as the technical difficulty that goes into studying the sensory modality that is audition – recording primate auditory regions, and in the development and presentation of stimuli (Scott, 2005). Over the last three plus decades, functional neuroimaging methodologies (beginning with positron emission tomography, or PET, and shifting to functional magnetic resonance imaging, or fMRI) have enhanced and driven investigations into auditory perception and language (Talavage, Gonzalez-Castillo & Scott, 2014). This is not to say that modelling the anatomical organisation of the auditory cortex has by any means become any easier a feat to achieve, still presenting complexities to this day.

Within this, models of auditory processing have typically and what can now be referred to as traditionally, been domain-specific, that is, how particular aspects of neural processing are specialised for certain stimulus types (Spunt & Adolphs, 2017). In reference to models of the auditory system, attention has been mostly directed towards specific domains of auditory processing, for instance, the perception of intelligible speech and language (e.g., Hickok & Poeppel, 2004; Rauschecker & Scott, 2009). On the one hand, these domain-specific approaches have deepened our understanding of the functional properties of the auditory cortex, however, there exists a downside in that they cannot account for the perception and processing of sounds outside the specific domains (Jasmin, Lima & Scott, 2019). In line with this, Jasmin et al. (2019) instead proposed a more computationally driven domain-general model of cortical auditory processing. This way, one may be better able to account for several interacting computations, not unlike framework similarly devised for visual processing (e.g., Kravitz, Saleem, Baker & Mishkin, 2011; *see also* Rauschecker & Tian, 2000 *for an early attempt of application to the auditory system*). In particular, the authors based their domain-general auditory model on rostral-caudal patterns of intra/extracortical connectivity in the auditory cortex; differential temporal response properties of rostral/caudal auditory fields; as well as task-based functional engagement of rostral/caudal regions of the auditory cortex.

In terms of auditory anatomical organisation, at the base level, auditory (or rather, cochlear) nerve fibres project from the cochlea to cochlear nucleus wherein the auditory signal is deconstructed into several parallel representations (along the ascending auditory pathway) including the anteroventral, posteroventral, and dorsal -cochlear nuclei (Jasmin et al., 2019). Such divisions converge towards the auditory midbrain (Malmierca & Hackett, 2010). Without delving into specific functionality and projections, the cochlear nucleus and its divisions can be inferred to contribute to different pathways of auditory processing and the detection of several kinds of informational features of the auditory signal (Jasmin et al., 2019). Prior to the obligatory relay station, the inferior colliculus (IC), the divisions, as a collective, project to the primary nuclei of the superior olivary complex and the lateral lemniscus (Jasmin et al., 2019; Shamma & Fritz, 2009). From the IC, the auditory signal is thence projected to the auditory thalamus wherein underlying thalamic nuclei (including another obligatory relay station, the medial geniculate body; Purves et al., 2001) project to the auditory cortex (Shamma & Fritz, 2009). This has a rostral-caudal orientation, with core (three primary fields: the primary auditory area/A1, the rostral area/R, and the rostrotemporal area/RT; Kaas, 2012) and belt (belt and parabelt) projections (Jasmin et al., 2019; Malmierca & Hackett, 2010), with the belt surrounding the core, bordered laterally by the parabelt (Kaas & Hackett, 2000).

Per Jasmin et al.'s (2019) computational model, the authors pointed towards distinguishing caudal and rostral auditory streams in their responsivity to sensory input. In terms of the caudal auditory fields, they were associated with shorter response latencies, onset responses, as well as somatosensory input, and functionally with the auditory sensory guidance of sound production, the sensory guidance and processing of motor responses (action) to sounds, as well as sound-related spatial computations. In terms of the rostral auditory fields though, this stream was associated with longer response latencies, sustained responses, as well as visual input, and functionally with auditory recognition processes, connections to semantic networks, as well as several auditory streams of processing. Of particular interest, are the caudal auditory fields due to their association with both spatial and somatosensory processing.

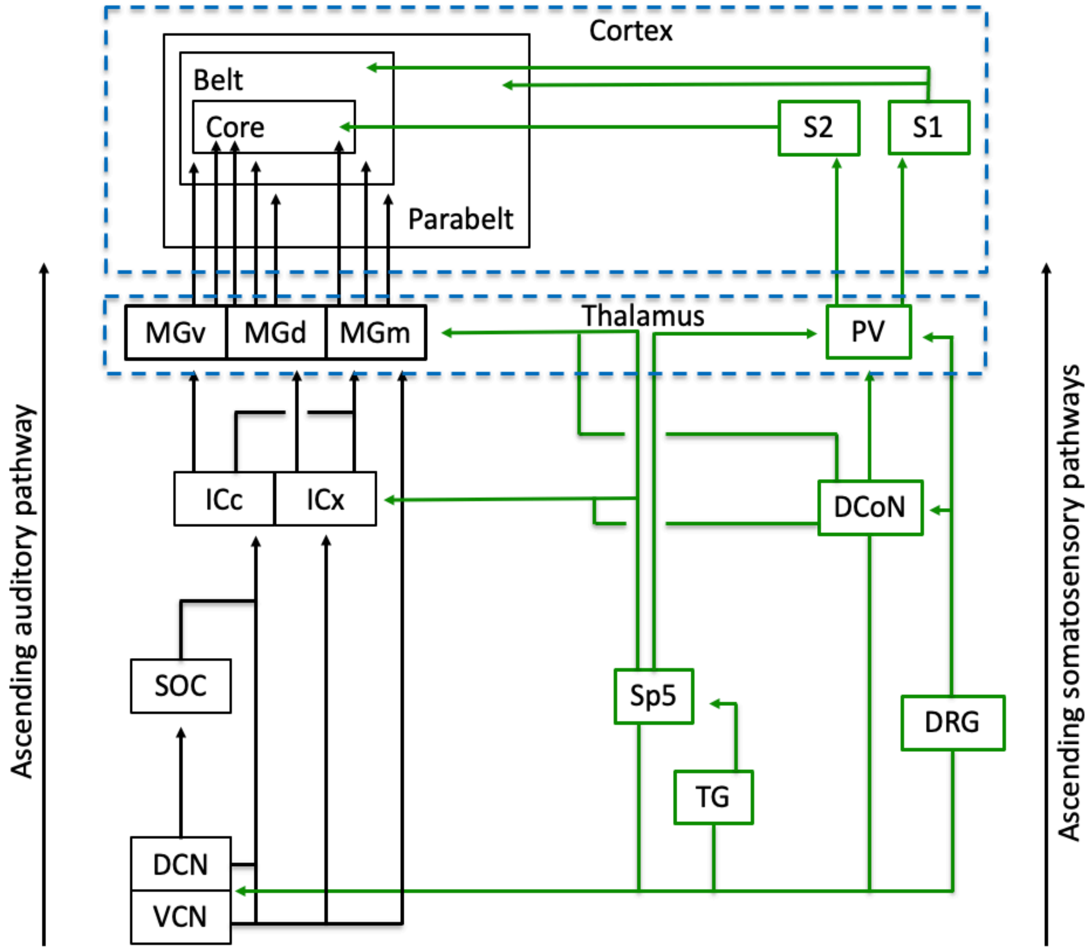
Traditionally, the sensory systems are regarded as separate entities (Wu, Stefanescu, Martel & Shore, 2015) yet events acting on a single sensory modality typically involve additional modalities and the auditory system is no exception, being subject to non-auditory influences such as vision and somatosensation (Hackett & Schroeder, 2009). Essentially, it would make sense for there to be sites of convergence of auditory input and input from another sensory modality, especially since such integration would improve the processing of the auditory signal (Wu et al., 2015). This is where Jasmin and colleagues' computational approach makes an impression – this evidential need to account for the many informational features an incoming auditory signal is deconstructed into, and the interacting computations. With specific focus on the possible link between audition and somatosensation, within the existing literature, there is evidence of somatosensory input influencing auditory processing from which an anatomical perspective happens at each level of the ascending auditory pathway, from the cochlear nucleus to the auditory cortex (Wu et al., 2015). The cortical links between the auditory fields and somatosensation, although rather lacking from a research standpoint, have still been reported on in studies of both human and non-human primates.

Starting with the latter, via intracranial recordings and fMRI, studies of non-human primates (macaques) have reported auditory-somatosensory convergence in the belt area CM, a subregion of the auditory cortex that is anatomically caudomedial (and directly adjacent) to the A1 (Kayser, Petkov, Augath & Logothetis, 2005; Fu et al., 2003; Schroeder et al., 2001; Smiley et al., 2007). This auditory-somatosensory convergence was suggested to underlie similar observable effects in humans (Fu et al., 2003). True, such an interaction has been reported as homologous in humans (Foxe et al., 2002). This highlights auditory-somatosensory convergence whereby the CM auditory fields in particular are responding not only to sound but also to touch as well as receiving inputs from somatosensory fields. More so, it evidences such convergence in cortical regions previously thought to be unimodal, regions that are earlier in the cortical processing hierarchy. This way, the traditional assumption that information from several sensory modalities undergoes substantial processing through unisensory systems followed by multisensory integration at a higher level of the cortical processing hierarchy (Foxe et al., 2002; Schroeder & Foxe, 2005; Lakatos, Chen, O'Connell, Mills & Schroeder, 2007) should be questioned. Thus, as previously suggested by Fu et al. (2003), such research has key implications for not only bolstering existing understanding of multisensory processing but also for revisiting and perhaps amending established views of unimodal processing. Now, although the findings suggest early multisensory integration (auditory-somatosensory), as highlighted by Foxe et al. (2002), not a lot can be said about the functional role of early integration. To this end, the authors proposed the early localisation of multisensory objects in space, while also proposing potential overlapping spatial maps in early cortical areas to solve the ‘binding problem’ (i.e., the challenge of identifying a mechanism underlying the process of how different features of sensory input are integrated into a single object, while also distinguishing it from the features of other sources; Burwick, 2014; Shamma, Elhilali & Micheyl, 2011; Treisman, 1996), with area CM as the key in both instances. Indeed, an intracranial recording study on non-human primates (rhesus macaques) revealed the role of caudal auditory belt areas (including CM) in the spatial localisation of sound (Rauschecker & Tian, 2000) and again, Jasmin et al.’s (2019) more recent reporting of the functional association of the caudal auditory fields in sound-related spatial computations. An illustration of the integration of auditory and somatosensory pathways, taken from Niven and Scott (2021), is provided in Figure 1.

As mentioned, the above research is lacking, and little progress has been made since the outlined study’s publications. However, there have been relatively recent reports of a perceptual phenomenon that seemingly encapsulates the likeness of a viable medium to further investigate the caudal auditory stream and may be reason enough (alongside Jasmin et al., 2019) to start thinking about cortical auditory modelling once again. This phenomenon is known under the initialism ‘ASMR’, or the autonomous sensory meridian response. What makes this particular phenomenon relevant, is the fact that it is an acoustically and spatially distinct response that is able to elicit somatosensation (specifically, a feeling of touch) – ASMR may be one of, if not the key missing piece that is needed to link the ways in which audition and touch interact in the 'real world'. So, based on the above discussion, it is entirely possible to elucidate that the caudal auditory fields, with their links to both somatosensory and spatial processing, may be vital in the perception of ASMR.

Figure 1

An illustration of the integration of ascending somatosensory and auditory pathways.



Note. This figure illustrates the integration of ascending somatosensory pathways (in green) into the ascending auditory pathway (in black). The dorsal and ventral cochlear nuclei (DCN, VCN) receive ascending somatosensory inputs from trigeminal ganglia (TG), spinal trigeminal nuclei (Sp5), dorsal root ganglia (DRG) and dorsal column nuclei (DCoN) via the marginal cell area of the VCN. Also, there are separate inputs to the central and external nuclei of the inferior colliculi (ICc, ICx), and the auditory thalamic nuclei. There are projections from primary and secondary somatosensory cortex (S1 and S2, respectively) to core, belt and parabelt auditory fields. [superior olivary complex = SOC, dorsal nucleus of medial geniculate body = MGd, medial nucleus of medial geniculate body = MGm, ventral nucleus of medial geniculate body = MGv, posterior ventral nucleus of thalamus = PV). Adapted from Niven, E. C., & Scott, S. K. (2021). Careful whispers: when sounds feel like a touch. *Trends in Cognitive Sciences, 25*(8), p. 646.

CHAPTER 2: An Overview of the Autonomous Sensory Meridian Response

2.1. What is ASMR?

The autonomous sensory meridian response, or more commonly recognised under its initialism ASMR, is a relatively recent description of an atypical perceptual phenomenon that has seen a gradual rise in research over the past few years. ASMR is best described as a pleasant experience that encompasses somatosensation (typically described as a tingling sensation) as well as a feeling of relaxation typically reported to be emotionally positive (Barratt & Davis, 2015; Poerio, 2016). The phenomenon is elicited via a range of audiovisual stimuli (informally termed 'triggers' by ASMR online communities) and is said to have a somatic distribution primary to the scalp and neck which may radiate downwards to the shoulders, back, and limbs (Barratt & Davis, 2015; Smith, Fredborg & Kornelsen, 2017). It is worth noting that despite the research and online communities adopting the use of the term ASMR, the words that make up the initialism are not accurate descriptors of the sensory experience attributed to the response and likewise for the method of elicitation. As detailed in Niven and Scott (2021), an alternate term such as audiovisual elicitation of somatosensation (AVES) is more apt for (at the very least) research. However, due to ASMR being the dominant terminology present both within and outside existing literature, the term 'ASMR' will be used throughout the entirety of the thesis.

In spite of the issue in chosen terminology, of the stimuli that elicit the response, research has shown these consistently include whispered speech, nonverbal sounds (e.g., tapping) and 'personal attention' roleplays (e.g., Barratt & Davis, 2015; Fredborg et al., 2017; McErlean & Banissy, 2017). To note, the stimuli are not limited to these examples and there appears to be an inconsistency in terms of this general audiovisual description. While the vast majority of ASMR stimuli contain an auditory element (e.g., speech or object sounds), it is actually unclear whether or not other sensory/non-sensory properties such as visual, spatial, interpersonal and/or environmental elements are just as important to the elicitation and intensity of the response or are better outlined as sub properties. Regardless, the stimuli are still external and mostly social (i.e., generated from human-centric movement and behaviour) in their nature (Poerio, Blakey, Hostler & Veltri, 2018). Until recently, the prevalence of ASMR was unknown, but thought to be highly prevalent in the general population (McErlean & Banissy, 2018). Poerio, Ueda, and Kondo (2022b) recently suggested an approximate 20% ASMR-sensitivity in the general population based on their study that investigated the prevalence rate of synaesthesia in ASMR in the general population. Studies have also reported the age of onset to be between 5-15 years (Barratt & Davis, 2015; Poerio et al., 2018) and the onset time for experiencing the response at 59.54s with a range of 0-90s (Smith et al., 2017). With a rise in empirical research conducted on ASMR in recent years, on ASMR stimulus properties, phenomenology, the personality, physiological and neural profiles, and potential benefits, this review will explore the findings, as well as compare the response to other more well-established atypical perceptual phenomena including synaesthesia, frisson and misophonia.

2.2. The Online Emergence and Following of ASMR

Reports of individuals experiencing ASMR have long predated the internet (Gallagher, 2016) yet it has been as recent as 2010, that the phenomenon gained public attention (del Campo & Kehle, 2016), and 2015 when the first peer-reviewed article was published (Barratt & Davis, 2015). Thus, it is understandable that research into the response is scarce (Poerio et al., 2018) but on the rise. Over the last decade, the internet and the rise in social networking has enabled the labelling of the sensation under the initialism ASMR (Poerio et al., 2018). Indeed, the roots of the phenomenon as it is known today can be traced back to discussions in online health forums with one individual, Jennifer Allen, taking it upon themselves to coin the term under the initialism 'ASMR' in an effort to create an objective and definitive term for the phenomenon, a term that would also safeguard the ASMR community from ridicule (Richard, 2016). Since its coining, ASMR has gradually spread to several online platforms such as Reddit (https://www.reddit.com/), YouTube (https://www.youtube.com/), and Spotify (https://open.spotify.com/) where it has amassed a thriving online culture (Bjelić, 2016; Eid, Hamilton & Greer, 2022; Gallagher, 2016), sometimes referred to as the 'Whisper Community' (Andersen, 2015).

Certainly, one can trace back its online expansion via publicly available worldwide search term history whereby searches for the term ASMR began to increase close to the year it was coined (around 2010), starting from mid 2011 and up to late 2012 (Google Trends, 2011; 2012). To this end, with the sheer number of ASMR videos circulating on online platforms, such media draws in thousands to millions of hits and subscribers (Eid et al., 2022). This is reflected in Google web searches and YouTube searches from the years 2004 (when this data was first collected) to 2023 (Google Trends, 2023a; 2023b; *see* Figures 1. and 2.). Away from the ASMR population though, regular internet users will likely be familiar with the initialism (Koumura, Nakatani, Liao & Kondo, 2019), expressing the extent to which ASMR has circulated online, arguably achieving a status of online 'fame' in recent years. Taking all of this into consideration, it appears sensible to state that ASMR emerged in online networks, while at a glance, this method of delivery may also be how it has spread.

Klausen (2019b), in consideration that online searches for ASMR (from 2012 specifically) skyrocketed, argues that this explosive growth appears to be caused by supply and demand. In this case, the demand quite obviously is in reference to more/new content able to elicit ASMR, and the supply being the available content to elicit the response, content that is now specifically created by individuals who are appropriately referred to under the portmanteau 'ASMRtists' (Barratt, Spence & Davis, 2017). *Briefly, due to its informality, subsequent use of the term ASMRtist(s) will thus be referred to under the term 'host(s)'.* While it is sensible to assume that demand for ASMR has increased since the term's coining and that this has been met with a supply that has been specifically tailored to elicit the response, one must also consider the role of the internet and social networks in the spread of ASMR considering its origin (and continuation) as a sort of internet culture.

In line with this, it has been proposed that current research now supports the view that there is indeed an interaction between humans and machines versus a previous division of the real world from the digital world (Waldron, 2017). This leans on the idea that digital (algorithmic) and human behaviours are combinable. Central to this, is the work of Gallagher (2016) who argued that algorithmic organisation of online platforms (i.e., search engines) is as responsible for the spread of ASMR, as the individuals who searched for it. What Gallagher meant by this, is that people searching for ASMR may have ultimately led to such jargon being algorithmically spread and solidified prompting algorithmic search/sidebar suggestions for ASMR, and vice versa.

Building on this, Waldron (2017) argues that the emergence of ASMR thus, is owed to both online platforms and forums, and the sharing capabilities of social media and mainstream media coverage, again hinting at the spread of ASMR equally shared between algorithmic and human interaction. Additionally, it is highly plausible that the anecdotal and now researched claim that ASMR has therapeutic utility for conditions such as anxiety and insomnia, or even the relaxation it is attributed with alone, has bolstered this dual human-algorithmic take on the emergence and expansion of ASMR. This does indeed seem to be a more appropriate way to justify how ASMR has emerged and spread, and at an explosive rate, via an act of both algorithmic and human involvement. The following of ASMR thus, refers mainly to the so-called whisper community where the growing availability of ASMR content has provided ASMR-sensitive (and possibly even ASMR-insensitive) individuals, the ability to continually revisit this content and discover new ASMR stimuli, enabling them to greatly increase the likelihood of experiencing ASMR on an everyday basis (but not accounting for possible habituation).

Figure 1

Google searches for ASMR from the years 2004-2023

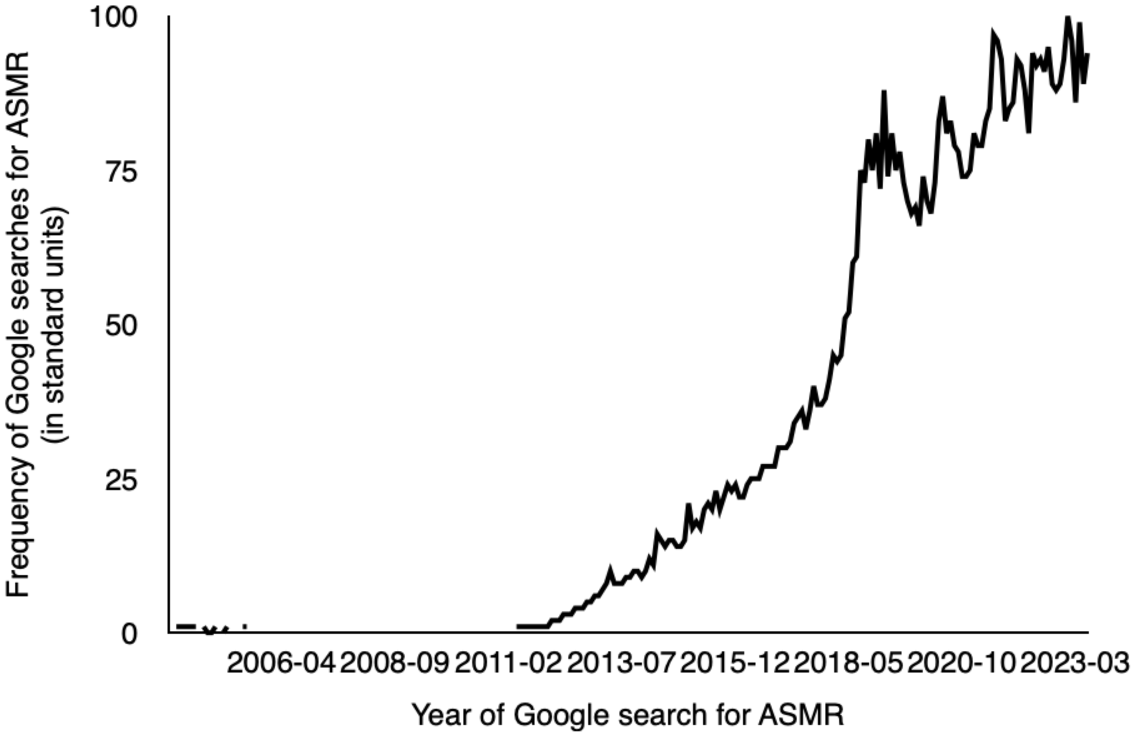
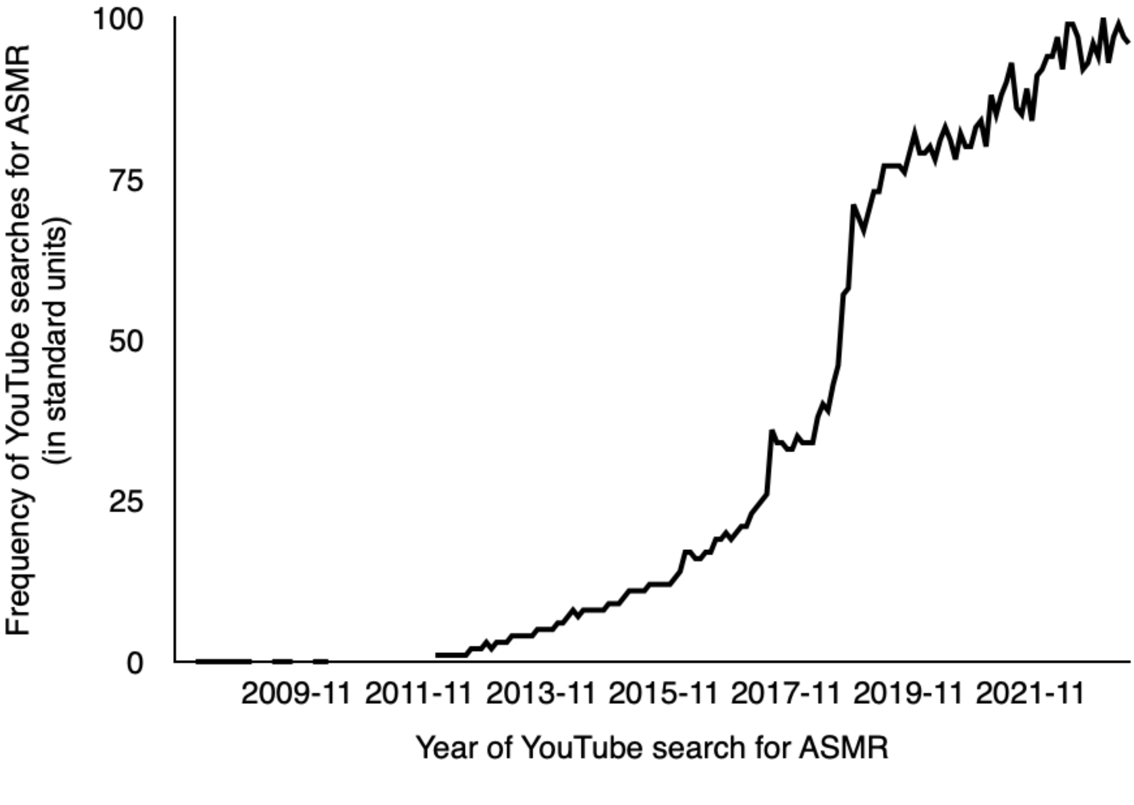


Figure 2

YouTube searches for ASMR from the years 2004-2023



2.3. ASMR-Eliciting Stimuli

Previous studies have surveyed ASMR-sensitive populations to gain an insight into their experiences (Kovacevich & Huron, 2019). Of particular interest here, is the research that took typical examples of ASMR-eliciting stimuli prevalent on online platforms and reported on the likelihood of such stimuli in eliciting the associated sensations of the response in ASMR-sensitive samples. This way, such research produced lists of ASMR-eliciting stimuli (e.g., Barratt & Davis, 2015; Fredborg, Clark & Smith, 2017; McErlean & Banissy, 2017; Poerio et al., 2018).

Barratt and Davis (2015) were the first to publish a peer-reviewed paper on ASMR. The researchers recruited a sample of self-reported ASMR experiencers (via the ASMR subreddit 'ASMR. Sounds that feel good'; https://www.reddit.com/r/asmr/) and provided them with an exploratory survey on demographics and ASMR characteristics. Of particular relevance, the researchers wanted to identify and compile a list of the most common ASMR-eliciting stimuli. The stimuli they selected were chosen from those that were typical of ASMR media at the time and encompassed several sensory domains including audition and vision while also having interpersonal qualities.

Considering audition, whispering topped their list as the most highly ASMR-inducing stimulus with 75% of participants reporting as such, while nonverbal 'crisp sounds' such as the sound of foil and finger/nail tapping were reported by 64% of participants. Considering vision, this included seeing movements – both slow (53%) and repetitive (36%). Generally, in ASMR media, movements refer to a host moving parts of their body (e.g., hands, head) or an object (e.g., brushing hair or the microphone itself) which are deliberately slow and repetitive to evoke ASMR sensations. One stimulus in particular was strongly audiovisual, while also consisting of a highly interpersonal quality – 'personal attention' (69%). Personal attention is a mix of stimuli where a host, typically in the form of a role-play, essentially attends to and pampers/cares for the listener via motivational/encouraging (whispered) speech while making consistent eye-contact (with the camera but in a way that appears as if they are looking at the viewer-listener) and using slow and repetitive movement of their hands (as if reaching out to the viewer-listener), head (e.g., nodding in a sort of gestural sense of agreement), and/or object hence the mix of auditory, visual, and interpersonal properties. A framing device in the form of a narrative thus appears to be essential and examples could include visiting a spa, friend, or hairdresser even and thus draws on real life events.

A similar pattern of results is reported by McErlean and Banissy (2017) whose participants (also self-reported ASMR-sensitive individuals recruited from the ASMR subreddit) indicated their favourite ASMR stimuli and responsiveness to specific ASMR stimuli. For reference, the authors described responsiveness as the degree to which a stimulus evokes ASMR by choosing 1-of-4 options (no, mild, strong -effect, or unpleasant/uncomfortable), and thus, is essentially a measure of the intensity of the ASMR experience for the set of stimuli incorporated. Whispering was the strong favourite, at 41%, followed by crisp sounds (36.1%) and personal attention (34.9). Regarding responsiveness, specifically the strong effects, whispering was the strongest inducer with 54.2%, followed by finger tapping (53%), brushing (49.4%) and two personal attention role-plays (visiting the: doctor-44.6% and spa-39.8%). Several subsequent studies have reported similar findings (Fredborg et al., 2017; Kovacevich & Huron; 2019; McErlean & Osborne-Ford, 2020; Poerio et al., 2018).

To note, the ASMR-eliciting stimuli reported in these studies have come from those specific to ASMR media, stimuli that are indeed common and intended to evoke ASMR and are effective in doing so. This is not to say however, that ASMR cannot occur outside the realm of online-situated ASMR media as the response can be elicited unintentionally. Indeed, the majority of stimuli specifically intended to elicit ASMR likely originated from day-to-day activities/occurrences. A good example of this may be going to get a haircut which typically consists of multiple elements such as the snipping of the scissors, brushing off cut hair, the feel and sound of the trimmer, and the focused attention of and interaction with the hairdresser, which are all common ASMR stimuli on their own and collectively as a specific personal attention roleplay. In fact, one participant in Kovacevich and Huron's (2019) study commented on how Bob Ross triggered their ASMR long before the initialism existed – this is also commonly echoed in anecdotal accounts. Bob Ross was a painter who had his own instructional television series where he would paint a scene whereby his 'personal attention' to the viewer-listener, his softly spoken / almost whispered voice, and the sound of the paintbrush is akin to that of what would be considered ASMR-inducing qualities.

Overall, what the collective studies have shown, by compiling lists of common ASMR-eliciting stimuli, is that audition and vision are the core sensory modalities that make up ASMR stimuli, but also that such stimuli can be cross-modal and have sub-properties that should not be disregarded. Although such lists are non-exhaustive (Barratt et al., 2017), the studies only incorporate a small number of ASMR-eliciting stimuli. Yet, they have effectively identified some of the most common examples as their research intended. Focusing on a smaller number of stimuli that are more frequent in ASMR content versus attempting to include as many stimuli associated with evoking ASMR experiences may have been and may still be the better option overall. Using fewer stimuli would make the study feasible and using common ASMR stimuli would make it more likely that ASMR responses are elicited in sensitive individuals.

Alternatively, while incorporating common ASMR-eliciting stimuli mostly caters for differences in preference, there will always be individual differences and often at two levels. The first is the difference in the stimuli that evoke an experiencer's ASMR (i.e., a stimulus preference). For instance, one person may prefer solely auditory stimuli while others may prefer solely visual stimuli or those that are audiovisual. This extends, of course, to specific categories of stimuli such as whispering and personal attention and even sub-categories within these. Indeed, the collective research findings convey this variability. Second is the difference in the intensity of the ASMR experienced (i.e., individualism). For instance, ASMR-sensitive individuals may respond to the same categories/sub-categories of ASMR stimuli but differ in the intensity to which such stimuli elicited their response.

Moreover, despite some stimuli frequently eliciting ASMR content such as whispering and personal attention, because ASMR is continually developing and branching out, the rise of new ASMR-eliciting stimuli and changes in preferences are unavoidable, ultimately deepening the complexity of an individual's preferences. This makes it even harder to account for 'common' ASMR stimuli. Fredborg et al.'s (2017) factor analysis of their 'ASMR Checklist' revealed that the stimuli reported in their study clustered into five components versus one component. This prompted the authors to suggest that there may be ASMR subtypes, similar to that of other cross-modal atypical perceptual phenomena like synaesthesia. This may represent a solution, especially regarding variability in individual stimuli preferences and intensity of the ASMR experience.

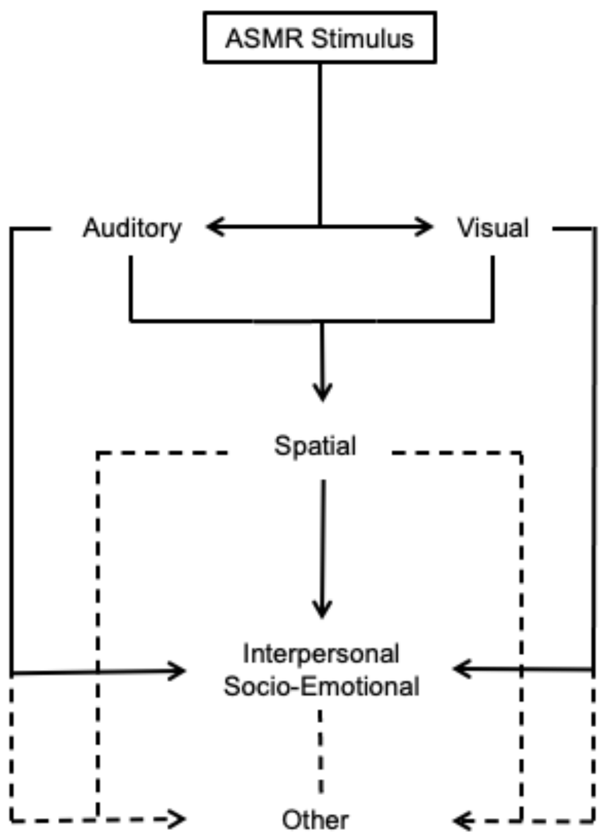
A final point of consideration with these studies, is that they only report on the more general ASMR-eliciting stimuli, and while this is useful, developing larger databases of effective ASMR-eliciting stimuli for future research that would also cater to several potential areas of research, would be more beneficial. An attempt was made by Fredborg et al. (2017) but included a limited number of stimuli (14) and is thus questionable. More recently though, Liu and Zhou (2019) established a video library of 60 ASMR-eliciting stimuli, and a recommended (for research) video library of 12 ASMR-eliciting stimuli (categorised into strong, medium, weak -intensities of ASMR). Although results indicated the stimuli to be reliable and effective ASMR inducers, it is still preliminary but promising, nonetheless.

2.4. ASMR Stimulus Properties

There is more to ASMR-eliciting stimuli than the stimuli alone. On the surface, the audiovisual nature of ASMR and listing the stimuli most likely to evoke the response seem to take precedence, meanwhile, the underlying properties of ASMR-eliciting stimuli and the qualities hosts possess often go unnoticed and overlooked. Although hosts can be individualistic in that they have their own style of ASMR akin to a method of distinguishing themselves and offering something different from ‘competing’ hosts, they do tend to adopt a few general features that they incorporate in their content. In this, hosts often speak directly into, and at proximal distance to the microphone, typically speaking in sibilant whispers and repeating particular words/phrases, all while maintaining a caregiving attitude (Manon, 2018). A similar case can be made for nonverbal ASMR content. In this sense, ASMR media can be considered somewhat formulaic though with many hosts seemingly adopting/incorporating one, if not all these features, means they may be vital to the process in which ASMR is triggered in the viewer-listener. Ultimately, describing ASMR as being triggered via audiovisual stimuli alone is too simplistic considering that there is clearly something a lot more complex going on hence the need to outline any potential underlying properties – to get a better idea of the properties that evoke and intensify ASMR (*see* Figure 3.). Thus, underlying spatial, auditory, visual, and interpersonal stimulus properties and other relevant factors will be reviewed below.

Figure 3

Preliminary ASMR stimulus property mapping



2.4.1. Spatial Location of Sound

With regards to the spatial location of sound, an early example of ASMR (prior to its coining) has shown that sound presented proximally (but not distally) to the head resulted in participants reporting a tactile tickling sensation (Kitagawa & Igarashi, 2005). Interestingly, these researchers used the sound of an ear being brushed on a dummy head microphone – a sound not at all uncommon in current ASMR media while ASMR content is typically recorded in close proximity to the microphone.

Indeed, a recent study on ASMR suggested that the interaction between audition and somatosensation relates to the ability to localise sound in the space around the head (Koumura et al., 2019). This may tie in with the microphones hosts use to record content and why ASMR-sensitive individuals wear ear/headphones while listening to ASMR.

Hosts typically use binaural microphones (microphones that sit in the ears, *for an overview, see* Paul, 2009) to record their content. Survey research has referred to this with one study, Barratt et al. (2017) reporting 84% of their sample regularly consumed binaural ASMR content with 58% feeling that binaural ASMR was more effective than regular (i.e., monaural) ASMR, and 61% feeling that binaural ASMR intensified the ASMR experience. Also, another study reported that several of their participants specified a preference for binaural headphones in order to experience the depth of the sound (Barratt & Davis, 2015). This way, recording ASMR content close to the microphone and listening to it with (regular) ear/headphones may help elicit and/or intensify ASMR sensations by reducing spatial distance such that a sound recorded at a proximal distance to the microphone is heard and localised in the space surrounding the head. The use of binaural microphones and binaural ear/headphones may reduce this spatial distance and extend the intensity of the ASMR experience further.

A more recent study though, did report of preferences in spatial distance whereby water pouring (a less common nonverbal ASMR-eliciting stimulus) is preferred at a ‘higher’ distance (i.e., well above the microphone) (Barratt et al., 2017). The researchers however, argued that this was due to the confound of sound where louder sounds are less likely to evoke ASMR but can remain effective distally. This infers that there are times (albeit uncommon) when ASMR-eliciting stimuli do benefit from distal locations, and that there are likely other properties at work that are having a combined effect with spatial location that need addressing. The auditory, visual, and interpersonal properties may represent such properties.

2.4.2. Auditory Properties of ASMR-Eliciting Stimuli

Most ASMR-eliciting stimuli are auditory in some aspect (Barratt & Davis, 2015). This is consistent in findings from studies that have listed common ASMR-eliciting stimuli, with whispered speech rated as highest in all (*refer* to 2.3.). While ASMR stimuli may often be audiovisual, audition plays a key role. However, the underlying auditory properties have received less attention. For example, the literature suggests that whispering is the most common ASMR-eliciting stimulus, yet there are no studies suggesting why this is. It is more than likely that there are consistent acoustic, phonetic and/or interpersonal properties that may be relevant in evoking and intensifying the experience of ASMR.

In a more recent study, Koumura et al. (2019) investigated ASMR stimulus properties plus individual mood states and personality traits via self-report questionnaires and estimates of ASMR for a 17min duration of participants listening to solely auditory binaural tapping and brushing sounds. Of the findings related to stimulus properties, the authors reported that participants' estimates of ASMR were very strongly associated with acoustic features. Specifically, this included differences in amplitude, spectral centroid, and spectral bandwidth. This led the researchers to suggest that the finding is indicative of ASMR being more easily evoked by low-pitched sounds with dark timbre.

This is consistent with previous survey research reporting 77% of an ASMR-sensitive sample agreed that the pitch of ASMR stimuli affected the intensity of the ASMR experience, with the majority (56%) reporting that low-pitched ASMR sounds produced more intense ASMR (Barratt et al., 2017). This preference ties in with a previous study on music-assisted relaxation on anxiety reporting that the pitch of a sound should be low to promote relaxation since high pitched sounds tend to elicit tension (Robb, Nichols, Rutan, Bishop & Parker, 1995). One of the associated sensations attributed to ASMR is relaxation while there is evidence both anecdotally and within the literature to suggest ASMR is and can be used to combat conditions like anxiety and thus low-pitched ASMR may behave in a similar way to low-pitched music.

This preference may also tie in with the spatial location of sound in terms of the proximity effect where the closer the microphone is to the sound being recorded, the greater the increase in a low frequency response. Although this description may indeed be a good description of an ASMR stimulus such as whispering, it may not be representative of every ASMR stimulus (e.g., nonverbal crinkling) and thus pitch and timbre alone may account for the ASMR experience.

Phonetic characteristics may also be important. In their example of auditory ASMR stimuli, Scott (2016) referenced the whispering of plosive consonants. Both plosives and fricatives appear to frequent ASMR content. Plosives are produced by constricting airflow in the vocal tract (using the lips, teeth, or the palate) followed by suddenly opening the tract and releasing the built-up pressure (Alwan, Jiang & Chen, 2011) and in English consists of the letters b, d, g (voiced) and p, t, k (voiceless) (Asadi et al., 2020). Conversely, fricatives are produced by constricting airflow in some regions along the vocal tract where air blown through the constriction is turbulent (Alwan et al., 2011) and in English consists of the letters z, v (voiced), s, f, h (voiceless) and the voiceless sound ʃ (Asadi et al., 2020). These plosives and fricatives are particularly observable in 'trigger word' videos, a staple in ASMR media. The words or phrases incorporated within these differ from video-to-video, though they share a few similarities in that they: are whispered, repeated successively, often emphasise plosives and fricatives, and can be interpersonally connotative. Phonetic analyses on verbal ASMR content then, may be provide insight into why particular words and phrases are effective at eliciting and/or intensifying ASMR sensations.

On interpersonal properties, as stated by Manon (2018), hosts typically employ an attitude of caregiving within their content. This interpersonal quality to a host's voice has recently been referred to as 'semantic dialogues' (dialogues wherein social interactions occur) (Liu & Zhou, 2019), and have both social and emotional undertones though single trigger words and phrases arguably contain this quality also. Regardless, this interpersonal quality is observable in not only the host's voice, but also in their movements and interactions with objects (visual stimuli).

Away from potential underlying acoustic, phonetic and socio-emotional properties, there are other auditory factors that may influence ASMR including: repetitive sounds, auditory manipulations, and the language/accent of a host. First, the successive repetition of sounds is typical of ASMR media (e.g., trigger words/phrases or nonverbal sounds such as tapping) and is comparable to the repetitive movements hosts typically employ within their content. Repeating trigger words or phrases may help evoke and potentially prolong (and intensify) ASMR sensations due to the consistent repetition of a word(s) whose underlying auditory properties (e.g., low pitch, whispered versus typical speech, interpersonally connotative) are helping to evoke and intensify ASMR. Second, hosts can manipulate their recorded content by including, for example, overlays or echoes (of the recorded audio) which may achieve a similar effect as the one proposed for repeating words/phrases. Third, differing auditory properties may make one language or accent more effective at evoking and/or intensifying ASMR than others and anecdotally, there have been references to language preferences. There are likely other factors of audition, not described here, that may be overlooked but relate to the experience of ASMR.

Thus, ASMR entails more than simple aspects of auditory stimuli. Despite mainly being auditory, it is worth noting how ASMR and ASMR-eliciting stimuli still encompass properties from several sensory domains. Still, ASMR would benefit from future exploration of the role of audition – an investigation of the auditory properties (acoustic, phonetic, and socio-emotional / interpersonal) underlying ASMR stimuli. An insight into the role of these properties on ASMR may also identify methods of developing effective ASMR-eliciting stimuli.

2.4.3. Visual Properties of ASMR-Eliciting Stimuli

ASMR is rarely reported to be elicited by visual stimuli alone. This may be because seeing a host and/or object that they are manipulating, is less important to the sounds that a host or object produces. Whether seeing a host or stimulus object is necessary to the experience of ASMR is something that has been researched.

As discussed earlier, a pre-ASMR study, Kitagawa and Igarashi (2005), reported that their participants experienced an auditory illusion wherein sound presented proximally to the head induced a somatosensory tactile sensation (similar to ASMR). By presenting solely the sound or images (or both) of the stimulus (ear brushing on a dummy head microphone), viewing the scene had little-to-no effect on the tactile sensation. This suggests that an auditory stimulus is more likely to induce ASMR than a visual stimulus.

Specifically addressing ASMR, Barratt et al. (2017) explored visual aspects of ASMR-eliciting stimuli in their survey which included: focus on small physical details, material, symmetry, and colour of ASMR-eliciting stimulus objects. Here, participants were asked to indicate how important each aspect was in eliciting ASMR. The findings were mixed, especially for focusing on small physical details and material. However, colour and symmetry were least important with 53.5% and 39.4% of participants respectively indicating these visual aspects were not at all important. From this, the authors suggested that visual aspects of ASMR-eliciting stimuli can influence ASMR but appear to be less vital than their auditory counterparts, later concluding that for many ASMR-sensitive individuals, the sounds of ASMR-eliciting stimuli are effective at evoking the ASMR experience without the need to visually see the object of the sound’s origin.

In a more recent study, Koumura et al. (2019) determined whether ASMR-inexperienced individuals could reliably experience ASMR after a 2-week break, to which they reported high reliability. Interestingly, the ASMR stimuli were solely auditory. This indicates not only that ASMR-inexperienced individuals may likely be able to easily experience ASMR and thus, questions how widespread the phenomenon is within the population, but also suggests that seeing a stimulus may not be as important as the sound it makes.

Generally, these studies suggest that visual stimuli are poorer at eliciting ASMR experiences. This is not to say that vision is irrelevant, as seeing a stimulus may enhance or amplify the experience of ASMR, in both evoking the response and potentially intensifying it. There may also be those who prefer solely visual stimuli. Also, one must consider that research on common ASMR-eliciting stimuli consistently reports personal attention as one of the most highly ASMR-inducing stimuli, yet this is a stimulus that does not always require a great deal of audio but near always requires visual elements such as repetitive movements and (the host) interacting with / focusing on objects and/or the viewer. Within these personal attention roleplays (and general ASMR videos), one could argue that attention is key, visually attending to the host (and thus evoking somewhat of an interpersonal association), the stimulus objects, and/or the recording microphone (if in view). Likewise, performance also fits in with this concept of attention in which ASMR, especially these personal attention roleplays can be seen as a performance given by the host, for the viewer-listener to attend to. Providing the viewer-listener with something to concentrate on while listening to the sounds being produced (which is originating from said ‘something’) may add to or even intensify the ASMR experience, while it may also make individuals associate what they are seeing with real life instances. Whether attention and performance are as relevant as audition in ASMR is an unknown but does indeed fuel the audition-vision debate.

Interestingly though, support can be drawn from the research of another similar perceptual phenomenon in misophonia. Despite being elicited via mainly auditory stimuli, visual stimuli have been thought to amplify misophonic episodes (Taylor, 2017) with one study reporting that unpleasant sounds were perceived and rated as more averse when the played sound was accompanied by an image associated with that sound (e.g., the sound of scraping accompanied by the image of fingernails on a blackboard) (Cox, 2008). This could translate over to ASMR whereby visual stimuli accompanying their auditory counterpart result in more intense ASMR sensations. Again, this also touches on the idea that ASMR is truly cross modal with ASMR-eliciting stimuli encompassing properties from several sensory domains – in this case, visually attending to the host/object and listening to the sound they produce.

Another potential role for visual stimuli is in the context of the ASMR content. What is meant by this is the backdrop/s used in the content, props, and appearance of the host to basically set the scene such that it matches the ASMR the host intended to create – often the case for personal attention roleplays.

Generally, whether seeing an ASMR-eliciting stimulus is important to the elicitation of ASMR needs exploration. Even in the case for personal attention, audition is still a key component. It is possible that ASMR media may have influenced the concept of ASMR being elicited via audiovisual stimuli since ASMR-specific content is often solely audiovisual. Here, experiencers may be conditioned to associate the ASMR they are experiencing with both the auditory and visual aspects of the stimulus since this is the norm. However, seeing the stimulus may be less important in generating ASMR compared to the accompanying sound. This is similar to how spatial and interpersonal properties are overlooked but play a role in ASMR. Therefore, it may be appropriate to describe ASMR as elicited via mainly auditory, and not audiovisual stimuli, though perhaps not until research has hailed similar findings to those discussed above.

2.4.4. Interpersonal Properties of ASMR, and Intimacy

Interpersonal factors seem to be important to the experience of ASMR, observable in both auditory and audiovisual ASMR-eliciting stimuli. The vast majority of ASMR media include interpersonal stimuli such as whispering and personal attention (Barratt et al., 2017) which Poerio et al. (2018) suggests may impact social and non-social feelings. Despite this, interpersonal properties of ASMR is not a topic that often comes up in the literature hence the lack of research (Klausen, 2019b). The potential reasoning behind this interpersonal property of ASMR will be explored with emphasis on spatial, visual, and especially auditory, properties of ASMR and its association with personality traits.

It is worth considering the voice of the ASMR host. As previously mentioned, Liu and Zhou (2019) recently discussed what they referred to as semantic dialogues in ASMR, dialogues in which social interactions occur. Despite there not currently being a conversation or discourse analysis on dialogue taken from ASMR videos, solely watching/listening to a few ASMR videos can easily give one a sense of how noticeable it is that hosts almost always refer to the viewer-listener within their dialogues, scripted or unscripted and independent of the type of ASMR. The typical ASMR dialogue is thus evocative of social interaction, albeit one that is simulated. Moreover, as previously stated, Manon (2018) noted how hosts employ an attitude of caregiving within their content. A host's use of personal pronouns to address the viewer-listener, use of emotive language, and the methods used to deliver their speech (e.g., via whispering) can make the ASMR produced come across as personalised while also conveying this caregiving attitude. Taken together, ASMR content produced should have distinguishable interpersonal qualities, though one must stress their presence is not limited to solely auditory, but also visual -stimuli and spatial properties which can all interact.

Research has also suggested that the spatial location of ASMR stimuli may have a role in eliciting and intensifying ASMR experiences. It is possible that reducing spatial distance by recording stimulus sounds at a proximal distance to the microphone is heard and localised in the space surrounding the listener's head, with binaural microphones and ear/headphones potentially increasing the reality of the spatial locations of the sounds and intensifying ASMR experiences further. When hosts record their content close to the microphone and listeners use ear/headphones when listening, ASMR may be more easily elicited and may be more intense (*refer to* 2.4.1.).

One could also infer that this supposed reduction in spatial distance of ASMR-eliciting stimulus sounds prompts simulated social interaction by bringing the host and listener closer thus having an interpersonal effect in the form of some sort of temporary pseudo companionship. This way, the simulated realness of the sounds may enhance social aspects. Indeed, this viewpoint has seemingly been expressed in the literature on at least two separate occasions.

First, Smith and Snider (2019) argued that "these [ASMR-associated] sounds are intimate because the listener has to be close enough to hear them". If the ASMR stimuli are heard as proximal, listeners may feel as if the host is 'physically' standing next to / behind them whispering 'directly' into their ears.

Second, and tying in with this proposed spatial-interpersonal association, is Klausen's (2019b) concept of the pronoun 'you'. With sound guiding this idea of spatial proximity, audition clearly plays a key role in the perceived closeness of the host to and by the listener. Andersen (2015) has discussed this in outlining how ASMR experiences are reliant on the impression of the host's voice to produce an intimate aural space that is shared between the host and listener. Building on this, Klausen (2019b) argues that the use of the pronoun ‘you’ by hosts can be seen as a mechanism for both producing and visibly highlighting the distance between host and listener, while also enabling the listener to feel addressed, embraced and relaxed without the need to account for (real) social interaction. Here, the language a host uses can be seen as a form of personalisation while guiding spatial proximity whereby the personalised language (personal pronouns) a host uses may provoke a sense of shared closeness since the host is (indirectly) addressing the listener. In fact, Poerio et al. (2018) recently reported that spoken ASMR videos made ASMR-sensitive subjects feel more socially connected compared to matched controls, a finding that did not occur for nonverbal auditory ASMR videos. They went on to theorise that ASMR is potentially a form of social grooming (which in humans, has been defined as a behaviour that constructs social relationships; Takano & Ichinose, 2018) that facilitates wellbeing and interpersonal bonding.

Arguably, the use of emotive language and the underlying auditory properties discussed here (*and in* 2.4.2.) may also have a similar effect to personal pronouns. Taken together, personalisation in the form of personal pronouns spoken by a host while addressing the listener, along with spatial proximity (i.e., audio-spatial interactions), make a case for interpersonal socio-emotional properties underlying ASMR and its stimuli (particularly auditory / audio-spatial).

With this (audio)spatial-interpersonal association concentrating on auditory ASMR-eliciting stimuli, seeing the host may also have a similar, if not, additive effect in terms of closeness – especially in the case of personal attention ASMR. More recently, Klausen and Have (2019) have argued that ASMR provides sociality through telepresence and pseudo-haptic experiences, experiencing a sense of touch and presence through digital/technological means. In terms of ASMR, seeing the host on screen or seeing them reach their hand out to the microphone as if they were about to touch the viewer-listener may stimulate the viewer-listener to feel as though the host is physically with them and about to physically touch them. Waldron (2017) touches on this in that technological mediums are allowing the transcendence of distance such that a host's presence and touch can be 'felt' rather than 'thought' where the auditory amplification of microphones and ear/headphones make these experiences possible. In essence, there appears to be a sensory expectation and such an effect is not unlike that seen in another perceptual phenomenon known as mirror-touch synaesthesia outlined in later sections.

Accounting for the outlined theories on the interpersonal properties of ASMR, Klausen (2019a) suggested 'para-haptic interactions' as an argument for ASMR being felt as somatosensory (tactile/haptic specifically) both physically and imaginatively via binaural qualities and narratives/role-plays that are supported by audio and visuals.

Finally, within the personality research, ASMR-sensitive subjects have been reported to score higher on neuroticism (Fredborg et al., 2017). Neuroticism makes up one dimension of the Big Five Inventory (BFI) of personality traits and is included in most major models, including both three and five-factor models (Lahey, 2009). The trait refers to individual differences in negative emotional responses and is operationally defined by several items referring to: irritability, anger, hostility, vulnerability, anxiety, depression, and self-consciousness (Fredborg et al., 2017; John and Srivastava, 1999; Lahey, 2009; McErlean & Banissy, 2017).

Interestingly, ASMR has been suggested to temporarily attenuate depression, stress, and anxiety (Baker, 2015; Barratt & Davis, 2015; Bjelić, 2016; Poerio, 2016). Previous survey research reported that a portion of an ASMR-sensitive sample demonstrated moderate-to-severe depression while also using ASMR to temporarily alleviate symptoms of their depression (Barratt & Davis, 2015). Taking this into account, Fredborg et al. (2017) expected ASMR-sensitive individuals to score higher on neuroticism versus controls. This hypothesis was supported, leading the researchers to suggest the finding indicated lower levels of emotional stability. The authors went on to hypothesise that the higher neuroticism scores could be explained by the sub-facet, self-consciousness due to enhanced awareness of physiological/psychological states during ASMR experiences where there is a shared 'hyper-sensitivity' to somatic/interoceptive sensations between ASMR and negative affect.

Essentially, this implied that those who tend to experience more negative emotion may also have an increased likelihood to experience ASMR somatosensation. Thus, this may be interpreted as evidence for the underlying interpersonal properties to ASMR as there must be a social and/or emotional aspect benefitting neurotic/depressed individuals. Research has previously demonstrated that individuals with more severe depressive symptoms experience less positive social interactions but are more reactive to their occurrence (Steger & Kashdan, 2009). Potentially, this positive and highly personalised simulated social interaction the viewer is having with the host is one of the reasons behind the attenuation of their symptoms of depression (as may be the case in other conditions like stress and anxiety) and may be strengthened since no real face-to-face interaction is required, as highlighted in Klausen's (2019b) concept of the pronoun 'you', which may subsequently benefit those who also suffer from social anxiety. It is worth mentioning however, that another ASMR-personality study did not report their ASMR-sensitive sample as scoring higher on neuroticism although this may have been down to methodological differences and thus requires further testing, potentially with clinical (e.g., clinically depressed) ASMR-sensitive samples (*discussed in* 2.7.1.).

The above points demonstrate that interpersonal properties of ASMR are important and encompass more than one sensory domain. It is arguably a combination of auditory, spatial, and visual properties (and within these, attention, and performance) that enable intimate (non-sexual) social interaction to occur between a viewer-listener and a host and it is within these properties that the interpersonal properties become noticeable. Though one may argue that these types of interaction are mediated and facilitated through digital/technological mediums versus real face-to-face interactions, one may instead consider this as an alternative and new way to conceptualise human interaction in the digital age of today's society. As quoted by Abdallah & Engström (2020), "[i]t is likely that the hosts attempt to generate both an emotional and physical connection to the viewer through combining elements from real-life relationships and different ASMR triggers". Overall, the overarching concept that ASMR is a combined cross-modal effort reveals itself, along with the likely potential that the interpersonal properties are important in eliciting and intensifying ASMR experiences.

2.4.5. Other Relevant Factors

Although the stimulus properties outlined above (2.4.1-4.) do seem to have the most precedence, there are other non-sensory stimulus properties that can contribute to the experience of ASMR. These include the optimal duration of

ASMR stimuli, the number of (different) stimuli within ASMR, the perspective of stimuli (first/third person), and stimulus realism are examples of those that have come up in the literature and may all play a role.

Survey research has indicated that, on average, ASMR-sensitive individuals consume 3 ASMR videos per session (i.e., in a single sitting) with the majority reporting to watch ASMR daily (42.3%) or 2-3 times per week (30.9%) (McErlean & Osborne-Ford, 2020; Poerio et al., 2018). Within survey research, individuals have been reported to mostly differ in their preferred timings, that lasted between 1-10min (68%), versus 11-20+min (30%) (Barratt et al., 2017). With respect to the number of (different) stimuli, the same study reported participants indicated that two ASMR-eliciting stimuli were optimal (47%), followed by one stimulus (24%), three (15%), and four+ (13%). The findings imply that a shorter duration of ASMR content per stimulus, and smaller numbers of (different) stimuli are preferred and perhaps more easily elicit ASMR. Indeed, Smith et al. (2017) reported that the average ASMR onset time for their ASMR-sensitive sample was 59.54s (with a range of 0-90s). An interesting next step would be to explore the duration of ASMR (somatosensation); this is not simple, as the ASMR response is a reported experience, and is variable across participants.

Regarding stimulus perspective, Barratt and Davis (2015) suggested that the first versus third person perspective of ASMR stimuli may affect an individual's experience of ASMR. In a later study, Smith et al. (2017) reported that 10/11 of their ASMR sample experienced more intense ASMR when hosts (in ASMR media) addressed them directly (versus a depiction of a scene from a third person perspective). Although no explanation was provided, it is possible that this relates to the interpersonal property of ASMR where the listener-viewer wants a more personalised experience (*as discussed earlier* 2.4.4.). Finally, Barratt et al. (2017) also reported on the realism of ASMR-eliciting stimuli, that stimulus (object) sounds in ASMR media should ideally be realistic in that they echo the sound expected, and that the content should not appear scripted or forced. This was based on the concept of flow, described as optimal experiences that occur during a state of complete immersion in an activity (Mao, Roberts, Pagliaro, Csikszentmihalyi & Bonaiuto, 2016). The authors related this to factors of the flow-like state where an effortless flow to content may be conductive to evoking ASMR. This may also relate to how, generally, the origins of ASMR stimuli are taken from real-life.

Outside factors may also be relevant. Two such examples were covered above – the type of microphone to record ASMR content (binaural versus standard) and the type of ear/headphones for listening to ASMR media (*refer to* 2.4.1.; 2.4.4.), and context (*refer to* 2.4.3.).

Other properties that have been reported in the literature include specific time(s) to engage with ASMR and preferred ‘environmental’ conditions. For the former, Barratt and Davis (2015) reported that evenings (before sleep) were the preferred time of engagement with 81% of their sample indicating as such, though some of their sample engaged in ASMR content upon waking (4%) and during morning-midday (2%), while 30% engaged in ASMR irrespective of the time of day. Although this is the only example of such data on this topic, it is consistent with previous reports indicating that ASMR is typically used as a sleep-aid, while the 30% figure is indicative of people using ASMR as a relaxant whether this is to help with anxiety or just as a work/study-aid.

For the latter, the same study reported that just over half of their sample (52%) preferred specific environmental conditions, the majority of which indicated quiet, relaxed conditions to help induce ASMR. A similar finding was conveyed in a study by Barratt et al. (2017) where the adjective 'relaxed' was rated as the atmospheric characteristic most associated with evoking ASMR. Moreover, in a more recent example, McErlean and Osborne-Ford (2020) also reported similar findings where 49% of their sample stated they required specific conditions to experience ASMR. Of these, quiet and relaxed conditions were also reported (e.g., quiet room) but so too was specific lighting (dim), temperature (dependent on the individual) and location (quiet room, bed / lying down). This too, fits in line with the idea of people using ASMR as a sleep and study/work aid, while the finding that 51% of an ASMR-sensitive sample reported consuming ASMR media daily or several times per week (Poerio et al., 2018; *see also* McErlean & Osborne-Ford, 2020) only seems to bolster this and exemplify the growing usage of ASMR in day-to-day life.

2.5. The Personality and Empathic Profile of ASMR

Why do some people experience ASMR? There are three individual difference profiles that have been studied: personality, neural and physiological differences.

In terms of personality, the Big Five Inventory (BFI) is an established self-report measure of personality traits consisting of five personality dimensions, or domains: openness to experience (reflected in intellectual curiosity and a preference for novelty/variety), neuroticism (degree of emotional stability, impulsivity, and anxiety), extraversion (degree of sociability, assertiveness, and talkativeness), agreeableness (degree of helpfulness, cooperativeness, and sympathy), and conscientiousness (degree of discipline, organisation, and achievement-orientation) (Komarraju, Karau, Schmeck & Avdic, 2011; *for a further overview of the trait dimensions and what scoring higher or lower on each typically infer, refer to* Roccas, Sagiv, Schwartz & Knafo, 2002). Each dimension is allocated a number of items and for each item, responders provide ratings via a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) which is subsequently scored by a researcher (John, Donahue & Kentle, 1991; McErlean & Banissy, 2017).

The relationship between the BFI and ASMR has been studied (Engelbregt, Brinkman, van Geest, Irrmischer & Deijen, 2022; Fredborg et al., 2017; McErlean & Banissy, 2017). Fredborg et al. (2017) investigated whether ASMR-sensitive individuals would differ from non-ASMR-sensitive controls on the five trait dimensions of the BFI. They recruited 290 self-reported ASMR-sensitive individuals and matched controls and gave both groups the BFI (John et al., 1991) to complete. The researchers concentrated their attention on two of the trait dimensions in particular, openness to experience and neuroticism, predicting differences between the two groups based on the scores of these two trait dimensions. This research focus was based on McCrae (2007) who, using the Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992; which examines the same five trait dimensions of personality as the BFI), found experiencing chills (a sensation central to another perceptual phenomenon known as frisson) during aesthetic experiences such as music was the best predictor of openness scores. From this, Fredborg et al. (2017) predicted that their ASMR-sensitive group would score higher on openness to experience considering that the associated sensations of ASMR may be partly due to heightened sensitivity and receptivity to sensations (i.e., those elicited via ASMR stimuli). The focus on neuroticism was based on the association between neuroticism and anxiety/depression. Barratt and Davis (2015) had reported that a significant portion of their ASMR-sensitive sample reported moderate-to-severe levels of depression. Fredborg et al. (2017) therefore predicted higher neuroticism scores for their ASMR-sensitive sample. In addition to the BFI, the ASMR-sensitive sample alone, were also given a questionnaire on ASMR phenomenology (the 'ASMR Checklist') which was developed to establish intensity ratings for a set of 14 ASMR-eliciting stimuli, and whether any potential differences in intensity ratings were associated with BFI scores.

Results demonstrated that, compared to controls, the ASMR-sensitive sample scored significantly higher on both openness to experience and neuroticism, but significantly lower on the remaining three trait domains: conscientiousness, extraversion, and agreeableness. For the reported result of each of the five trait dimensions, the researchers provided a brief overview detailing the potential explanations.

For openness to experience, an explanation appeared to be one regarding the generalisability of heightened sensitivity and receptivity to sensations in ASMR-sensitive individuals to those who experience frisson reporting enhanced sensitivity to aesthetic matters such as art/music. This can seemingly be interpreted whereby scoring higher on openness to experience may contribute to the likelihood of eliciting ASMR sensations in ASMR-sensitive individuals.

Elevated openness to experience has been reported in the personality literature of other more well-established atypical perceptual phenomena including both synaesthesia (Banissy et al., 2012; 2013; Chun & Hupé, 2016; Rouw & Scholte, 2016) and frisson (Colver & El-Alayli, 2016; McCrae, 2007; Nusbaum & Silvia, 2011; Nusbaum et al., 2014; Silvia & Nusbaum, 2011). As will be discussed below, these studies also typically report mixed results for the remaining BFI personality domains where openness seems to be the most consistent trait.

There is another issue in this literature: the subjects are self-reporting. This, however, is a larger issue within the ASMR literature since there are currently no independent and standardised screening protocol in place to objectively affirm whether an individual is ASMR-sensitive, apart from two relatively recent attempts (Hostler, Poerio & Blakey, 2019; Swart, Bowling & Banissy, 2021 – ASMR-Experience Questionnaire / AEQ). Self-report is common in research on phenomena such as synaesthesia that have standardised measures in place (e.g., consistency tests such as the Revised Test of Genuineness/TOG-R; Asher, Aitken, Farooqi, Kurmani & Baron-Cohen, 2006). In outlining some of this synaesthetic personality literature where they too argued that it is rather mixed (at least for the domains that are not openness to experience), Hossain, Simner and Ipser (2018) summarised that the literature appears to be founded on self-referral and/or unverified synaesthesia yet still report that the association with openness to experience is found. Thus, it seems suitable to infer that openness to experience may be a domain that overlaps in the personality research with at least one other perceptual phenomenon.

The relationship between neuroticism and ASMR was found, which the researchers suggested indicated lower levels of emotional stability in the ASMR group. They suggested that the elevated neuroticism scores could be explained by the sub-facet self-consciousness due to the enhanced physiological and/or psychological states during ASMR experiences. This was consistent with a previous non-ASMR study that reported a positive correlation between neuroticism and several somatic symptoms tied to internal bodily states (Rosmalen, Neeleman, Gans & de Jonge, 2007). Fredborg et al. (2017)

suggested that ASMR and negative affect may potentially share an enhanced sensitivity to both somatic and other interceptive sensations. Moreover, elevated neuroticism has also been reported in personality literature on synaesthesia (Chun & Hupé, 2016; Rouw & Scholte, 2016) and frisson (Maruskin, Thrash & Elliot, 2012; Silvia & Nusbaum, 2011).

Regarding lower extraversion in the ASMR population (i.e., introversion), the researchers provided two alternate explanations: that (pre-existing) introversion may increase the likelihood of experiencing ASMR (1), or the inverse where introversion may be a result of experiencing ASMR (2). One synaesthesia study (Rinaldi, Smees, Carmichael & Simner, 2020) reported low extraversion in a sample of young synaesthetes. They suggested that extraversion may have been masked in other personality-based synaesthesia research (e.g., Banissy et al., 2013; Chun & Hupé, 2016; Rouw & Scholte, 2016) due to their participant recruitment method having relied on *adult* subjects who were *self-motivated* to take part in their studies (i.e., those who are already likely to score high on extraversion). Instead, Rinaldi et al. (2020) recruited *non-motivated*, *young* synaesthetes whose dominance (an element of extraversion reported to increase with age; *see* Caspi, Roberts & Shiner, 2005) is underdeveloped. However, neither of these two factors (recruitment method or underdeveloped dominance) apply to Fredborg et al.'s (2017) findings. This may infer that Fredborg et al.'s, (2017) two potential explanations could be feasible but, as the researchers suggested, can only be tested by testing extraversion specifically with behavioural and/or social manipulations.

For lower conscientiousness and agreeableness, this is mostly consistent with the personality literature on synaesthesia (Banissy et al., 2012; 2013; Chun & Hupé, 2016; Rouw & Scholte, 2016) and frisson (*see* Maruskin et al., 2012).

The researchers noted however, that there was no obvious reason for their relations but suggested more nuanced sub-facets of these broad trait dimensions may provide better explanations. While the consensus seems to suggest openness to experience is a marker for sensitivity to these collective perceptual phenomena (at least, individually), it would also be interesting to rule out the possibility of the other domains also being markers. To achieve this, conducting personality research on these individual phenomena with measures specific to each of the remaining domains (rather than the BFI or one of its revisions) or specific traits that come under these domains may be the way forward as addressed in discussing extraversion.

Finally, regarding the subjective intensity ratings from their ASMR Checklist, the ASMR stimuli were reported to be positively correlated with the BFI trait dimensions of openness to experience and neuroticism. This suggests these traits are linked to ASMR, but it does not tell us the direction of causality.

McErlean and Banissy (2017) also investigated the ASMR-personality relationship, extending the focus to empathy. Taking a slightly different path from Fredborg et al. (2017), the researchers did not make direct predictions on what they expected to find, instead using the (then) available research as a basis to which they could later compare their findings, while employing measures of both personality and empathy. The researchers recruited a sample of 83 self-reported ASMR-sensitive individuals and 85 matched controls and administered the BFI (John et al., 1991) and the Inter-Personal Reactivity Index (IRI; Davis, 1980) as a means to examine the personality and empathic traits of their subject groups with a particular emphasis on the ASMR experiencers.

For context, the IRI is a common 28-item 5-point Likert scale rated measure of (trait) empathy consisting of four separate subscales: perspective taking (the tendency to adopt the psychological perspective of another individual), fantasising (the tendency to imaginatively identify with fictious characters and situations), empathic concern (the tendency to experience feelings of concern toward others) and personal distress (the tendency to experience feelings of discomfort and concern upon witnessing the negative experiences of another individual) where the first two subscales are typically considered to reflect cognitive components of empathy and the remaining two affective components (Beven, O'Brien-Malone & Hall, 2004; De Corte et al., 2007). McErlean and Banissy (2017) compared the BFI and IRI scores of the two groups against one another. Compared to controls, the ASMR-sensitive sample scored higher on openness to experience but lower on conscientiousness (on the BFI) and scored higher on empathic concern and fantasising (on the IRI). For the reported results, the researchers gave a brief overview detailing the potential explanations.

For higher empathic concern, the researchers suggested ASMR may be associated with heightened sympathy for distressed individuals. There exists one specific form of synaesthesia wherein empathy is relevant, mirror-touch synaesthesia (MTS) where such synaesthetes consciously experience overt tactile sensations on their body elicited from observing another individual being touched (Banissy & Ward, 2007; Banissy et al., 2011; Bolognini, Rossetti, Fusaro, Vallar & Miniussi, 2014; Ward & Banissy, 2015). Research on empathy has also reported MT synaesthetes as scoring higher on empathic concern (Ioumpa et al., 2019), where Bolognini et al. (2014) explained that the conscious sharing of touch which is central to MTS may depend more on the affective components of empathy (i.e., empathic concern and personal distress). This may translate over to ASMR where individuals may be more likely to experience the associated sensations of ASMR (or experience them at a greater intensity) if the individuals in question score higher on the affective components of empathy. Perhaps though, it is as simple as taking the association as it is where ASMR-sensitive individuals may simply be more sympathetic to those who are distressed and nothing more. Ultimately, this is an area that needs elaboration, perhaps from future research specific to the potential association between ASMR and empathy.

For higher fantasising and openness to experience, the researchers grouped the two as they are conceptually similar since, they both tap into an individual's imagination, where they collectively associated both with being a key skill related solely to visually elicited ASMR. This seemingly ties in with the explanation Fredborg et al. (2017) provided who also reported increased openness to experience in their ASMR-sensitive group. Again, they explained higher openness to experience in terms of heightened sensitivity and receptivity to sensations in ASMR-sensitive individuals to those who experience frisson reporting enhanced sensitivity to aesthetic matters such as art and/or music.

What is interesting though, particularly from a visuo-interpersonal ASMR viewpoint, is that this may also draw on the aforementioned novel concept of digital/technological mediums (i.e., video). This is ultimately in reference to the role of attention and performance in ASMR media which is particularly visible in the common collective stimulus of ASMR personal attention roleplays which draw in the viewer-listener. McErlean and Banissy (2017) even touched on this in their explanation, detailing that having a heightened tendency to fantasise and ability to 'imaginatively transpose' oneself into a fictional/virtual reality may indeed be involved in the ASMR elicitation process. To this end, they gave the ASMR example of roleplays where the viewer-listener can become imaginatively immersed in the video and feel as if they are truly part of it. This is exactly what these theories underlying the interpersonal properties of ASMR refer to, particularly Klausen's (2019a) elaborative 'para-haptic interactions' approach.

As previously stated, a major takeaway from elevated openness to experience is the interpretation that scoring higher on this domain may contribute to the likelihood of experiencing ASMR. Due to its likeness to fantasising however, and the current study reporting elevated levels of this trait and grouping it with openness to experience, also paints fantasising in a similar way. Moreover, elevated openness to experience and fantasising have been reported in synaesthesia (Banissy et al., 2013; Chun & Hupé, 2016; Mas-Casadesús, 2020; Rouw & Scholte, 2016). As suggested by the researchers, an appropriate next step in the investigation of individual differences in the personality traits of ASMR-sensitive individuals would be to extend these findings to a systematically recruited sample to help counter selection bias though this is still currently a fair way off from being feasible.

For lower conscientiousness, the researchers explained that ASMR-sensitive individuals may have the general traits related to the conscientiousness subscale but also lack direction. Again, this is consistent with Fredborg et al. (2017) who explained that they did not identify any obvious reason for lower conscientiousness scores in their ASMR-sensitive sample, instead, suggesting that one of the more nuanced sub-facets of this trait dimension may better explain the finding.

Briefly, neuroticism was also found to be higher in the ASMR-sensitive sample which is consistent with Fredborg et al. (2017). However, this difference did not survive multiple correction. To note, this has also been reported in a similar study on the personality profile of synaesthesia (Banissy et al., 2013).

Further, no significant group differences were found for either extraversion or agreeableness. Considering the mixed findings from the literature of other perceptual phenomena, this is unsurprising though the absence of extraversion may also represent an example of Rinaldi et al.'s (2020) implied masking of extraversion.

A final point the authors made was on the potential association between ASMR and absorption. Absorption is a personality trait that refers to the tendency to become deeply immersed in sensory experiences as they are occurring and is conceptually similar to the trait dimension, openness to experience, most so to the to the sub-facets: fantasy, aesthetics and feelings (Sirois, 2014; Witthöft, Rist & Bailer, 2008). The trait is measured with the 34-item 5-point Likert scale rated Tellegen Absorption Scale (TAS; Tellegen & Atkinson, 1974). It has been reported to be higher in synaesthetes (*see* Chun & Hupé, 2016). Thus, although they did not employ any measures of the construct, McErlean and Banissy (2017) suggested that higher levels of absorption would be expected from an ASMR-sensitive sample since it is related to fantasising.

Most recently, Engelbregt et al. (2022) also investigated ASMR personality interactions. Unlike the existing literature though, they did utilise the BFI, instead opting to incorporate the HEXACO-Simplified Personality Inventory (HEXACO-SPI), an extended version of the BFI. The authors reported no significant relationship between ASMR and personality traits. This may, however, be a product of underlying methodological issues such as using a different personality measure and recruiting a smaller sample compared to the existing research, as the authors recognised.

Further, Roberts, Beath and Boag (2019) reported on an association between ASMR and absorption propensity. McErlean and Osborne-Ford (2020) compared an ASMR-sensitive sample to matched controls on the measures of flow (optimal experiences that occur during a state of complete immersion in an activity, Mao et al., 2016), mindfulness (non-judgemental attendance to internal and external stimuli occurring in the present moment, Baer, 2003), and absorption. Following McErlean and Banissy (2017), they expected elevated levels of absorption among ASMR-sensitive individuals versus controls based on the phenomenological similarities between this trait and ASMR. The researchers recruited 124 ASMR-sensitive individuals and 124 matched controls and administered the TAS as the measure of absorption. Moreover, the ASMR-sensitive sample alone, were given an ASMR questionnaire designed by the researchers that was based on items from previous ASMR survey research (Barratt & Davis, 2015; Fredborg et al., 2017; McErlean & Banissy, 2017). The study thus included items on ASMR characteristics including intensity, pleasantness and viewing habits. Similar to Fredborg et al. (2017), results from this questionnaire were compared to the results of the TAS to highlight potential correlations between ASMR characteristics and personality traits.

Results revealed that the ASMR-sensitive sample reported elevated absorption as opposed to controls. The authors explained that this suggested that ASMR-sensitive individuals exhibit an increased readiness for experiential involvement and ability to become completely immersed in the current experience. This is fair considering typical descriptions of the trait absorption and the fact that attention does seem to be of importance to the whole ASMR experience, at least for visually elicited ASMR.

They also make note of how absorption is conceptually similar to the traits, openness to experience and fantasising, both of which have been reported as elevated in ASMR-sensitive samples from previous ASMR research (Fredborg et al., 2017; McErlean & Banissy, 2017), suggesting that a combination of all three traits (all of which being elevated) may contribute to the experience of ASMR (i.e., potentially making it more likely to experience the response. However, while openness to experience, absorption and fantasising may be similar, it is possible that these traits and ASMR are underpinned by a single variable – McErlean and Osborne-Ford (2020) postulated that openness to experience may be the dominant factor.

Last, regarding McErlean and Osborne-Ford's (2020) ASMR questionnaire, they reported a positive correlation between absorption and (subjective) ASMR intensity, suggesting the trait may be linked to the extent that ASMR is experienced. This is similar to Fredborg et al.'s (2017) reporting of openness to experience and neuroticism as positively correlating with subjective ASMR intensity ratings. However, this relationship is also correlational.

Overall, there do appear to be individual differences in the personality and empathic profile of ASMR-sensitive individuals compared to controls. Current findings have collectively associated ASMR with elevated openness to experience, neuroticism, empathic concern, fantasising and absorption, and lower conscientiousness, agreeableness, and extraversion. The consensus appears to be that scoring higher on a trait dimension may infer it contributes to the experience of ASMR in some way (typically in terms of increasing the likelihood of experiencing the response). In particular, openness to experience seems to be a candidate marker for ASMR-sensitivity. Also, the similarity in the personality profiles of individuals who experience synaesthesia and ASMR would make for an interesting study where, as McErlean and Banissy (2017) suggested, could be explored via systematic examination of the prevalence of synaesthesia in ASMR-sensitive populations, using objective measures to verify synaesthetic experiences (e.g., Eagleman, Kagan, Nelson, Sagaram & Sarma, 2007) unlike the previous attempt from Barratt and Davis (2015).

2.6. ASMR and Other Atypical Perceptual Phenomena

With ASMR being a relatively recently described atypical perceptual phenomenon, it was only a matter of time until researchers started to draw similarities with other more well-established perceptual atypicalities. For example, Klausen (2019b) states that despite the rapid growth of ASMR, the majority of the published research deals with examining phenomena related to ASMR, giving the examples of mindfulness, misophonia, frisson, and synaesthesia. Regarding those that can be considered atypical perceptual phenomena, three have been jointly investigated alongside ASMR: synaesthesia (Barratt & Davis, 2015; McErlean & Banissy, 2017), frisson (del Campo & Kehle, 2016; Kovacevich & Huron, 2019), and misophonia (Barratt et al., 2017; McErlean & Banissy, 2018; Scofield, 2019), as all three have phenomenological characteristics that link to ASMR (Fredborg et al., 2017) and likewise for the personality, physiological and neural profiles (*outlined below*, 2.6.2.-2.6.4.).

These associations have furthered current understandings of ASMR. However, Barratt et al. (2017) noted that due to the comparison of ASMR with frisson, it has taken time to recognise ASMR as a distinct response. This is likely the case for the comparison of ASMR with synaesthesia and misophonia. When exploring understudied phenomena like ASMR, identifying what separates it from other atypical sensory associations is paramount (Smith, Fredborg & Kornelsen, 2019b). Even if ASMR is an extension of another perceptual phenomenon, it is not clear which ASMR more closely resembles. This section will review the phenomenological characteristics and the personality, physiological and neural profiles of ASMR and other similar perceptual phenomena.

2.6.1. What Constitutes ASMR

Before comparing ASMR to other perceptual phenomena, it seems appropriate to first briefly outline what has already been reported in terms of the phenomenological characteristics of ASMR. Since the vast majority has been covered throughout this review, this overview will remain relatively brief. Regarding the phenomenological profile of ASMR thus, the phenomenon: has audiovisual (both separately and combined) inducing stimuli that is typically taken from human speech, movement and/or behaviour; is associated with eliciting somatosensation (a touch sensation) and a state of relaxation; has a specific somatic distribution (scalp, neck, back, shoulders, limbs); is typically described as pleasant which may be attributable to positive emotion; is automatic; is controllable (i.e., can be turned on and off); is predictable (i.e., despite variability in intensity, ASMR-sensitive individuals will typically know the stimulus/stimuli that generate the most intense ASMR); and has a specific personality and empathic (*see* 2.5.), physiological (*see* 3.2.) and neural profile (*see* 3.1.1.; 3.2.2.).

2.6.2. Synaesthesia

Synaesthesia is a blending of the senses, whereby perceiving a property from one stimulus belonging to one specific sensory modality involuntarily elicits a second percept not associated with the first sensory modality (Banissy, Jonas & Cohen, 2014; Chiou & Rich, 2014; Smith et al., 2019b). Grapheme-colour synaesthesia is a common example where certain colours (or ‘photisms’) are perceived in response to seeing a letter, word and/or number (or ‘grapheme’)

(Jäncke, Beeli, Eulig & Hanggi, 2009; Smilek, Dixon & Merikle, 2003). Also, lexical-gustatory synaesthesia where certain tastes are perceived in response to seeing/hearing words (Colizoli, Murre & Rouw, 2013). Here, the triggering stimulus is referred to as the '*inducer*', while the secondary (synaesthetic) experience is the '*concurrent*' (Chiou & Rich, 2014) hence the term inducer-concurrent relationship. Theoretically, it has been suggested that synaesthesia can occur within or between any of the senses (Mulvenna & Walsh, 2005) where it has been reported that there is a minimum of 60 known variations (Banissy et al., 2014) which has likely risen since.

ASMR has been reported to resemble auditory-tactile and sound-emotion synaesthesia due to the feeling of touch triggered by ASMR-associated sounds, and the pleasant emotion experienced during ASMR, respectively (Barratt & Davis, 2015). A similar case could also be made for ASMR and mirror-touch. This potential association between ASMR and synaesthesia has been discussed within the published ASMR literature on several occasions.

Barratt and Davis (2015) were the first to suggest that there may be a link between the two perceptual phenomena. For context, the authors asked participants to self-report whether they believed themselves to be synaesthetes and to specify the form experienced. This assumption that the two perceptual phenomena are linked was thus based on the reported 5.9% prevalence of synaesthesia in their self-reported ASMR-sensitive sample relative to a previously reported 4.4% prevalence rate of synaesthesia in the general population (Simner et al. 2006).

Their reported prevalence rate did, however, fall short of exceeding the estimated level of synaesthesia in the general population to a statistically significant degree. Also, despite the researchers assessing the consistency of these reports in a follow-up approximately 4 weeks following participation, their finding came from and is still self-reported (i.e., non-clinical) synaesthesia (unlike Simner et al., 2006). The prevalence of synaesthesia is always higher in instances where the measure is self-report (McErlean & Banissy, 2017) thus, the 5.9% being true synaesthetes may be questionable. What was also interesting here, was that for the participants who specified their form of synaesthesia, a variety of subtypes were reported including: grapheme-colour, grapheme-personality, time-space and pain-gustatory. There was no mention of auditory-tactile or sound-emotion synaesthesia which they originally likened ASMR to, potentially implying that ASMR is distinct but that it may co-occur with synaesthesia or that synaesthetes in general (i.e., regardless of the variant) are more likely to be ASMR-sensitive. However, this needs testing.

Despite their reported figure (5.9%) falling short of being higher than the general population (and that the likened subtypes were not reported), the researchers still argued that the relationship between the two perceptual phenomena was possible. This was based on ASMR being reported to follow a synaesthetic pattern in terms of an inducer-concurrent relationship, and that ASMR is somewhat predictable, while also suggesting that ASMR and misophonia, another perceptual phenomenon, represent two ends of the same spectrum of a form of (sound-emotion) synaesthesia (*covered in* 2.6.4.).

Considering the proposed inducer-concurrent relationship for ASMR, audiovisual stimuli appear to resemble synaesthetic inducers, while somatosensation and relaxation resemble synaesthetic concurrents. Fredborg et al. (2017) previously reported how ASMR, and synaesthesia share the same perceptual or cognitive stimuli to both reliably and automatically elicit an atypical sensory response. While ASMR and synaesthetic responses are typically similar in this way, an individual's (ASMR-sensitive or synaesthetic) experience of the 'concurrent' is debatably distinct in terms of tangibility (i.e., is it perceptible via touch) as acknowledged by Barratt and Davis (2015). ASMR sensations were argued to be tangible. The researchers cite this difference as being down to ASMR typically described within the literature in a physical sense, which physiological research now supports (Poerio et al., 2018; Koumura et al., 2019; *see 3.2.*). This would infer that ASMR sharing a likeness to synaesthesia in terms of an inducer-concurrent relationship is only on the surface. However, the researchers also argued that this difference of tangible concurrents neglects the positive emotion (and relaxing) sensation that accompany the somatosensory tactile sensation/s of ASMR experiences. Instead, the researchers suggested that the somatosensation felt is a secondary phenomenon directly resulting from the positive emotion (and relaxation). This way, somatosensation is not considered to be the primary concurrent. While it is true that emotion and relaxation should not be neglected, considering the current research, it is more likely that either the inverse is true (i.e., that emotion and relaxation are secondary, which Valtakari, Hooge, Benjamins & Keizer, 2019 have alluded) or that both are essential and therefore cannot be separated as synaesthetic subtypes. Furthermore, to accept the spectrum would be contradictory since this would also neglect somatosensation and even the role that visual ASMR stimuli play and is itself debatable (*further covered in* 2.6.4.). The researchers may have benefitted from instead suggesting ASMR as a new variation (or subtype) of synaesthesia altogether versus relating it to currently known forms.

As for predictability, this is one phenomenological characteristic that does appear to be similar between the two perceptual responses, since ASMR has been described as predictable (Smith & Snider, 2019). As previously noted, those who are ASMR-sensitive differ from one another in that they each have a specific ASMR-eliciting stimuli that will evoke their ASMR experiences to varying degrees of intensity which the percentage differences in the survey research on ASMR-eliciting stimuli seemingly allude (e.g., Barratt & Davis, 2015; Fredborg et al., 2017; McErlean & Banissy, 2017; Poerio et al., 2018). This way, ASMR-sensitive individuals will typically know what stimulus/stimuli elicit the most intense ASMR which may be similar to how synaesthetes know exactly what triggers their synaesthesia – hence both being predictable. However, on closer inspection, although both groups can be considered individualistic, this too is arguably distinct. Here, synaesthetes are individualistic in terms of the triggering stimulus (the inducer) where a particular stimulus will trigger a particular synaesthetic experience in one synaesthete but will differ in another to varying degrees. ASMR-sensitive individuals though, are individualistic in terms of the variation in intensity of an ASMR-eliciting stimulus where it is likely that such individuals can be triggered by several (if not all) ASMR-eliciting stimuli but vary in how intense these each are. This concurs with del Campo and Kehle's (2016) description of ASMR experiences being dynamic and wave-like, which, Smith et al, (2019b) argue is in stark contrast to synaesthesia, usually identical across exposures and over time thus building on the distinction that ASMR is individualistic in terms of response intensity and synaesthesia in terms of inducing stimuli.

Furthermore, the sensory experiences of these two perceptual phenomena differ slightly in terms of automaticity. While both phenomena are considered automatic (Barratt & Davis, 2015; Fredborg et al., 2017), there is an air of scepticism around whether ASMR is *consistently* automatic when considering that Smith et al. (2017) reported an average ASMR onset time of 59.54s (with a 0-90s range) for their ASMR-sensitive sample (Smith et al., 2017).

The above discussion on the phenomenological characteristics of ASMR and synaesthesia is complex. The literature mostly uses descriptive terminology on how they both differ or are similar and objective evidence is needed to link the two. The next section outlines the personality and empathic, physiological, and neural profiles to come to a more comprehensive take on whether the two are associated.

Regarding personality profiles, previous research on the personality and empathic profile of synaesthesia has shown the phenomenon to be characterised by higher levels of openness, neuroticism, positive and disorganised schizotypy, absorption, and fantasising, and lower levels of agreeableness and conscientiousness (Banissy et al., 2012; 2013; Chun & Hupé, 2016; Rouw & Scholte, 2016). Research on the personality and empathic profiles of ASMR has shown a degree of consistency with these findings. For instance, McErlean and Banissy (2017) reported elevated openness to experience, fantasising, and empathic concern, and reduced conscientiousness, suggesting ASMR appears to have a similar personality profile to synaesthesia, specifically drawing on findings of variations of synaesthesia for colour. Fredborg et al. (2017) identified a similar pattern to the personality profile of ASMR: scoring higher on openness and neuroticism, and lower on conscientiousness and agreeableness, while enhanced absorption has also been reported (McErlean & Osborne-Ford, 2020). While the two do seem to share a similar personality profile, further testing is required to build up a more comprehensive personality profile of ASMR, especially before comparing it to synaesthesia.

With regards to physiological profiles, there have been examples of ASMR and synaesthesia research using physiological parameters to measure the associated sensory responses. An example here is eye-tracking where research on synaesthesia has shown that pupil dilation is greater when grapheme-colour synaesthetes are presented with incongruently coloured graphemes (Paulsen & Laeng, 2006). An eye-tracking study on ASMR revealed that ASMR experiences resulted in increased pupillary diameter at the specific level (during reported episodes of ASMR somatosensation) (Valtakari et al., 2019). The findings from both studies were thus placed as physiological evidence for both responses. Also, another psychophysiological study on ASMR revealed increased skin conductance and reduced heart rate during ASMR, a finding that is rather contradictory on its own (*covered in* 3.2.) and more importantly, a finding that is not reported in the synaesthesia literature (though this requires testing).

As for the neural profiles, both phenomena show similarities in the findings from resting-state fMRI studies – atypical functional connectivity of resting-state networks, especially the default mode network (DMN) where a 'blending' of such networks is implied (Smith et al., 2017; 2019b; Dovern et al., 2012). Similar findings are also present in studies on other similar sensory experiences such as auditory verbal hallucinations (*for a review, see* Alderson-Day, McCarthy-Jones & Fernyhough, 2015) and psychedelic drugs (Roseman, Leech, Feilding, Nutt & Carhart-Harris, 2014). Further, atypical thalamic activity reported in two fMRI studies on ASMR has been linked to a case of acquired (sensory-emotional) synaesthesia as a result of a thalamic infarct (Schweizer et al., 2013). As Smith et al. (2019a) suggested, these shared findings may underlie both phenomena.

2.6.3. Frisson

Frisson is described as a typically musically induced affect associated with a pleasurable pilomotor sensation, encompassing the experience of chills, thrills, shivers, goosebumps/flesh/tingles, coldness (Colver & El-Alayli, 2016; Harrison

& Loui, 2014; Maruskin et al., 2012), to name a few. Over the last few decades, there has been a rise in published research on the topic (Colver & El-Alayli, 2016; Grewe, Katzur, Kopiez & Altenmüüller, 2011). Within the literature, one will come across several descriptive terms associated with this perceptual phenomenon such as (aesthetic or musical) chills, thrills, and skin orgasms (Harrison & Loui, 2014). As Harrison and Loui (2014) argued however, frisson is the most accurate and usable term considering that it integrates within it, emotional intensity with somatosensation (touch) not localised to any one specific bodily region. *For clarity, this review will refer to this perceptual phenomenon as 'frisson' henceforth*.

Research has built on the pilomotor sensation that purportedly characterises the phenomenon by reporting on a specific somatic distribution with the sensation experienced on the scalp, neck, spine, and limbs, typically originating at the back of neck, and spreading down the back (Konečni et al., 2007; Nusbaum, & Silvia, 2011). Also, regarding this somatic distribution, respondents have been found to have the ability to locate instances within presented material (typically music) which would likely trigger their frisson (Sloboda, 1991). Consistent examples include new or unexpected harmonies or dynamics, the unexpected entrance of a new voice (e.g., the emergence of solo instruments from orchestras or sustained high-pitched tones), increases in loudness, and/or music that is 'nostalgic-thoughtful' or 'melancholic-sad' (Guhn, Hamm & Zentner, 2007; Huron & Margulis, 2010; Panksepp, 1995; Sloboda, 1991). The experience itself typically occurs most during these instances (del Campo & Kehle, 2016) though this is not without saying the 'expectations' are reported to be dependent on the enculturation of the individual experiencer (Guhn et al., 2007) where familiarity with the stimuli in question (e.g., music) can influence the sensation/s experienced such as an increase (Panksepp, 1995).

While frisson has most frequently been kept within the confines of research on music (Colver & El-Alayli, 2016), the associated sensations have also been reported to be induced through film, video games and amusement park rides (Kovacevich & Huron, 2019). In fact, one study presented evidence of induction via stimuli from several differing sensory modalities: aural, visual, tactile, and gustatory stimuli in addition to elicitation from mental self-stimulation (Grewe et al., 2011). In this respect, frisson is another example of a perceptual phenomenon that involves several sensory modalities. Thus, it is unsurprising to find references within the literature suggesting an association between frisson and ASMR. There have currently been two published examples to date that have concentrated specifically on the two perceptual phenomena (del Campo & Kehle, 2016; Kovacevich & Huron, 2019) while others have touched on the link between these two responses.

Acknowledging that, at the time of publication, there was no literature that had jointly investigated the sensory responses of ASMR and frisson, del Campo & Kehle (2016) were the first to publish a review trying to outline how the two perceptual phenomena are linked by drawing on both phenomenological similarities and differences. The inducing stimuli, physical descriptions of the associated sensations, somatic distribution, and the potential accompaniment of neurotransmitter release were cited among the similarities. Contrarily, differences included the inducing stimuli (again), emotional valence, duration, and prevalence. Taking this into consideration, as well as current findings, the extent to which these statements are accurate will be reviewed thus.

To start, the inducing stimuli were first explained as a difference in terms of frisson which is mainly associated with music and emotion, but then as a similarity in consideration of Grewe et al.'s (2011) finding that frisson was induced via stimulation from multiple distinct sensory modalities. Although the stimuli that induce both phenomena are mainly audiovisual, it does not mean they are identical. Delving deeper into the underlying properties of these stimuli, as an example, one will find that the auditory stimuli that elicit frisson characteristically include sounds that have acoustic/musical properties that are the different from the auditory properties underlying auditory ASMR-eliciting stimuli. Previous ASMR research agrees (Fredborg et al., 2017; Kovacevich & Huron, 2019). The acoustic/musical properties of frisson typically include sounds that are loud, approaching (crescendos), scream-like and unexpected (Huron & Margulis, 2010). As previously outlined, the underlying auditory properties of ASMR instead include sounds that are quiet, proximate, more vocalised, and intimate (i.e., they carry interpersonal qualities). Hence, ASMR may be more of a polar opposite to frisson in this regard.

Following the other reported similarities, physical descriptions of the associated sensations of both responses can indeed appear to be similar in terms of ASMR somatosensation being highly comparable to the chills (or similar sensations) of frisson. As a matter of fact, tingles are often described as one of the experiences that frisson encompasses and ASMR somatosensation is often characterised as a tingling sensation. The similarities are not complete: ASMR also involves (general) relaxation while frisson can also include non-dermal reactions such as tears, globus sensations, and muscle tension/relaxation (Harrison & Loui, 2014). In terms of the tingling sensation though, studies conducted on both ASMR and frisson have shown they are associated with an increase in the physiological parameter of skin conductance (Grewe et al., 2011; Guhn et al., 2007; Poerio et al., 2018). In line with this, the researchers also noted how piloerection sometimes occurs in both phenomena, a point that Kovacevich and Huron (2019) also agree on.

Next regards the similarity of somatic distribution. In consideration of Harrison and Loui's (2014) argument on the most appropriate term to describe the experience of 'frisson' as a whole, that the term frisson itself is applicable since it integrates emotional intensity with touch not localised to any one specific bodily region, makes it highly comparable to the somatic distribution of ASMR. The literature on frisson typically includes descriptions of experiencing the sensation on the neck, scalp, and spine (Nusbaum, & Silvia, 2011) which vary from person to person. Konečni, Wanic and Brown (2007) even explained the sensation as usually starting in the back of the neck (with piloerection) and spreading down the back (and arms as well as to other areas) and thus, is almost identical to the somatic distribution of ASMR (*see* Barratt & Davis, 2015; Koumura et al., 2019; Swart et al., 2021). Again, this is another point Kovacevich and Huron (2019) agree on. What is also relevant here is the concept of how pleasurable each sensory response is which del Campo and Kehle (2016) have not appeared to make any reference. It is, however, a similarity both phenomena seemingly share – that both are normally described as pleasant (Kovacevich and Huron 2019).

Finally, the similarity on the potential accompaniment of neurotransmitter release is currently pure speculation. Although there is evidence of neurotransmitter (e.g., dopamine) release during periods of frisson (e.g., Salimpoor, Benovoy, Larcher, Dagher & Zatorre, 2011), it is purely theoretical for ASMR but has briefly been touched on in a functional imaging study that reported brain activity in associated regions such as the nucleus accumbens/NAcc (the reward pathway) (e.g., Lochte, Guillory, Richard & Kelley, 2018) which may link (*see also* 3.1.3.).

Next came the reported differences. The researchers drew on those from anecdotal reports of individuals familiar with both perceptual phenomena. First was emotional valence, perhaps one of the biggest differences between ASMR and frisson – they are associated with different states. While emotion undisputedly plays a role in ASMR, the overall 'state' that ASMR puts individuals in is one specific to relaxation and contentment versus frisson whose sensations are specifically described as those associated with excitement and arousal.

Second came duration, that frisson is typically described as short-lived, with the experience being described as seconds long (Nusbaum, & Silvia, 2011), lasting up to 10s (Fredborg, Clark & Smith, 2018), versus the reported longer lasting ASMR (of several minutes, as the researchers noted). There are currently no findings on the duration of ASMR however, research has shown that the average onset time for ASMR was relatively fast at 59.54s with a range of 0-90s (for a sample of ASMR-sensitive individuals) while preferences for ASMR media duration for single ASMR-eliciting stimuli have been reported to range from 1->21min (Barratt et al., 2017; Smith et al., 2017). Specifically, Barratt et al. (2017) reported a greater percentage of ASMR-sensitive participants preferring shorter lasting ASMR media ranging from 1-10min (68%) versus 11->21min (30%). Although one cannot exactly gauge the duration of ASMR experiences from this, it is quite likely that ASMR can be elicited relatively fast and at least has the potential to last for several minutes (but will be dependent on the perceived intensity of the ASMR by individual experiencers), even if this is on the shorter end of this time spectrum. Thus, in light of these findings, it is entirely possible that the anecdotal reports are correct in that ASMR can last several minutes opposed to the short-lived duration of frisson. One point worth considering though, is in reference to the eliciting stimuli of both responses. Ultimately, it is still unclear whether ASMR has the potential to be maintained for several minutes by experiencing the sensation in bursts over the course of ASMR media which is often minutes long versus frisson stimuli that appear to be shorter.

Last was prevalence, the assumption that ASMR occurs less frequently within the general population opposed to frisson which has been reported to range from 25-90% in previous studies (Grewe et al., 2011; Nusbaum, & Silvia, 2011; Sloboda, 1991). While there is still no consensus on the prevalence of ASMR, it is likely that the phenomenon is more common than del Campo and Kehle (2016) reported.

Relevant here is the preliminary study of the relatively recent Koumura et al. (2019) who applied a test-retest paradigm as a means to indicate whether or not ASMR-inexperienced individuals could reliably experience ASMR after a 2-week break. While this is only preliminary and incorporates the same self-report ASMR screening protocol as the majority of current ASMR research applies in the recruitment of ASMR-sensitive participants, because the researchers did report high reliability, and solely presented auditory stimuli as the inducing stimulus (and not the typically combined audiovisual stimuli ASMR research is used to) the finding does seem to allude to the idea that ASMR-inexperienced individuals may indeed be able to easily experience ASMR thus, questioning how widespread the phenomenon is within the population. Regardless, this would make for an interesting study.

As already touched upon in reviewing del Campo and Kehle’s (2016) discussion comparing ASMR with frisson, Kovacevich and Huron (2019) also attempted to outline the relationship between the two perceptual phenomena. Briefly, they referred to the two sensory responses being similar in that they are typically described as pleasurable, associated with pilomotor activation, and have an almost identical somatic distribution, but differ in terms of the inducing stimuli and their underlying (auditory) properties as well as differing in the way the respective associated sensations are described. What was interesting however, is that rather than solely discussing the phenomenological characteristics contrasting the two, the researchers applied a known theoretical construct in Huron's (2006) suppressed fear theory to try to explain how it may be possible for two similar responses to arise from highly contrasting inducing stimuli.

The basic premise of Huron's (2006) suppressed fear theory is that pleasure is elicited following activation/s in subcortical regions associated with fear which is then suppressed due to the cognitive appraisal that the eliciting stimulus is harmless. With frisson, the acoustic/musical properties identified by Huron and Margulis (2010) described near the beginning of this section are plausibly linked to alarm which is argued to lead to the subcortical activation of fear (Huron, 2006; Kovacevich & Huron, 2019). Kovacevich and Huron (2019) argue however, that having such properties (especially sounds that are loud, scream-like and/or surprising) are not the only way to induce fear where despite the obvious differences in properties underlying the inducing stimuli, it can also be induced in ASMR through the mechanisms of proximity and intimacy.

Specifically, Kovacevich and Huron (2019) drew on personality studies on both ASMR and frisson for support. They argued that the higher levels of openness to experience and neuroticism reported in both ASMR, and frisson experiencers represented an increased likelihood to experience the associated sensations of the two sensory responses as such experiencers are more vigilant and prone to perceive threat. Thus, they interpreted both perceptual phenomena as starting as subcortical fear responses which are both cognitively assessed as harmless with pilomotor sensations symptomatically representing fear and the pleasantness of the sensory responses representing the cortical assessment but differ in the inducing stimuli. While the researchers have developed a hypothesis to provide an explanation for what is arguably the major difference between ASMR and frisson, it is rather hard to conclude ASMR as being a type of frisson solely based on this. In fact, the applied theory does seem to imply that despite the two perceptual phenomena both beginning as fear responses and the subsequent suppression of fear via cognitive assessment of the eliciting stimuli being inconsequential, they still end up differing in the stimuli that induce both responses. Also, there is arguably an issue in that the authors drew on personality research. Such findings on both ASMR and frisson has been mixed to say the least, with neuroticism only being reported (as significant) on a single occasion, not to mention the scarcity of such research on ASMR.

Last, while not specifically focused on the ASMR-frisson association like the above two studies, Fredborg et al. (2018) did refer to the relationship. As part of their ASMR checklist (updated version of Fredborg et al.'s, 2017 ASMR Checklist), two items were specific to frisson – one on whether they experienced it and another on whether they were able to distinguish ASMR from frisson experiences. Of their 284 ASMR-sensitive sample, 248 (87.3%) reported that they experienced frisson, with 90.7% reporting the experiences of the two phenomena were indeed distinct. Similarly, participant observations in another study reported the same (Kovacevich & Huron, 2019). Overall, there appears to be a trend developing here where these perceptual phenomena share some similarities with one another, but the existence of differences leans towards the opposite, that they are still distinct, with experiencers even identifying the distinctness in the experiences of the phenomena themselves.

So, as with synaesthesia, the phenomenological characteristics of ASMR and frisson are relatively mixed with both sharing similarities while also showing differences. Again, instead of concluding the two perceptual phenomena are distinct based off the phenomenological differences, their attributed personality, physiological and neural profiles will be outlined and compared to come to a more complete grasp on whether the two are associated sensory responses.

First, regarding personality profiles, there have not been many studies that have examined the role of personality traits in frisson. The first to explore this was McCrae (2007) who specifically examined openness to experience and frisson across cultures. McCrae implemented Costa and McCrae's (1992) NEO-PI-R which contains one item (188) that appears to directly address a frisson-like experience in reading '[s]ometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement' (McCrae, 2007, p. 6). Of the 51 cultures explored, this specific item correlated with openness to experience in 50 and had one of the highest item-total correlations with the trait in 32/50 cultures (the highest of all openness to experience items). From this, McCrae reported this item of openness to experience as the best indicator of the trait across the several translations of the NEO-PI-R, placing frisson as a cross-cultural/universal marker for the trait. Since then, studies on the personality profile of frisson have shown that openness to experience is characteristic of frisson, particularly that this dimension has been reported to predict the frequency of frisson episodes in frisson-sensitive individuals (Colver & El-Alayli, 2016; Nusbaum & Silvia, 2011; Nusbaum et al., 2014; Silvia & Nusbaum, 2011).

While openness is the trait most frequently reported within the literature, other trait dimensions of the BFI have been reported to be positively or negatively associated with frisson (del Campo & Kehle, 2016). For instance, Silvia and Nusbaum (2011) showed that the frequency of frisson episodes was predicted negatively by a subscale of openness to experience as well as conscientiousness, but positively by subscales of extraversion and neuroticism. Maruskin et al. (2012) reported extraversion, neuroticism, and openness to experience as positive predictors, and agreeableness as a negative predictor. In preliminary analysis of the Big Five dimensions of personality, Panksepp and Bernatzky (2002) instead, found agreeableness to be the only trait to correlate with frisson, while reward dependency (a similar trait to agreeableness) has been reported to positively predict frisson (Grewe, Nagel, Kopiez & Altenmüüller, 2007). Thus, Maruskin et al. (2012) were perhaps correct in communicating that although the Big Five have been evidenced to predict frisson in at least a single study, none have consistently predicted the phenomenon. In comparison to ASMR and synaesthesia, there does appear to be a pattern wherein openness to experience has frequently been reported for all three perceptual phenomena however, considering the inconsistencies in the frisson studies, it is hard to place the findings as resembling the personality profile of either ASMR or synaesthesia.

Moving on, with regards to physiological profiles, the findings from multiple studies suggest that both perceptual phenomena are distinct in this regard. As previously touched on, studies on the physiological profile of ASMR have applied heart rate, skin conductance and eye-tracking as physiological parameters to measure the associated sensory responses. There are examples of research on frisson that have also used these physiological parameters. For instance, several studies have consistently found increases in skin conductance during frisson episodes (Craig, 2005; Grewe et al., 2009b; 2011; Guhn et al., 2007), a finding similarly reported during episodes of ASMR (Poerio et al., 2018). However, the distinctness between the two become visible when comparing the findings from studies that have applied measures of heart rate. While ASMR-sensitive individuals have been reported to display a reduced HR (Poerio et al., 2018), the opposite is true for frisson which has consistently been characterised by increases in HR (Benedek & Kaernbach, 2011; Blood & Zatorre, 2001; Grewe et al., 2009b; 2011; Guhn et al., 2007; Salimpoor, Benovoy, Longo, Cooperstock & Zatorre, 2009; Salimpoor et al., 2011; Sumpf, Jentschke & Koelsch, 2015).

Eye-tracking is another measure that studies on both ASMR and synaesthesia applied. These studies found increases in pupil dilation during episodes of ASMR (Valtakari et al., 2019) and synaesthesia (Paulsen & Laeng, 2006). This trend has also been revealed in the frisson literature with one study finding that pupil diameter increased during episodes of frisson (Laeng, Eidet, Sulutvedt & Panksepp, 2016). Like the eye-tracking studies on ASMR and synaesthesia, all three phenomena do appear to share increased pupillary diameter as a physiological response characteristic of their respective sensory responses. Unfortunately, this is again just one similarity which also comes from single studies on all three ends while also being an aspect of physiology that is generalisable to several phenomena.

A final point on physiological profiles is that studies on frisson have also used respiratory measures such as respiratory rate and depth (Benedek & Kaernbach, 2011; Grewe, Kopiez & Altenmüüller, 2009a; Salimpoor et al., 2009; Sumpf et al., 2015) though this is not without saying that the reports have been inconsistent within the literature. This is an area however, that has not yet been investigated in ASMR research but would be an interesting avenue to explore, nevertheless. Again, while further testing is necessary, the physiological profile of frisson, thus far, does appear to be mostly distinct – from both ASMR and synaesthesia.

Last, concerning the neural profiles of ASMR and frisson, there are examples of both similarities and differences within the literature. For example, a task-based fMRI investigation of ASMR revealed increased activity in the nucleus accumbens (NAcc), dorsal anterior cingulate cortex (dACC), supplementary motor area (SMA) and insula, all of which have been previously reported in PET and fMRI studies on frisson (*for a review, see* Harrison & Loui, 2014). Since the majority of studies that have reported (increased) NAcc activity, Lochte et al. (2018) and the frisson studies have explained this (mainly) in terms of reward which is fair. What is interesting however, is that dopamine, often involved in this 'reward system', has been found to be released during episodes of frisson (Salimpoor et al., 2011) to which Lochte et al. (2018) suggested may also be possible during ASMR experiences, as also previously theorised by del Campo and Kehle (2016). This would be an interesting future avenue of exploration (*further detailed in* 3.1.3.).

While the above specified areas are consistent with findings from studies on frisson, there are of course differences. For example, activity in the DMN and other resting-state systems that was consistent in both ASMR and synaesthesia studies (the so-called 'blending') is absent, while Lochte et al. (2018) also referred to the medial prefrontal cortex (mPFC) having found it to display increased activity during ASMR in their study and comparatively decreased activity during frisson in another study (Blood & Zatorre, 2001). As was the case with comparing the personality, physiological and neural profiles of ASMR to those of synaesthesia, is that the presence of differences seems to suggest that ASMR is indeed a distinct response.

2.6.4. Misophonia

The term misophonia, also referred to as selective/soft sound sensitivity syndrome, literally translates to a ‘hatred of sound’ (derivates from the Greek ‘misos’, or hate and phónè, or voice) and is typically described within the audiology literature as an abnormally strong sensitivity to particular sounds that are accompanied by intense, distressing emotional reactions and autonomic arousal (Cavanna & Seri, 2015; Edelstein et al., 2013; Jastreboff & Jastreboff, 2002; Palumbo, Alsalman, De Ridder, Song & Vanneste, 2018; Taylor, 2017).

Briefly, the origin of misophonia can be traced back to hyperacusis. Hyperacusis can be described as a frequent auditory disorder wherein sounds of normal volume are perceived as too/painfully loud, typically defined as an increased sensitivity to sound (Rouw & Erfanian, 2018; Sheldrake, Diehl & Schaette, 2015). When descriptions of hyperacusis failed to apply to several cases of subjects voicing complaints over a reduced tolerance of sound either with or without tinnitus (perceiving a sound which has no external acoustic source, Henry, Dennis & Schechter, 2005), Jastreboff proposed and coined the term misophonia (Jastreboff, 2000; Jastreboff & Jastreboff, 2001). Opposed to hyperacusis as well as other auditory related conditions (e.g., tinnitus and phonophobia, a misophonic variant wherein fear is the dominant emotion experienced in response to sound, Cavanna & Seri, 2015) thus, the meaning and the context of occurrence, of sounds, matter in misophonia (Jastreboff & Jastreboff, 2015).

Those sensitive to this response are individualistic in that particular stimuli are more likely to elicit the response which vary from person-to-person, typically recognised during childhood but can emerge in later life (Cavanna & Seri, 2015; Rouw & Erfanian, 2018). Regardless of specificity, typical misophonia-eliciting stimuli are repetitive, social, trivial, and human-generated, particularly oral and nasal sounds including chewing, slurping, swallowing, crunching, (gum) popping, whistling, throat clearing, (lip) smacking, sniffing, and breathing (Cavanna & Seri, 2015; Edelstein et al., 2013; Rouw & Erfanian, 2018; Taylor, 2017; Wu, Lewin, Murphy & Storch, 2014). It is not without saying that non-human-generated sounds can also generate misophonic episodes with cutlery clinking and scraping, vehicle/engine noise, animal noise and other loud and high-pitched sounds being given as previous examples (Cavanna & Seri, 2015; Taylor, 2017).

Similar to ASMR, while auditory stimuli are the main misophonic inducer, the response can be elicited by cues from other sensory modalities such as the visual observation of certain movements including eating (where the sound/s are inaudible), finger pointing, leg swinging, foot shaking and hair twirling (Cavanna & Seri, 2015; Taylor, 2017). In fact, visual stimuli have been considered to amplify misophonic episodes (Taylor, 2017) where it has previously been shown that unpleasant sounds are perceived and rated as more averse when the played sound is accompanied by an image associated with that sound (e.g., the sound of scraping accompanied by the image of fingernails on a blackboard) (Cox, 2008).

The unpleasant and aversive emotional reactions resulting from these stimuli typically include feelings of anxiety, panic, distress, disgust, irritability, anger and (less often) rage (Cavanna & Seri, 2015; Edelstein et al., 2013). There is also a report of physical manifestations supposedly accompanying these emotional/psychological responses such as body pain/tightness (may be specific to the chest, arms, or head), heightened muscular tone, hyperthermia (abnormally high body temperature), diaphoresis (abnormally excessive perspiration), tachycardia (abnormally fast heart rate), hypertension (high blood pressure), and dyspnea (shortness of breath) (Schwartz, Leyendecker & Conlon, 2011; *see also* Edelstein et al., 2013; Rouw & Erfanian, 2018). As for the intensified autonomic arousal, it is unsurprising given the accompanying averse emotional reactions (Taylor, 2017) and physical accompaniments (Schwartz et al., 2011) which psychophysiological studies measuring autonomic responses during misophonic episodes via parameters such as heart rate and skin conductance seem to support (Edelstein et al., 2013; Kumar et al., 2017; Schröder et al., 2019).

Based on the aversive nature of this response, misophonics tend to develop and employ a number of coping strategies during episodes such as avoidance and blocking (*see* Edelstein et al., 2013) since misophonia symptomology can result in a wide range of impairments from school/work to family and/or other social structures (Cavanna & Seri, 2015). On top of the physiological findings, neuroimaging has also been applied to the investigation of misophonia. Specifically, the potential underlying brain regions associated with the response (Kumar et al., 2017; 2021; Schröder et al., 2019). These too may be considered individual differences associated with the phenomenon. Similar to synaesthesia and frisson, parallels have been drawn between ASMR and misophonia, on phenomenology, as well as these physiological and neural profiles.

Initially, Barratt and Davis (2015) made the link between ASMR and misophonia. Within the literature, ASMR is typically described as eliciting a *positive emotional response* (associated with the ‘relaxing sensation’) alongside somatosensation to specific audiovisual stimuli whose underlying sensory properties are primed for such sensations to occur. Barratt and Davis (2015) thus referred to the potential merit of investigating *negative emotional responses* to external stimuli, proposing misophonia as a candidate that fits this description. In line with this, one might suggest misophonia could be labelled as the polar opposite of ASMR. Bolstering their claim, the authors suggested phenomenological similarities between the two perceptual responses including the inducing stimuli originating from human-centric movement and behaviour, as well as responses being automatic, unexplained by previously learned associations, and having some consistency. Based on these similarities, they suggested that the two phenomena may be related to another perceptual phenomenon, synaesthesia (*refer to* 2.6.2.) based on the idea that both responses somewhat followed synaesthetic patters. They specifically drew on an inducer-concurrent relationship (with external stimulation [e.g., auditory stimuli] being the inducer, and internal perceptual experiences [e.g., somatosensation and positive emotional responses / relaxation] the concurrent) and the predictability of such concurrents. Thus, they suggested that ASMR and misophonia may represent two ends of the same spectrum of a form of (sound-emotion) synaesthesia.

An issue with this perspective however, and one the researchers noted, was the tangibility of concurrents since ASMR also consists of somatosensation whose description is physical, not internal as the researchers outlined. Instead, the authors stated that accepting this would neglect the presence of positive emotion that accompany ASMR somatosensation, suggesting that ASMR may represent the positive end (and misophonia the negative) of the outlined spectrum and that the touch sensation is secondary to positive emotion (i.e., not the primary concurrent). Surprisingly, support can be drawn from a study on another perceptual response in frisson. Maruskin et al. (2012) drew on the differences between the experiences of two sensory concepts within frisson, goosetingles versus coldshivers (both sensations each being made up of two separate frisson sensations – goosebumps and tingles versus coldness and shivers, respectively). In a similar way to how ASMR and misophonia supposedly represent the positive and negative ends of a spectrum of sound-emotion synaesthesia, the authors arrived at the conclusion that the former goosetingles elicit positive affect while the latter coldshivers elicit negative affect.

Arguably, though, the inverse may also be true, that emotion and relaxation may be secondary to somatosensation which research has more recently alluded (Valtakari, Hooge, Benjamins & Keizer, 2019). Indeed, accepting this so-called spectrum would be contradictory since this would similarly neglect somatosensation and even the role of visual (and other non-auditory properties of) ASMR stimuli which have been reported to have a potential influence on such responses (e.g., Barratt et al., 2017). Also, while ASMR somatosensation may be described in the physical sense, it is still technically an illusory percept and is thus more akin to simulated touch which fits Barratt and Davis' (2015) 'internal' description of ASMR and misophonic concurrents. More so, as the researchers also pointed out, there is no (negative) equivalent to ASMR somatosensation (e.g., numbness/irritation) mentioned in the misophonia literature which leans away from the viewpoint that the two phenomena are indeed polar opposites. Thus, it may be worth considering referring to the spectrum as one of *sound sensitivity* (or generally, *experience*) instead of (sound-emotion) synaesthesia due to the conflicting points discussed above. Overall, though, Barratt and Davis (2015) identified a potential relationship between ASMR and misophonia and introduced a few notable phenomenological similarities between the two, and the concept that they may represent two ends of a spectrum of *experience*. This, however, was merely an introduction into this association between the two phenomena, one in which should be explored further with more focused research.

In the years following Barratt and Davis (2015), Barratt et al. (2017) made reference to the relationship between the two phenomena. Briefly touching on this link, the authors gave the example of *mouth sounds* as a means to highlight the idiosyncratic relation between ASMR and misophonia. *To note, these 'mouth sounds' refer to sounds related to eating/consuming food and drinking and are thus non-verbal, non-vocal sounds and should be considered separate from speech.* As outlined, the misophonic literature typically cite orofacial sounds as a common inducer. There are also references to this category of sounds as ASMR inducers both anecdotally and within the literature. In fact, there is a trend in studies that have reported on the perceived intensity and observations of specific ASMR-eliciting stimuli where mouth sounds are included but will typically be the least observed and rated as the least intense ASMR-eliciting stimulus (e.g., Fredborg et al., 2017; Kovacevich & Huron, 2019; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018). Although it appears as if these sounds do not typically lead to ASMR sensations, the fact is, this does not apply to every ASMR-sensitive individual due to the highly individualistic nature of the response. Similarly, not every individual who reports being misophonic will experience misophonic sensations as a result of exposure to orofacial sounds. Barratt and colleagues even noted that there does not appear to be a suitable reason for such disparity in responses to the same stimulus. While still unclear, it may be a possibility that ASMR-sensitive individuals who do not experience ASMR sensations from an orofacial stimulus, may instead experience misophonia and vice versa for misophonic individuals. Ultimately, what is important is that this category of auditory stimuli can elicit both sensory responses, dependant on the individual, who may or may not experience both phenomena.

Moreover, as part of a demographics section of their questionnaire on the features of ASMR, Barratt et al. (2017) reported approximately 43% of their sample of ASMR-sensitive individuals confirmed they also experienced misophonia. This was rather intriguing since in a later publication, the aforementioned statistic coincides with a large-scale misophonia study that reported 49% of their misophonic sample also experienced ASMR (Rouw & Erfanian, 2018). While this seemingly implies that the two phenomena are likely associated and can co-occur, it still does not explain how or why this may be the case.

Building on the above findings, McErlean and Banissy (2018) conducted a study in order to establish whether or not ASMR is associated with increased levels of misophonia by administering Wu et al.'s (2014) Misophonia Questionnaire (MQ) to both ASMR-sensitive individuals and controls. Briefly, the MQ was developed to assess the presence of misophonic symptoms, the resulting emotions and behaviours and the severity of an individual's sound sensitivity, respectively consisting of three subscales including the Misophonia Symptom Scale (MSS), Misophonia Emotions and Behaviours Scale (MEBS) and Misophonia Severity Scale. Subsequent analyses revealed that the ASMR-sensitive sample scored higher on all three scales of the MQ compared to controls.

The researchers thus inferred that ASMR may be linked to an *enhanced sound sensitivity* (MSS), and that this enhanced sensitivity to sound may be associated with *negative behavioural and emotional outcomes* (MEBS), and a *greater level of severity* (misophonia severity scale) – compared to controls. Ultimately, this study was the first real attempt at jointly investigating ASMR and misophonia and their findings suggested that ASMR-sensitive individuals may display increased levels of misophonia symptomology (based on the three MQ subscales). While this requires further testing (and replication) and perhaps with another misophonia instrument, it is preliminary evidence supporting Barratt and Davis' (2015) spectrum as well as the aforementioned findings on the co-occurrence of these phenomena (Barratt et al., 2017; Rouw & Erfanian, 2018).

Extending on this, and the concept that the literature still had a limited understanding, Scofield (2019) aimed to explore the ASMR-misophonia relationship further, while also establishing the types of auditory stimuli that trigger both perceptual phenomena. With a sample consisting of both ASMR-sensitive individuals (N = 220) and controls (N = 28), subjects listened to a series of 12 human and object -generated 1min audio clips typical of ASMR and misophonia elicitation and two 1min white noise controls. Each clip was followed by a set of questions measuring the emotional and sensory responses that are indicative of ASMR-sensitivity (or not) by assessing the nature, frequency, intensity, and duration of the sensation, as well as the emotional response and level of engagement or avoidance (versus pre-audio clips). Next, subjects were provided with a definition of ASMR in which those who responded as experiencing the phenomenon were given an adapted version of Fredborg et al.'s (2017) ASMR Checklist while every subject was given an adapted version of Wu et al.'s (2014) MQ.

Regarding the relationship between ASMR and misophonia, Scofield (2019) reported weak but significant correlations between all the measured variables which they suggested was indicative of a relationship between stronger tendencies to experience ASMR and higher levels of misophonia. Indeed, this is consistent with the previous research (Barratt et al., 2017; Barratt & Davis, 2015; McErlean & Banissy, 2018; Rouw & Erfanian, 2018). Regarding the auditory stimuli, whispering was the strongest ASMR inducer (followed by crinkling), while eating sounds were the strongest misophonic inducer. Again, this is also consistent with the previous research (Barratt et al., 2017; Barratt & Davis; 2015; Fredborg et al., 2017; Kovacevich & Huron, 2019; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018). So, despite the imbalance in their control group, the study still did well in combining key aspects of previous ASMR-misophonia research (e.g., the eliciting stimuli and the co-occurrence of the two responses) and in reporting consistency in these results.

For the most part then, the two responses appear to be similar phenomenologically although the application of objective research methodologies to evidence any potential underlying mechanisms as well as a comparison between the findings for both phenomena is paramount (McErlean & Banissy, 2018). Again, with ASMR, research has attributed the response with personality and empathic, physiological, and neural profiles which highlight possible individual differences associated with the response (versus other similar perceptual responses). Unlike synaesthesia and frisson, only the latter two have been attributed to misophonia.

ASMR has a specific personality and empathic profile (*refer to* 2.5.). While the findings are relatively mixed, certain traits such as openness to experience have shown consistency in both the relevant ASMR research and the wider perceptual literature spanning both synaesthesia and frisson (*refer to* 2.6.2.; 2.6.3.). While there is an apparent void in personality research on misophonia, the existence of such personality investigations of ASMR as well as other perceptual phenomena suggests that similar designs may work in future personality and empathic investigations of misophonia. Indeed, the existence of literature on the covariance of personality traits and noise sensitivity (which misophonia is technically a form of) also suggests this to be possible (*for a comprehensive list of relevant studies, refer to* Shepherd, Heinonen-Guzejev, Hautus & Heikkilä, 2015).

As for the objective methods, both responses have physiological and neural profiles. Regarding the former, psychophysiological investigations of misophonia have associated the response with increased autonomic activity indexed via the parameters heart rate and skin conductance, both of which have been reported to be heightened in misophonic individuals (Edelstein et al., 2013; Kumar et al., 2017). This is consistent with frisson (*refer to* 2.6.3.) but again, physiologically, this is where ASMR is disparate since increased skin conductance, but reduced heart rate has been reported (Poerio et al., 2018; *see also* 3.2.).

Regarding the neural profile, both responses have reported brain activations following ASMR and misophonic stimulus presentation via functional neuroimaging (namely fMRI). One misophonia study, Kumar et al. (2017), reported increased AIC activity in their misophonic sample in response to solely misophonic trigger sounds (i.e., visual misophonic triggers had no such effect). The AIC is part of the salience network (SN) important in the perception of interoceptive signals and the processing of emotions. The same researchers reported increased functional connectivity between the AIC and core areas of the DMN (ventromedial prefrontal cortex and posteromedial cortex) whose coupling may suggest that processes related to associative learning and memory may play a key role in increased AIC activity to misophonic trigger sounds (*see also* Brout et al., 2018). Interestingly, this abnormal functional connectivity and in particular, the link to the DMN, is somewhat consistent with the findings of fMRI investigations of ASMR (*refer to* 3.1.1.) as well as synaesthesia (*refer to* 2.6.2.), again hinting at a potential shared network. A similar point can be made for Schröder et al. (2019) whose fMRI analysis revealed increased activity in the right: insula, ACC, and STG in their misophonic sample.

While this is positive, similar to the neural comparison of ASMR with synaesthesia and frisson, it is worth noting that fMRI investigations on both respective phenomena have revealed differences in brain activations which even differ (though likely due to methodology) between fMRI investigations on the same phenomenon (*again, see* 3.1.1.). These differences alongside how fMRI research conducted on both phenomena are still technically in their infancy, complicates justifications of sharing a similar neural profile, at least until future research suggests otherwise. Once more, as was the case with comparing the personality, physiological and neural profiles of ASMR to those of synaesthesia and frisson, is that the presence of differences seems to suggest that ASMR has the grounds to be considered distinct.

2.6.5. Summarising the Association Between ASMR and Other Perceptual Phenomena

As stated, Klausen (2019b) identified that despite the rapid growth of ASMR, much of the published research deal with examining phenomena thought to have an association with ASMR, with synaesthesia, frisson and misophonia being examples of three such phenomena. It is likely that attention has been fixated on these associations since these phenomena are more well-established within the scientific community. At one end of the scale, this has bolstered the ASMR research base but at the other end, it has not helped in differentiating ASMR as a standalone condition.

The above discussion was to elucidate whether this is the case by providing a summary on the current associations between ASMR and these other perceptual responses in terms of phenomenological characteristics as well as the personality/empathy, physiological and neural profiles. While it is fair to say that ASMR research is still very much in its infancy, there have been consistent differences in all these categories separating ASMR from all three phenomena. Although there have been similarities, the existence of differences paints a picture that ASMR is indeed distinct and it is this very reason that props up across several ASMR papers (e.g., del Campo & Kehle, 2016; Fredborg et al., 2017; Smith et al., 2019b; Valtakari et al., 2019). The ideal next step here is to further research the phenomenological characteristics and personality/empathy, physiological and neural profiles of each phenomenon separately and in greater detail to deepen our understanding, especially ASMR and misophonia, before starting to make comparisons as the studies have been doing.

It is likely, however, that Smith et al. (2019b) are correct in suggesting that the distinctness of ASMR compared to the other perceptual phenomena relies on differing patterns of neural activity, but this is yet to be confirmed. Perhaps even, comparing these other perceptual conditions to one another (i.e., not to just ASMR) would also be useful. This could possibly be achieved in a similar way to Barratt and Davis' (2015) concept of ASMR and misophonia representing two ends of the same spectrum of sound sensitivity (in discussing synaesthesia) which could ultimately help kickstart models (or a single multi-model) encompassing several perceptual conditions. Regardless, until a greater understanding of the phenomena discussed is achieved, it appears sensible to consider and refer to ASMR as distinct.

2.7. Benefit to ASMR

As outlined throughout this chapter and the chapter following, research on ASMR has primarily concentrated on the nature of the response and the possible factors underlying its elicitation. There is however, one other area that has, until recently, received less attention, the beneficial aspect ASMR seemingly provides. Within this, the potential therapeutic application and utility of ASMR as well as its association with mindfulness, is relevant.

2.7.1. Therapeutic Application and Utility

Anecdotally, ASMR has been associated with therapeutic utility. Browsing ASMR-focused online forums, platforms, and even articles will often attest to this idea (*see also* Klausen, 2019b). Central to this is the relaxing sensation ASMR is attributed with alongside ASMR somatosensation. Although it is still unclear whether one of these sensations leads to the other (e.g., relaxation is secondary to ASMR somatosensation), the current discussion will focus solely on what has been said and found about the therapeutic potential of the response.

Fredborg et al. (2017) briefly touched on future ASMR research examining the potential therapeutic benefits the response supposedly provides, where they suggested the relaxing sensation attributed with the phenomenon may prove to be an effective ‘remedy’ for stress and related disorders. Ahuja and Ahuja (2019) distinguished between ASMR-sensitive individuals who associate the phenomenon with relaxation, and those who reportedly utilise it to relieve symptoms underlying conditions such as insomnia, stress, anxiety, depression, and chronic pain. Ultimately, ASMR has been seen as a method to promote relaxation and provide non-medicinal temporary attenuation of associated symptomology of such conditions also referred to as an ‘antidote’ (Baker, 2015) or ‘folk cure’ (Massanari et al., 2015). While ASMR media in general is purported to help in this matter of alleviating symptomology, one should also consider that there is an expanse of such media circulating on online platforms that are tailored to specifically ‘help’ viewer-listeners with conditions such as those outlined above. It has been argued that due to rising public recognition for ASMR media, individuals have begun to increasingly use ASMR for therapeutic benefit and take to public forums to explain ASMR as an alternative to lacking/ineffective treatments (Barratt & Davis, 2015; Poerio et al.; 2018). This too, has been purported to be play a part in the popularity of the phenomenon (Bjelić, 2016; Liu & Zhou, 2019). Indeed, hosts of ASMR media have also adapted to ongoing events such as the Covid-19 pandemic by creating content specific to such events (*see* Buckley, 2022). Despite coming from anecdotal accounts, ASMR is clearly having a beneficial effect and research has begun to pick this apart.

It is appropriate to begin with the survey research which has provided statistics to convey the purposes to which individuals use ASMR. Returning to the work of Barratt and Davis (2015), questions on the reasons for ASMR engagement revealed the promotion of relaxation topped with 98%, followed by 82% to help with sleep and 70% to deal with stress. Moreover, the researchers also wanted to outline the potential effect of ASMR on mood and chronic pain. For the former, they reported that 80% of their sample felt ASMR positively impacted their mood (though this did decrease over time) while a correlation between Beck Depression Inventory (BDI – Beck, Steer & Brown, 1996) and mood scores were suggested to be representative of subjects who scored high on the BDI having the greatest benefit from engaging in ASMR, which was further supported by 69% of their ASMR-sensitive subjects who scored moderate-to-severe depression on the BDI reporting that they utilised ASMR to ease their symptoms of depression. For the latter, 38 subjects with chronic pain (out of a total of 45) reported that ASMR improves their symptoms where analyses revealed a significant difference in symptomology before and during ASMR which was maintained in the following three hours post ASMR engagement. Furthermore, the researchers reported that several subjects described engaging in ASMR as an alternative to interventions that have been ineffective, again hinting at the therapeutic utility of the response.

Similar findings have been reported in several subsequent studies. Of these, McErlean and Banissy (2017) were next and reported that the greatest motivator to engage in ASMR media was to promote relaxation with 85.5% of their ASMR-sensitive sample agreeing, followed by use as a sleep aid (41%) and to help reduce anxiety (10.8%). Following, Poerio et al. (2018) reported 83% of their ASMR-sensitive sample watched ASMR media to trigger the response for relaxation and/or sleep purposes. However, since this statistic came from a single question (on the reasoning behind wanting to trigger ASMR with the dual example of sleep/relaxation), it is difficult to justify the specific usage other than that ASMR is mostly being utilised for reasons similar to those currently reported. Then, in a slightly different approach, as a result of their content analyses, Kovacevich and Huron (2019) reported sleep as the ‘function’ that was observed most by the raters, marginally followed by anxiety relief, relaxation, a work aid, and a means to ease pain/sickness. Last off, in a similar fashion to McErlean and Banissy (2017), McErlean & Osborne-Ford (2020) reported relaxation as the greatest motivator to watch ASMR at 71% followed by sleep (60.1%), improving mood (especially in relation to anxiety and depression) (12.8%) and as a work aid (6.8%).

Following, away from research that has identified reasons for ASMR engagement but still in the realm of surveys, a recent study, Smejka and Wiggs (2022) showed increased relaxation and improved mood following the presentation of ASMR stimuli. The greatest effect was among those who experienced ASMR (confirmed post stimulus presentation) and those in the depression and combined (insomnia and depression) groups to which the researchers suggested ASMR media has the potential to be utilised in improving mood states and alleviating the symptomology of conditions such as depression and insomnia. A similar finding and ultimately future implication were revealed by Eid et al. (2022) whereby anxiety was attenuated post-ASMR stimulus presentation.

The above research has demonstrated that ASMR-sensitive individuals do indeed utilise ASMR for therapeutic benefit. The issue, however, is evidence of a mechanism to which ASMR achieves such a feat, a factor in which these studies have seemingly disregarded but is nevertheless crucial to furthering our understanding.

In line with this, one potential explanation may have presented itself within the ASMR-personality literature with Fredborg et al. (2017). To recap, the authors based their research on the link between neuroticism and depression as well as the prior work of Barratt and Davis (2015) whose ASMR-sensitive sample reported moderate-to-severe depression whilst also using ASMR to temporarily alleviate their symptoms. Their findings showed that ASMR-sensitive subjects scored higher on neuroticism than controls which was suggested to indicate lower levels of emotional stability. In essence, while ASMR-sensitive individuals may score higher on neuroticism, especially if they exhibit symptoms of conditions like depression, engaging in ASMR media does appear to be having a positive effect whereby a regulation of emotion may be plausible as studies have previously suggested (e.g., Poerio et al., 2018). The fact that individuals have reported to use ASMR to temporarily attenuate their symptoms of conditions such as depression does seem to support this concept. This again draws on a similar discussion (of the same study) in a previous section of this review (*see* 2.4.4.) wherein interpersonal properties of ASMR may account for the reports of attenuation of symptomology.

In keeping with this, Eid et al. (2022) represent a more recent example. The researchers showed that ASMR-sensitive individuals had significantly higher neuroticism, trait anxiety, and video management -scores, again linking ASMR-sensitive individuals with a propensity to experiencing negative emotion but also anxiety disorders. Additionally, the researchers reported (pre-stimulus) state anxiety was significantly attenuated following the presentation of ASMR media in solely the ASMR-sensitive group, while further analyses highlighted neuroticism and trait and (pre-stimulus) state anxiety as pre-existing group differences that may indeed account for the attenuation of state anxiety. This way, engaging in ASMR media does appear to have anxiety-alleviating effects and the authors proposed its employment in clinical settings in future. With heightened neuroticism in ASMR-sensitive individuals however, as mentioned in 2.5., was not consistent with McErlean and Banissy (2017), who, despite initial consistency, their finding failed to achieve statistical significance.

Another personality trait that has been linked to the therapeutic utility of ASMR is absorption. Upon reporting elevated absorption in an ASMR-sensitive sample, McErlean and Osborne-Ford (2020) hinted at the idea that the individuals who utilise ASMR to alleviate stress and anxiety may become fully absorbed in ASMR media which acts as a form of distraction form their psychological distress, likening this to the more well documented effect of virtual reality gaming on pain reduction (e.g., Jameson, Trevena & Swain, 2011).

While this is currently theoretical, physiology is another piece of evidence that is perhaps more established. In discussing the (anecdotal) claims on the therapeutic utility of ASMR, Poerio et al. (2018) referred to the need to establish whether ASMR produced reliable emotional and physiological changes to verify these claims (which they showed). The researchers suggested their findings are consistent with the concept that ASMR media can indeed regulate emotions as well as provide therapeutic utility, giving the examples of reducing heart rate, promoting positive affect and interpersonal connection. The authors particularly drew on their finding of a reduced heart rate in ASMR-sensitive subjects since it was comparable to findings from clinical trials using music-based stress reduction in cardiovascular disease (*see* Bradt, Dileo & Potvin, 2013). The finding also seemingly ties in with the aforementioned concept that the interpersonal properties of ASMR may account for the reports of attenuation of symptomology with physiological findings as the connector in this proposed explanation for ASMR-based attenuation of symptomology. It is important to note however, that this explanation is speculative at this moment in time while the physiological element only has two studies to currently draw findings from to which Valtakari et al. (2019) appropriately suggested the potential application of ASMR as a therapeutic tool requires a greater understanding of the underlying physiological mechanisms of ASMR (a point made previously by Lochte et al., 2018).

So, given the supposed benefits of ASMR, the ideal next step would be to investigate the potential clinical benefit of the response by incorporating ASMR as part of a treatment plan (Barratt & Davis, 2015; Lochte et al., 2018). Although this has not yet come to fruition, Lee, Song, Shin and Lee (2019), Vardhan, Venkatesh and Yadav (2020), and Cash et al. (2018) represent the closest examples of such research, the first two concentrating on sleep and the latter on stress reduction.

Despite its subjectivity, the survey research has consistently reported sleep to be one of the main reasons for ASMR engagement or perhaps more appropriately, reengagement. In modern society, sleep plays an integral role in life, one in which humans reportedly spend approximately 30% of their lives asleep (Badran, Yassin, Fox, Laher & Ayas, 2015). Expectedly, an insufficient amount of sleep is detrimental resulting in a whole host of adverse medical and mental dysfunctions, as well as social and economic difficulties yet it is nonetheless regarded as a prominent and common issue (Chattu et al., 2019; Lee et al., 2019). Unsurprisingly, this has led to the development of several approaches to improving sleep quality including pharmacological, behavioural, and novel interventions.

One of these so-called novel approaches is the application of sensory (especially auditory) stimuli which have been shown to improve the quality of sleep (e.g., Besedovsky et al., 2017; Harmat, Takács & Bódizs, 2008; Leminen et al., 2017). A binaural beat is an example of one such auditory stimulus. This refers to a perceptual auditory illusion that takes place when two almost equivalent pure tones (with slightly different frequencies) are dichotically presented and are typically perceived as an auditory sensation at the difference of frequency (Goodin et al., 2012; Jirakittayakorn & Wongsawat, 2017; Perez, Dumas & Lehmann, 2020; Wahbeh, Calabrese, Zwickey & Zajdel, 2007). For instance, when playing a tone of 400 Hz to the left ear (the standard tone) and 406 Hz in the right ear (the carrier tone), a 6 Hz binaural beat is perceived. To note, they are best perceived when both frequencies are approximately 400 Hz with the frequency difference being no more than 35 Hz (Goodin et al., 2012). Interestingly, this so-called binaural beat can generate what is known as the frequency-following response (FFR) which can induce brain activity that corresponds to the perceived binaural beat (the brain oscillates at the rate of the binaural beat frequency), otherwise referred to as entrainment (Jirakittayakorn & Wongsawat, 2017; 2018). Thus, activities, cognition and behaviour can be manipulated via brain entrainment from binaural beats (Jirakittayakorn & Wongsawat, 2018).

In a study that has applied binaural beats to induce sleep, Jirakittayakorn and Wongsawat (2018) argued thus, that they could be used to modulate sleep stages since they can modulate behavioural states. While they have been shown to induce frequencies in the different sleep stages (e.g., Jirakittayakorn & Wongsawat, 2017; 2018), they can also generate negative affect in the listener and be rather distracting (i.e., potentially stop the induction of sleep) and have even been reported to cause dizziness (Noor, Zaini, Norhazman & Latip, 2013). There are, however, examples of research that has paired binaural beats with a second auditory stimulus (e.g., music) and successfully mitigated the adverse effects accompanying binaural beats (e.g., Gantt, Dadds, Burns, Glaser & Moore, 2017; Wiwatwongwana et al., 2016). Although untested, it was highly possible that ASMR could also be utilised in a similar fashion, especially in light of the subjective survey research findings and anecdotal reports that ASMR is being used as a sleep-aid.

Thus, it appears to be a combination of the two, that have served as the inspiration behind Lee et al.'s (2019) study wherein the inclusion of ASMR was hoped to counter the negatives that accompany binaural beats. In their investigation, the researchers proposed a novel auditory stimulus in combining both binaural beat and ASMR as a means to generate entrainment of the dominant frequency in stage one of non-rapid eye movement (NREM) sleep and to induce psychological stability. Put more simply, they proposed and investigated the effects of a combined auditory stimulus of binaural beat-ASMR as a novel approach to induce sleep and improve mood.

Thus, a total of 15 subjects took part in subsequent EEG recordings. The study had two main parts. First, in an effort to identify the optimal combination ratio (binaural beat to ASMR), the researchers combined a 6 Hz binaural beat with ASMR-eliciting stimuli at three decibel ratios (45:60, 30:60, 20:60). To note, 6 Hz was specifically chosen due to its correspondence to the theta band for inducing NREM sleep stage 1. Ultimately, a ratio of 30:60 dB was reported as the most effective inducer of theta power (where theta was the researcher's 'target' frequency band to be induced via binaural beat). Second, the combined auditory stimulus was compared against only a binaural beat, only an ASMR-inducing stimulus (naturalistic sounds: rain, sea waves, waterfall, forest, river) or a control (silent stimulus). Also, to investigate changes in psychological stability, the researchers incorporated the 32-item Brunel Mood Scale (BRUMS-32; Lane & Jarrett, 2005) which consists of 8 factors (anger, tension, depression, vigour, fatigue, confusion, happiness, calmness) each with 4 'mood descriptors' in which participants respond via ratings on a 5-point Likert scale. This was provided to subjects to complete before and after the presentation of each auditory stimulus.

Results showed that for the combined auditory stimulus, theta power increased in the midline associated with the transition into sleep. This was interpreted as the combined auditory stimulus being able to induce sleep, or perhaps more accurately, induce the brain signals required for sleep. Further, regarding psychological stability, results from the BRUMS-32 showed that calmness scores increased post presentation of the combined auditory stimulus (likewise for the ASMR only condition) while for comparison, anger scores increased post presentation to the only binaural beat condition. This seems to suggest that due to combining binaural beats with ASMR, the benefits of binaural beats (in this case, the induction of sleep and positive mood) were retained while the adverse effects were resolved due to the presence of ASMR. The implications of this research, therefore, is in the applicability of the combined auditory stimulus as an intervention to improve sleep quality and in the relief of negative emotions.

There are of course a couple of issues that need to be ironed out in subsequent studies or replications, particularly with regards to ASMR. With consideration of the sample, the sample size was relatively small at 15 but more importantly, the researchers did not indicate whether they were ASMR-sensitive. Although it is understandable that the researchers were merely interested in whether the combined auditory stimulus had an effect on sleep induction and mood, the inclusion of an ASMR-sensitive sample opposed to non-ASMR-sensitive may have had an impact on their findings. Theoretically, if an ASMR-sensitive sample was recruited, one may expect a greater increase to theta power and therefore faster induction of NREM sleep stage 1 and greater calmness scores on the BRUMS-32. Even so, if they were non-ASMR-sensitive, the findings would perhaps allude to the concept that ASMR-inexperienced individuals may be able to experience ASMR or at least the reported benefits (in this case, as a sleep-aid) which also has relevance in the mapping of ASMR prevalence rates. Ultimately, recruiting both groups would have been beneficial to identify any potential group differences.

Next, regarding the ASMR stimuli that were combined with binaural beats, the researchers used the sounds of rain, sea waves, waterfall, forest, and river over more commonly reported ASMR-eliciting stimuli such as whispering and tapping. Their explanation for this was based on how the more typical ASMR-eliciting stimuli are able to elicit ASMR somatosensation (i.e., a feeling of touch) which, according to the researchers, would not offset the inconvenience of the binaural beat. Although the utilised stimuli technically come under the 'umbrella of ASMR-eliciting stimuli' and the original source label them as such, they are not widely regarded as typical ASMR-eliciting stimuli. Instead, they perhaps more accurately come under the category of relaxing naturalistic sounds. Moreover, while it is currently unclear whether all ASMR stimuli elicit somatosensation, it is also presumptuous to firmly explain these naturalistic sounds as not being able to induce ASMR somatosensation. This also very clearly highlights the lack of accounting for the variability in ASMR intensity between individuals. Both ASMR-sensitive and non-ASMR-sensitive participants may indeed experience somatosensory sensations from the presented stimuli. Even if the presented stimuli truly do not evoke somatosensation, there does not appear to be any justification (e.g., a preliminary study conducted by the researchers or mention of previous research) within the research paper to clarify this. Therefore, this too may have had an impact on the study findings where, as theorised for recruiting an ASMR-sensitive sample, combining ASMR-eliciting stimuli that are typically reported in the media as well as in the survey research may have shown a greater increase to theta power and calmness scores.

Despite the criticism, there are implications of this research for ASMR. Specifically, that EEG may be applicable as a neuroimaging technique to investigate the phenomenon as previously outlined which has since been achieved (*see* 3.1.2.); that ASMR can induce sleep and/or improve sleep quality thereby substantiating the survey research findings and anecdotal claims that ASMR can be utilised as a sleep-aid; and that ASMR on its own or alongside another intervention can be trialled as an intervention for sleep within a clinical setting. Ideally, studies utilising a similar methodology but with ASMR stimuli typical of ASMR media (versus controls) would be beneficial before taking it into clinical settings. Along these lines, Vardhan et al. (2020) recently called on the need for a reliable diagnostic tool for insomnia in India due to the current method consisting of clinical interviews given by doctors which was subjective and prone to human error. Instead, they proposed EEG as a more appropriate measure but more relevant to the current discussion, suggested utilising ASMR to enhance the quality of sleep. Again, further research is paramount, but the existence of these (objective) studies is a step in the right direction in furthering discussions on the therapeutic utility of ASMR.

Cash et al. (2018) then, examined the role that expectations play in eliciting ASMR. Due to a consideration of the reported benefits the response provides on top of the ease of watching ASMR from the comfort of one's home, whether or not the associated sensations (and thus benefits) of ASMR represented a placebo effect were explored. Consisting of ASMR-sensitive individuals and controls, each subject read suggestive instructions (manipulated to be leading or misleading in terms of ASMR induction) prior to listening to three audio clips (ASMR-inducing, foil – resemblance to ASMR, and control). Upon analysing their data, the authors reported that their non-ASMR-sensitive subjects experienced ASMR when listening to audio prefaced with leading instructions while ASMR-sensitive subjects only experienced ASMR when the audio was specific to ASMR-induction. This suggested that the ASMR-sensitive sample were unaffected by the manipulated expectation however, their ASMR ratings indicated that they were instead influenced by their own expectations driven by prior history of ASMR engagement. This led the researchers to suggest that ASMR may be explained by expectations and the reported benefits as placebo effects. In context, ASMR-sensitive individuals would expect reductions in symptomology of conditions such as depression from engaging in ASMR media as it may have previously helped, to which these individuals would experience temporary placebo-induced reductions.

While this is a fair assumption, it has also been a point of debate among ASMR researchers. Cash et al. (2018) seemingly based their concept that 'ASMR may be a placebo effect' off the finding that the ASMR-sensitive group reported lower ASMR ratings for the non-ASMR audio clips (foil and control stimuli). This however, as Hostler et al. (2019) explain in a subsequent commentary paper, cannot account for whether high ASMR ratings for ASMR-inducing audio clips are caused by expectation where they argue a more likely explanation is that the perceptual expertise of ASMR-sensitive individuals enables the reliable identification of the associated sensations of ASMR (or not) to presented stimuli. This way, the lower ratings would be due to the fact that the ASMR-sensitive group recognise the non-ASMR audio as non-ASMR-eliciting. Hostler et al. (2019) also acknowledged that this interpretation would mean that the ASMR ratings of the controls may not be valid since they do not have the aforementioned 'perceptual expertise' to correctly classify any resulting sensations as those typically associated with ASMR. Whether ASMR is a placebo effect though, remains unjustified and is still a matter of debate.

Regardless of the concept that the reported (therapeutic) benefits of ASMR are potentially akin to that of a placebo effect, the researchers stressed that this does not diminish the therapeutic utility of the response, likening the phenomenon to guided meditation and mindfulness practices which have reported similar benefits to the survey research findings outlined above (e.g., Chiesa & Serretti, 2009; Khoury, Sharma, Rush & Fournier, 2015). In particular, mindfulness-based stress reduction (MBSR), a meditation technique that focuses on awareness of bodily sensations (Chiesa & Serretti, 2009), was discussed which has seen success in both clinical and non-clinical populations (*for a list of relevant citations, refer to* Cash et al., 2018). With MBSR typically occurring in group environments, the application of ASMR as an at-home stress reduction technique was put forward along with the following benefits over other techniques: cost efficiency (freely available online), ease of use (at-home usage) and no physical requirement aside normal hearing ability. Hence, despite not reporting on whether expectations influence the attenuation of symptomology often attributed to ASMR, the authors have built the foundation for future discussions on the application of ASMR in a clinical setting.

In relation to this, another point of interest was their finding that non-ASMR-sensitive subjects reported experiencing the associated sensations of ASMR if led to expect the presented audio to be such that has been tailored to elicit the response. What this technically implies is that ASMR may indeed be experienced in non-ASMR-sensitive individuals as previously implied (*see* Koumura et al., 2019) which is relevant in mapping prevalence rates and in furthering discussions on the therapeutic utility of ASMR. Especially key to outlining the benefits to the phenomenon, the latter raises the question that if the associated sensations of ASMR can be reliably and consistently reported in non-ASMR-sensitive (or perhaps more appropriately, ASMR-inexperienced) individuals, then perhaps the reported benefits of ASMR can also extend to non-experiencers. More so, even if a non-experiencer does not report any of the somatosensory sensations associated with the response, perhaps the relaxing element alone may provide therapeutic benefit similar to the treatments ASMR was likened to which would pave the way for discussions on the mechanism/s underlying the ASMR-based attenuation of symptomology (which may indeed be a result of the physiological / interpersonal properties of ASMR as theorised above).

It appears thus, that an appropriate next step would be to thoroughly design an ASMR-based treatment plan considering the propositions Cash et al. (2018) outlined in terms of ASMR-based stress reduction before trialling ASMR within clinical settings. The same goes for other conditions such as insomnia where the findings of Lee et al. (2019) and Vardhan et al. (2020) should be explored further. As suggested, studies utilising a similar methodology to these wherein ASMR stimuli typical of ASMR media such as those consistently reported in the survey research (e.g., whispering and nonverbal sounds like tapping and brushing – *see* 2.3.) versus foil stimuli (i.e., those that bear resemblance to the presented ASMR-eliciting stimuli but differ slightly in their properties such as pitch – *see* Barratt et al., 2017; Koumura et al., 2019) and/or controls (e.g., white noise / silent stimulus) would be beneficial and also have practicality in exploring the neural underpinnings of the response through EEG.

With Cash et al. (2018) likening ASMR to a form of mindfulness-based intervention, this represents another area in which research has been conducted alongside ASMR and it is perhaps key to outline the findings of these studies and combine them with Cash et al.'s (2018) proposition to get a better sense of what an ASMR-based treatment plan would look like. Only after successfully implementing these so-called treatment plans would it make sense to trial ASMR within clinical settings. While the phenomenon is unlikely to be considered viable on its own, it is more appropriate to think that ASMR could be suggested as a complementary intervention (or co-treatment) alongside another credible treatment or two as Lochte et al. (2018) suggested and as Ahuja and Ahuja (2019) described – ASMR as a 'do-it-yourself' complementary therapy.

2.7.2. ASMR and Mindfulness

In a previous discussion, (*refer to* 2.6.) the phenomenology as well as the personality, physiological and neural profiles of ASMR were compared against other perceptual atypicalities including synaesthesia, frisson and misophonia. There is, however, another conscious state that bears some resemblance to ASMR, mindfulness. Mindfulness has been operationally defined as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment-by-moment" (Kabat-Zinn, 2003, p. 145). Put more simply, mindfulness refers to the non-judgemental attendance to both internal and external stimuli occurring in the present moment (Baer, 2003). The origin of the psychological construct is rooted in Eastern meditation practices (Baer, 2003; Shapiro, Carlson, Astin & Freedman, 2006), whereby such practices are ostensibly utilised to cultivate and develop mindfulness (Baer, 2003; Kabat-Zinn, 2003).

Key to the current discussion is the fact that mindfulness has been incorporated into several interventions (such as the previously outlined MBSR) that are now widely available in clinical settings (Baer, Smith & Allen, 2004). Such interventions have been suggested to generate reductions in conditions such as stress, anxiety, depression, eating disorders and pain (Baer, 2003). Its exclusion from the previous section (2.6.) thus, is down to its therapeutic utility which seems a great deal more appropriate in the current discussion of the potential benefits ASMR provides in which delving into the mindfulness literature may help better understand ASMR in this light.

Briefly, the association between ASMR and mindfulness lends itself to some shared phenomenological characteristics between the two phenomena (Barratt & Davis, 2015). This overlap has been based on how individuals engaging in ASMR media focus their attention on an external stimulus (i.e., an ASMR-eliciting stimulus) that elicits within them a feeling of relaxation and positive emotion and a somatosensory tingling sensation to which they focus their attention internally (Barratt & Davis, 2015; Fredborg et al., 2018). In a similar way to which mindfulness has been applied as an intervention for various debilitating conditions, the anecdotal reports and survey research findings on the potential therapeutic utility of ASMR paint the phenomenon in a similar likeness. In fact, Barratt and Davis (2015) categorised ASMR as an exercise in mindfulness meditation when discussing a potential explanation for the reported improvements in mood to both depressed and non-depressed subjects, which was seemingly based on the mindfulness descriptor of attention wherein individuals engage in ASMR focusing their attention on the stimuli and the elicited sensations. Arguably thus, elements of the ASMR experience echo some of the descriptors of mindfulness with greater emphasis on the concept of focused attention to internal and external stimuli within the present moment, as well as the benefits the two phenomena provide.

With consideration of the similarities between the two phenomena, Fredborg et al. (2018) believed they were enough to warrant an investigation into the relationship between ASMR and mindfulness, both state and trait. In context, a trait refers to an individual's relatively stable characteristic(s) / pattern of behaviour, while a state represents their experience in a particular moment, situation, or condition (Medvedev, Krägeloh, Narayanan & Siegert, 2017). Within the confines of mindfulness, this can be translated into the general tendency to be mindful as the trait, and the degree to which an individual is mindful at a particular moment in time as the state (Eisenlohr-Moul, Peters, Pond & DeWall, 2016; Medvedev et al., 2017). So, in a second part to their 2018 study, Fredborg and colleagues presented ASMR-sensitive (self-report) and control participants with two well-established (self-report) measures of mindfulness to complete, the Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003) which is more sensitive to trait mindfulness and the Toronto Mindfulness Scale (TMS; Lau et al., 2006) which is more sensitive to state mindfulness. The groups were compared on their scores from these questionnaires. Also, the relationship between the results of the MAAS and TMS and that of the previously outlined ASMR Checklist (Fredborg et al., 2017) were analysed.

Compared to controls, the researchers reported significantly higher scores on the MAAS, as well as the curiosity subscale of the TMS in the ASMR-sensitive sample. From this, they suggested the two phenomena appear to be related constructs. What was interesting however, in the current context of the therapeutic potential of ASMR, was that the researchers raised the question: given that mindfulness is associated with increased ASMR intensity, would training in mindfulness enhance ASMR experiences? Indeed, the current findings seem to suggest that this is the case. The therapeutic utility of ASMR has already been brought up within subjective survey research and anecdotal reports circulating in online forums. If other studies (in future) also report an association between ASMR and mindfulness whereby mindfulness (training) enhances the associated sensations of ASMR (i.e., relaxation and somatosensation) then perhaps the potential benefits that ASMR has on individuals may also be enhanced.

An interesting follow-up to this would be asking whether mindfulness training could allow ASMR-insensitive individuals to experience ASMR sensations. Although speculative, the researchers suggested future research investigating the therapeutic utility of ASMR alone and in conjunction with other interventions would help to address this potentiality. While the current review already alluded to the idea of trialling ASMR on its own, perhaps combining it with mindfulness is the way to go in terms of developing an ASMR-based / ASMR-combined treatment plan. Lee et al. (2019) combined ASMR with binaural beats as a novel method of sleep induction quality of sleep improvement. Thus, ASMR could be combined with mindfulness practices or training as a means to enhance psychosocial wellbeing. This also fits in line with Cash et al.'s (2018) likening of ASMR to guided meditation and mindfulness practices, particularly MBSR.

In fact, a recent example of research investigating the enhancement of psychosocial wellbeing through ASMR, also referred to the phenomenological association between ASMR and mindfulness as well as likening the improvement to psychosocial wellbeing ASMR purportedly provides to mindfulness-based treatment programmes (Ko Wai, 2020). Briefly, Ko Wai (2020) conducted semi-structured interviews on three university students. Upon running an interpretive phenomenological analysis on the transcripts, the researcher showed that ASMR videos enhance wellbeing via mindfulness-like experiences. Further to the point, Ko Wai (2020) also suggested that the influence of engaging in ASMR can extend to improving concentration, improving the quality of sleep (by stopping rumination), increasing self-confidence, and motivating altruistic behaviour.

An issue arises however, in that in a more recent study, McErlean and Osborne-Ford (2020) reported no group differences in mindfulness (scores) between ASMR-sensitive and control participants. This is clearly inconsistent with Fredborg et al.'s (2018) findings yet this is puzzling since both studies did not differ in the scales employed or in the method of participant recruitment. There were slight differences in the sample size with the previous study being larger (though a priori power analysis suggested the current study's sample was large enough), and in the control MAAS scores which were lower in the previous study yet both study's control MAAS scores were lower than the original (Brown & Ryan, 2003) regardless. This, however, is not to diminish Fredborg et al.'s (2018) findings and implications or the general concept that ASMR is associated and can be combined with mindfulness to explore the therapeutic utility it is claimed to provide.

Overall, the current research appears to be leveraged slightly in favour of associating ASMR with mindfulness and the potential for combining the two in the development of an ASMR-combined treatment plan, yet it is not without saying that further research investigating the relationship between the two is also a necessity. The fact of the matter is that combining ASMR with mindfulness represents a single way into developing an ASMR-based / ASMR-combined treatment plan where there are others including Lee et al.'s (2019) study that combined ASMR with binaural beats.

CHAPTER 3: Neurophysiological Profile of ASMR

3.1. The Neural Profile of ASMR

The research reviewed in Chapter 2 explored the nature of ASMR. Yet this kind of research does explore the underlying processes that lead to ASMR experiences. In order to develop a mechanistic model, an application of objective research methodologies, particularly neuroimaging, is required as a prerequisite to extract the relevant parameters that tell us about the neural underpinning of ASMR. In the first peer-reviewed paper published on ASMR, Barratt and Davis (2015) suggested that research that utilised neuroimaging methodologies like fMRI will reveal underlying brain areas associated with the response. Other perceptual phenomena (frisson, synaesthesia, misophonia) have been addressed using functional imaging. They also stressed that although ASMR would benefit from functional imaging, such investigation may also prove problematic as ASMR is reported to require quiet relaxed conditions (Barratt et al., 2017; Barratt & Davis, 2015) and loud scanner noise may hinder or completely inhibit ASMR experiences from occurring (Smith et al., 2019b).

Smith et al. (2019b) argued that there are two forms of fMRI techniques that can be applied to investigate the neural underpinnings of ASMR: task-based wherein brain activations are measured during ASMR elicited via presenting an ASMR task in-scanner, and non-task-based (e.g., resting-state fMRI) which examines how brain activity differs between ASMR-sensitive individuals and controls. Both forms are present in the literature. Other forms of neuroimaging also have the potential to be applied to ASMR investigations with electroencephalography (EEG) being a more recent example. To date, the literature consists of a total of six functional MRI and three EEG -studies that have yielded results in ASMR-sensitive individuals.

3.1.1. fMRI Investigations of ASMR

Smith et al. (2017) conducted the first functional imaging (fMRI) study of ASMR using fMRI to examine the functional connectivity of the DMN and establish whether the brains of ASMR-sensitive individuals differ from those of controls.

Functional connectivity has been defined as the statistical dependencies among remote neurophysiological events (Friston, 2011), or more conventionally by measuring similarity between signals from two brain areas (Mohanty, Sethares, Nair & Prabhakaran, 2020). The DMN is a task-negative resting-state functional network of anatomically segregated brain regions whose patterns of activity are synchronised (Simon & Engström, 2015) and is reported to be involved in several domains of cognitive and social processing (Li, Mai & Liu, 2014). Briefly, this network consists of three major subdivisions including the ventral medial prefrontal cortex (vmPFC), dorsal medial prefrontal cortex (dmPFC), and the posterior cingulate cortex, precuneus, and parietal cortex (Raichle, 2015). On the other hand, reduced functional connectivity of the DMN has been proposed to be a biomarker for atypical neural functioning (Smith et al., 2017).

So, Smith et al. (2017) hypothesised that their self-reported ASMR-sensitive sample (N = 11) would display reduced functional connectivity of the DMN relative to a matched control but also that ASMR would be associated with increased activity of the DMN in sensory cortices and other regions not associated with the DMN. The researchers reported that the DMN of the ASMR sample displayed atypical functional connectivity relative to controls. Specifically, they observed reduced functional connectivity between the frontal lobes and sensory and attentional regions but also increased connectivity between occipital, frontal, and parietal cortical regions. The authors interpreted this as reflecting a 'blending' of several resting-state networks. Interestingly, this is consistent with findings from other similar perceptual phenomena such as synaesthesia (Dovern et al., 2012) and misophonia (Kumar et al., 2017).

However, as in many ASMR studies, they lacked an independent and standardised screening protocol for ASMR-sensitivity. As with other perceptual phenomena (e.g., misophonia), the current method is reliant on self-report and the development of a universal screening protocol in its preliminary stage (Hostler et al., 2019; Roberts et al., 2019; Swart et al., 2021). Possible objective measures could include physiological factors. Heart rate, skin conductance and pupillary dilation have been implemented as measures of ASMR (Engelbregt et al., 2022; Poerio et al., 2018; Valtakari et al., 2019) and while physiology is not without limitations, it would provide an objective measure for future screening tools. This would be useful alongside fMRI which requires the on-site presence of participants and has been applied in misophonia research (e.g., Kumar et al., 2017; Schröder et al., 2019). While this is an issue for all ASMR studies, a screening protocol is especially vital in neuroimaging studies due to the sheer cost of conducting such research, with the goal being to understand the neural workings underlying ASMR and this can only be achieved if the subjects are truly ASMR-sensitive.

Additionally, the authors recruited a relatively small sample (N = 22), only half of whom were ASMR-sensitive. While small sample sizes have typically been accepted in fMRI studies, considering current views on such reporting practices, it has been reported that sample sizes of 30 or less are underpowered statistically (Dubois & Adolphs, 2016; Turner, Paul, Miller & Barbey, 2018) often resulting in inflated effect sizes and low replicability (Button et al., 2013; Dubois & Adolphs, 2016; Szucs & Ioannidis, 2017). Last, because this study used resting-state fMRI, no actual ASMR stimuli were presented to subjects during scanning meaning potential brain activation/s during ASMR sensations could not be assessed. So, the reported differences in brain activity between the two groups are statistical and not necessarily reflecting ASMR processed. A task-based fMRI study may rectify this.

Noting that that Smith et al. (2017) did not observe potential brain activation/s during ASMR, Lochte, Guillory, Richard and Kelley (2018) utilised task-based fMRI. The researchers presented five different 7-minute ASMR-eliciting videos to self-reported ASMR-sensitive subjects (N = 10) in-scanner. During stimulus presentation, the researchers reported activity in several regions. First, is significant mPFC activity which was suggested to potentially express the ability of ASMR videos in activating the brain similarly to real life social engagement. Previous research has reported on the fundamental role of the mPFC in social cognition (Amodio & Frith, 2006) where it is argued to be a key region in understanding the self and others (Frith & Frith, 2006; Grossmann, 2013). Lochte et al. (2018) also mention how mPFC activation during ASMR may be suggestive of a possible contribution of oxytocin to the feeling of relaxation the response provides based on Sabihi, Dong, Durosko and Leuner's (2014) finding that the neurohormone binds to receptors within the region and mediates relaxation responses. If correct, this would open interesting discussions on the possibility of a neurotransmitter theory of ASMR and within this, interpersonal theories of ASMR (*discussed further in* 3.1.3.). There was also significant brain activity within several somatosensory regions (particularly the secondary somatosensory cortex) involved in the perception of touch. This was interesting since the same activity that arises from actual touch was being reported in response to virtual touch (i.e., by the host in the relevant ASMR videos presented). This touches on the applicability of the interpersonal theories of ASMR. However, the authors did report additional activity in the foot region (of the somatosensory homunculus) which was not an area that was virtually being touched thus potentially indicating that the findings may not reflect simulated touch. Future exploration focused solely on the simulated touch from ASMR-specific videos may lend support.

Moreover, activity in the dorsal anterior cingulate cortex (dACC), supplementary motor area (SMA) and insula were reported and suggested to reflect an association between ASMR and empathy. This was thought to support ASMR's association with social cognition and is consistent with a previous ASMR study reporting an ASMR-sensitive sample as scoring higher in empathic concern (McErlean & Banissy, 2017). In terms of SMA activity, it may also reflect an association between ASMR and auditory imagery (Lima, Krishnan & Scott, 2016). Further, nucleus accumbens (NAcc) activity was reported and suggested to associate ASMR with reward. This may tie in with the pleasantness typically ascribed to ASMR descriptions.

As an overall explanation, the researchers put forward the concept that their results (and ASMR stimuli in general) are related to affiliative behaviours. These are behaviours that promote social bonding (Van der Meij, Almela, Buunk, Fawcett & Salvador, 2012) and thus involve interpersonal bonds between individuals including social grooming and care- giving/receiving which ASMR stimuli echo (Lochte et al., 2018), particularly present in personal attention ASMR videos. The researchers found support in previous fMRI research on affiliative behaviours that have reported heightened activity in the regions they observed, specifically the mPFC, NAcc, insula and IFG (*for an overview, refer to* Feldman, 2012). This again touches on the interpersonal theories attributed to ASMR. Overall, the researchers associated the brain activity observed with the experience of ASMR with the regions collectively associated with social engagement, emotional arousal, and reward. Again though, the same limitations in screening protocol and small sample size (which did not include a control) were present. However, Lochte et al. (2018) did succeed in applying task-based fMRI to the investigation of brain activation during ASMR and showed that ASMR can be experienced during scanning (i.e., scanner noise was not an issue) which was pivotal.

Smith et al. (2019a) built on Lochte et al.’s (2018) research by recruiting and testing a larger sample (N = 34) consisting of both ASMR-sensitive individuals and matched controls, while also incorporating control non-ASMR-eliciting stimuli. The researchers presented six different 4-minute videos to both groups during scanning, three designed to elicit ASMR and three controls.

During ASMR stimulus presentation, ASMR-sensitive subjects displayed greater activity in the cingulate gyrus and cortical areas associated with audition, vision, and movement. Also, when comparing ASMR-sensitive subjects to control subjects during ASMR stimulus presentation, the ASMR-sensitive group displayed greater neural activity in the right cingulate gyrus, right paracentral lobule, and bilateral thalamus. Collectively, the findings were interpreted as highlighting the complexity of an ASMR experience since the regions reported are associated with sensation, emotion, and attention, and were specific to ASMR-sensitive subjects. While ASMR screening is evidently a recurring issue, positive steps were taken: an increased sample size, and addition of a control group and control stimuli. Again, ASMR was shown to be experienced in-scanner, while their results showed some consistency with the previous findings.

Particularly, activity in the cingulate gyrus and regions associated with movement (Lochte et al., 2018) and atypical thalamic activity (Smith et al., 2017) which point towards potential neural substrates underpinning ASMR experiences.

Smith et al. (2019b) built on their original study (Smith et al., 2017) by again employing resting-state fMRI. Since their original study exclusively focused on the DMN, they extended their examination of functional connectivity to additional resting-state networks: salience (SN), central executive (CEN), sensorimotor (SMN), visual, and auditory, and recruited a larger sample size (N = 34) of both ASMR-sensitive individuals and controls (equally). The researchers did not detect the auditory network in their analyses thus, the functional connectivity of the DMN, SN, CEN, SMN and visual networks only, were examined to see if there were differences between the two groups.

Reduced connectivity in the salience and visual networks, and atypical connectivity in the default mode, central executive, and sensorimotor networks was reported in ASMR-sensitive subjects. This was associated with the experience/s of ASMR. Again, the lack of ASMR screening and ASMR stimulus presentation was present. However, the findings were consistent with the original study, again shedding light on the associations of ASMR with changes in resting-state networks and regional activity. Ultimately, ASMR-sensitive subjects had more blended (‘less distinct’) resting-state networks which has been reported in functional imaging research on synaesthesia (Dovern et al., 2012) and misophonia (Kumar et al., 2017). While this hints at such activity potentially not being specific to ASMR, it does open discussions for models of perceptual phenomena in which such brain activity may be a neural marker.

Lee, Kim and Tak (2020) utilised task-based fMRI as a means to test whether or not changes in functional connectivity within the DMN, affective touch network and self-/other networks occurred during ASMR. Previous ASMR-fMRI findings have identified regional brain activity during ASMR (Lochte et al., 2018) and associations between ASMR with changes in resting-state networks and regional activity (Smith et al., 2017; 2019b). Lee et al. (2020) argued however, how ASMR modulates connections among brain regions was still a grey area. The researchers recruited 28 subjects who participated in two fMRI sessions: the first being a 5min resting-state scan, and the second consisting of an ASMR task (watching 5min-long ASMR videos). Compared to resting-state functional connectivity, Lee et al. (2020) reported significant alteration of several connections within the three networks during ASMR engagement.

For the DMN, the researchers reported significantly increased functional connectivity between the posterior cingulate cortex (PCC) and the superior/middle temporal gyri, cuneus, and lingual gyrus during ASMR engagement. Drawing specifically on the increased functional connectivity between the PCC and superior temporal gyrus (STG), the authors interpreted it as refencing the involvement of ASMR in mentalising and self-referential processing. Moreover, reduced functional connectivity between the dorsolateral prefrontal cortex (dlPFC) and PCC during ASMR engagement was reported which was interpreted as a decrease in voluntary suppression of negative emotion based on previous findings on these regions and Poerio et al.'s (2018) explanation of ASMR stimuli resulting in a psychologically pleasant effect. Further, significantly increased functional connectivity between the left/right lateral parietal cortex (LPC) and the visual regions of the cuneus and calcarine during ASMR engagement was reported and suggested to reflect an increased visual input and processing from ASMR stimuli.

For the affective touch network, the researchers reported significantly increased functional connectivity between the right posterior insular cortex (Ig2) and the cuneus during ASMR engagement. This was suggested to indicate the visuo-auditory influence of ASMR stimuli based on previous reports indicating these regions' roles in the integration of information from both visual and auditory modalities, and visual processing respectively.

For the self-network, the researchers reported increased functional connectivity between the pregenual anterior cingulate cortex (pACC) and the mPFC during ASMR engagement. This was proposed to reflect self-referential processing elicited by ASMR stimuli. The implication of the findings as a collective was that ASMR could be elicited and maintained through ongoing interaction between regional activity involved in the integration of visual and auditory information and mentalising and self-referential processing.

Post-scanning, subjects completed questionnaires that assess changes in affective states (Multi-Affect Indicator; Warr, 1990; Warr et al., 2014) as a measure of the affective outcomes of watching ASMR-specific videos and to investigate the potential association of functional connectivity estimates with psychological changes of ASMR. Here, participants were instructed to specify how they felt during ASMR engagement in-scanner. Regarding the potential association of functional connectivity estimates with psychological changes of ASMR, ASMR-elicited affective state changes were significantly negatively correlated with functional connectivity involved in visual information processing which prompted the assumption that ASMR stimuli have the ability to attenuate high arousal states. However, the questionnaires were applied as a measure of the affective outcomes of the experimental condition (watching ASMR-specific videos) alone. This meant that the affective outcomes of the prior resting-state scan were not explicitly measured which makes interpretations of the correlation coefficient between these behavioural scores and the functional connectivity estimates harder to assess. As reported in their discussion, presenting subjects with the same questionnaires post resting-state scan would have allowed for a more explicit comparison.

Overall, this is currently the first and only attempt at providing a potential explanation for how ASMR explicitly modulates connections among brain regions. Also, the results have shown consistency with the previous findings (e.g., DMN, cingulate cortex, mPFC). It is, however, worth noting that a control non-ASMR-sensitive sample was not recruited and in fact, there was no indication that their sample were ASMR-sensitive. In the experimental condition, their participants were shown ASMR-eliciting stimuli though if the sample were non-ASMR-sensitive/unfamiliar with the response, it would be hard to justify the brain activity observed as resulting from an ASMR experience versus a presentation of general audiovisual stimuli. Although the behavioural questionnaire did generate responses on how these participants felt during ASMR stimuli engagement which would likely warrant descriptions akin to typical descriptions of the response, it is by no means a measure of ASMR. In their favour however, one could counter this with the fact that some of the observed activity was consistent with the previous fMRI findings on ASMR and other perceptual phenomena, suggesting the subjects may very well be sensitive to ASMR or generally sensitive to perceptual phenomena like ASMR. Recruiting an ASMR-sensitive sample and utilising a measure of ASMR intensity (e.g., Fredborg et al.'s, 2017 ASMR Checklist) would have been beneficial.

Most recently, Smith et al. (2020) again employed resting-state fMRI. This time, to investigate the functional connectivity associated with individual differences in the stimuli that elicit ASMR and the intensity of such responses. As outlined previously (*see* 2.3.), a major issue within ASMR research is not accounting for the variability in both ASMR stimuli preferences and intensity. To reiterate, there are specific ASMR stimuli that ASMR-sensitive individuals have a heightened sensitivity towards hence differences in stimuli preferences and intensity. The researchers recruited 15 self-reported ASMR-sensitive participants who completed the previously outlined ASMR Checklist (Fredborg et al., 2017) and a resting-state fMRI scan. Specifically, checklist scores were used as covariates to establish whether the functional connectivity of eight different resting-state networks differed as a result of sensitivity to five different ASMR stimuli.

Results showed low functional connectivity in sensory areas were linked to several of the ASMR triggers but more importantly, that the dorsal attention network was positively correlated with sensitivity to two ASMR stimuli. This was suggested to indicate atypical attentional processing attributed to ASMR. The exclusion of a control condition limits the possible interpretations, but the study demonstrates the functional connectivity associated with the individual differences in ASMR stimuli preferences and intensity, demonstrating that there are indeed individual differences in regard to the sensitivity to different ASMR stimuli. With this being an issue in ASMR research, the inclusion of some form of intensity scale would be beneficial, at least in selecting a more well-matched ASMR-sensitive sample in future research. Taking this to task-based fMRI seems an appropriate next step.

While still clearly in its infancy, the ASMR-fMRI findings have, overall, associated ASMR with activations in regions involved in sensation, emotion, attention, reward, mentalising, and self-referential processing, and a blending of resting-state networks which were interpreted as being evocative of the experiences associated with this perceptual phenomenon. Also, there was one potential explanation for how ASMR modulates connections among brain regions in Lee et al. (2020). The ASMR-eliciting stimuli these studies presented to their subjects were all short in duration which is consistent with previous findings from survey research (Barratt et al., 2017; Smith et al., 2017). Additionally, scanner noise was shown to not inhibit ASMR experiences as previously thought and some regions showed consistency across the resting-state and task-based ASMR-fMRI studies, and those from other similar perceptual phenomena. The identification of these brain regions is beneficial for future ASMR-fMRI studies as potential regions of interest, particularly those that have shown consistency.

Of note, there were recurring issues including the ASMR screening protocol, small sample sizes, and lack of control groups and stimuli. As mentioned, physiological parameters such as heart rate, skin conductance and eye-tracking may be a more appropriate alternative screening protocol, at least alongside neuroimaging methodologies. While larger samples are necessary to account for potentially low statistical power, inflated effect sizes and low replicability, if studies continually recruit small samples, a future meta-analysis would be interesting. As for the inclusion of control groups and stimuli, wherever possible, these should be considered. Also, touching on Smith et al. (2020), variability in ASMR intensity should be accounted for. Similar to screening protocol, adding an intensity scale (perhaps building on Fredborg et al., 2017) to multiple ASMR-eliciting stimuli (or select categories such as those reported in their FA) would also be beneficial, at least in selecting a more well-matched sample.

Future fMRI-ASMR studies that build on the current research by using their findings as neural markers while accounting for the issues would be an appropriate next step. Perhaps though, furthering task-based fMRI research presents a better option (versus solely resting-state) since it is better equipped to shed more light on how the response modulates connections among brain regions thus building on Lee et al. (2020).

An interesting point of consideration, though, is that brain regions associated with audition were rather overlooked despite the modality representing a core sensory component in the elicitation of the response. For instance, Smith et al. (2019b) failed to detect the auditory network within their resting-state fMRI analyses. Activation in associated regions has been reported in task-based fMRI studies on the neural underpinnings of ASMR, such as the superior temporal gyrus (Smith et al., 2019a) and auditory cortex (Lochte et al., 2018). Yet, both were relatively simplistic in being linked to the presentation of auditory stimuli. While this is fair, there is likely a lot more going on considering the complexity of the sounds that elicit ASMR (*refer to* 2.4.2.) where cross-modal interactions within the auditory system are a possibility, drawing on the review in Chapter 1. Despite this, no ASMR study that has employed neuroimaging as an investigatory method has focused specifically on auditory regions. As outlined by Smith et al. (2019a), this could be tested via manipulating auditory properties of several auditory ASMR-eliciting stimuli and presenting this in-scanner. Although untested, a future study incorporating a similar design would potentially provide insight into the underlying auditory mechanisms involved as well as highlighting potential and lesser-known cross-modal interactions within the auditory system, possibly even adding substance to the theory presented by Jasmin et al. (2019). Following suit, a similar study design on solely visual stimuli may also achieve a similar outcome. Future studies thus may find it appropriate to either increase the variability of the ASMR-eliciting stimuli that they present in-scanner or to focus for instance on solely auditory ASMR-eliciting stimuli (or both).

3.1.2. Other Forms of Neuroimaging and EEG Investigations of ASMR

Outside fMRI, other forms of neuroimaging such as EEG and/or magnetoencephalography (MEG) may also be useful in future investigations. EEG is a non-invasive functional imaging method that involves measuring electrical activity of populations of synchronously firing neurons within the brain via electrodes placed on specific scalp locations (Light et al., 2010). Similar to EEG, MEG is another form of non-invasive functional imaging but instead involves measuring magnetic fields generated by electrical activity of synchronously firing neurons within the brain via several sensor coils (which do not touch the subject's head/scalp) (Singh, 2014).

Smith and colleagues brought up EEG in two of their studies (2017; 2019a). Since EEG and MEG are more temporally sensitive, this would allow precise measurements of the time course of neural activity during an ASMR experience, specifically, the neural location and frequency before and after an ASMR experience (Smith et al., 2019a). While MEG has not been applied as a method to investigate other similar perceptual phenomena, EEG has, including synaesthesia (e.g., Jäncke & Langer, 2011) and misophonia (e.g., Schröder et al., 2014). This hints at the possibility of investigating ASMR through at least EEG. Similar to how fMRI scanner noise was once thought to be potentially inhibitory to ASMR, Smith et al. (2017) also discussed the possibility of electrode placement of EEG having a similar effect. However, since task-based fMRI studies showed scanner noise not to be inhibitory, electrode placement may also not be an issue.

Recently, there have been examples of research utilising EEG to study ASMR (Engelbregt et al., 2022; Lee et al., 2019; Fredborg, Champagne-Jorgensen, Desroches & Smith, 2021; Seifzadeh, Moghimi, Torkamani & Ahsant, 2021; Vardhan et al., 2020). While at first, this may come off as promising, it is important to note that two of these examples (Lee et al., 2019; Vardhan et al., 2020 – *see* 2.7.1.) applied EEG to investigate the potential effect of ASMR on sleep (with the former study even combining ASMR with the auditory stimulus of binaural beats). Neither study specifically investigated the underlying mechanism/s of ASMR as the fMRI research has done since the research goals were to induce / improve the quality of -sleep and not to specifically elicit ASMR and measure the time course of neural activity during episodes of the phenomenon. Fredborg et al. (2021), Seifzadeh et al. (2021), and Engelbregt et al. (2022) however, did.

Fredborg et al. (2021) recruited 14 self-reported ASMR-sensitive participants and 14 controls and presented them with 8 stimuli. Half of these were visual, the other half were auditory, and of these, half of each were designed to elicit ASMR while the others were controls. ASMR-specific stimuli (with emphasis on the auditory ASMR-specific stimuli in particular) were reported to elicit frontal lobe alpha wave activity in ASMR-sensitive subjects only, alongside similar increases in frequency bands associated with movement (gamma waves and sensorimotor rhythm). The researchers suggested thus that these findings reflect the attentional and sensorimotor characteristics that is often reported in descriptions of the phenomenology of ASMR which is fair.

Seifzadeh et al. (2021) wanted to determine the effect of ASMR on EEG signals by comparing signals (pre versus post ASMR video presentation). The researchers reported a general decrease in delta band power and no significant changes in theta band. They also reported an increase in alpha band power in the central region (plus a decrease in the occipital region), also evident in the beta 1 band frequency (sensorimotor wave), especially in the frontal region, while the gamma 1 and 2 bands were increased in the central and frontoparietal regions respectively. The authors suggested their results indicated the cognitive process and sensorimotor features (i.e., the somatosensory sensation of ASMR) of ASMR. While this is fair, what is interesting is the consistency with Fredborg et al. (2021).

Most recently, Engelbregt et al. (2022) investigated the effect of ASMR on mood, attention, heart rate, skin conductance, and EEG, and the interaction with personality. Specifically, regarding their EEG findings, the researchers reported watching ASMR videos was associated with decreased alpha power in their ASMR-sensitive sample alone, while decreased theta and increased beta power were reported in the whole group (ASMR-sensitive participants and controls). The authors suggested their results reflected the relaxing sensation attributed with ASMR, but also arousal and focused attention. What was interesting however, was the inconsistency with the existing literature but may be due to methodological issues with the former EEG studies focusing solely on the effect of ASMR on EEG, while Engelbregt and colleagues focused on other factors including an interaction with personality. Ultimately, these studies have shown that EEG is a neuroimaging methodology compatible with ASMR and that electrode placement may not be an issue indeed. Replicating the outlined studies and/or implementing similar designs (to them) may be an appropriate foundation for future research.

All in all, investigations of ASMR through these methodologies would be highly beneficial, perhaps more so for EEG/MEG, as a means to supplement and bolster our current understanding of the underlying neural mechanisms associated with ASMR (from fMRI), in locating potential areas to be further investigated via fMRI, and as a way to distinguish ASMR from other similar perceptual phenomena.

3.2. The Physiological Profile of ASMR

Previous research has consistently associated different perceptual phenomena with autonomic responses hence the subsequent application of physiological parameters to kickstart psychophysiological investigations of such phenomena. This autonomic label can be applied to ASMR, especially when considering that somatosensation is attributed as a key sensation of the response. In light of this, one study's results from aggregating two content analyses (to produce a single superset of categories) revealed 'tingling' (i.e., ASMR somatosensation) as the label (regarding physiological responses) that was observed most by the raters (Kovacevich & Huron, 2019). More so, studies have subjectively mapped the somatic distribution of ASMR somatosensation to specific bodily areas (Barratt & Davis, 2015; Koumura et al., 2019; Swart et al., 2021). Although the tingling sensation is clearly evocative of somatosensation, until recently, it had not been empirically tested. With neuroimaging methodologies having been applied to the investigation of potential neural networks underlying ASMR, one may reason that physiological parameters may also be a useful avenue to explore the experiences and underlying mechanisms associated with the phenomenon.

Valtakari et al. (2019) argue that it is because of its controversial nature that led to the interest in linking these subjective experiences of ASMR to objective physiological measures. Indeed, a functional MRI investigation of ASMR suggested the application of rudimentary physiological studies to establish the effects of ASMR stimuli on several indicators of physical and mental states such as heart rate, blood pressure, cortisol levels, respiratory rate, and skin conductance (Lochte et al., 2018). Currently, there exist three such studies that have investigated ASMR using physiological parameters, two using heart rate (HR) and skin conductance level (SCL) / electrodermal activity (EDA) (Poerio et al., 2018; Engelbregt et al. 2022), and another using eye-tracking (Valtakari et al., 2019).

Based on phenomenological comparisons with another perceptual phenomenon, frisson, Poerio et al. (2018) conducted a psychophysiological study to address whether ASMR is associated with changes in autonomic nervous system responses during ASMR experiences via HR and SCL parameters. The researchers recorded HR and SCL of both ASMR-sensitive subjects and matched controls while they were presented with two ASMR-eliciting videos and one control non-ASMR-eliciting video for comparison.

Against their expectations (reduced HR and SCL), the researchers reported reduced HR and increased SCL in their ASMR-sensitive group only. The authors concluded this finding was indicative of the (emotional) complexity of ASMR experiences. This was based on previous research that had shown how complex emotional experiences involve a blending of opposing emotional components and was consistent with physiological research on mixed emotions (*see* Poerio et al., 2018). This led to the suggestion that ASMR may be a complex emotional blend comprised of activating and deactivating positive affect. Considering however, that an increased SCL is typically associated with physiological arousal and a reduced HR with the opposite (Smith et al., 2019a), the finding comes off as contradictory, something the researchers themselves acknowledged. In terms of ASMR, the phenomenon is typically described as relaxing which the reduced HR appears to allude, yet the increased SCL finding suggests an association with physiological arousal. Despite the finding seemingly being contradictory, the response is physiologically possible as the researchers explained based on previous literature – particularly that the finding may reflect different underlying patterns of neural interactions (*see also* Eisenbarth, Chang & Wager, 2016). Based on Poerio et al.'s (2018) findings, as well as noting the contradictory nature of reduced HR and increased SCL, Engelbregt et al. (2022) similarly reported reduced HR and EDA (but only in ASMR-sensitive individuals who scored high on conscientiousness).

Both studies demonstrated that the physiological profile of ASMR is different from other perceptual phenomena including synaesthesia, frisson and misophonia. This is key since it enables researchers to distinguish ASMR from these other phenomena when conducting future experiments, an individual difference so to speak. That said, one must also point out that like the vast majority of ASMR research, these studies relied on self-reported ASMR-sensitive samples since independent and standardised screening protocol is mostly non-existent (*again, for a preliminary set of standardised measures, see* Hostler et al., 2019; *and more recently*, Swart et al., 2021). Engelbregt et al. (2022) did however, utilise an adapted version of the ASMR Checklist (Fredborg et al., 2017). Also, Poerio et al. (2018) referred to the lack of ASMR screening protocol and suggested consistency tests (such as those developed for synaesthesia) where potential subjects would report ASMR frequency/intensity over time (e.g., before and after a 1-week period) to assess the authenticity of their ASMR while also distinguishing between ASMR-sensitive and non-ASMR-sensitive individuals. Though this would be more effective than the current ASMR screening protocol (reporting whether or not they experience ASMR-typical sensations while watching ASMR-eliciting media, sometimes in a researcher's presence), habituation to ASMR stimuli needs to be considered, while one also begs to question if the application of physiological parameters would be the better option to test and select potential self-reported ASMR-sensitive subjects, especially in cases where something as costly as neuroimaging is applied as a method of investigation in ASMR research. Whilst these psychophysiological studies did employ modest sample sizes of ASMR-sensitive individuals (N = 55/38) and matched controls (N = 55/38), further testing and/or replications are required to check for consistency and thus the applicability as, for instance, an independent and standardised ASMR screening protocol. Perhaps until this is accomplished, consistency tests may be the way forward, followed by a combination of physiological parameters and consistency tests once physiological parameters have been tried and tested with ASMR.

Eye-tracking is a non-invasive method used to detect eye movements and analyse human cognitive processing (Mele & Federici, 2012; Valtakari et al., 2019). Within eye-tracking, there are different measures which include gaze, blink rate and pupil dilation (Eckstein, Guerra-Carrillo, Singley & Bunge, 2017). Similar to HR and SCL, eye-tracking has been used to investigate other perceptual phenomena such as synaesthesia (Paulsen & Laeng, 2006) and frisson (Laeng et al., 2016) where increases in pupillary diameter are typically reported. These studies essentially indicate that pupillometry can be an effective investigatory method of perceptual phenomena where pupillary diameter can be considered as a marker for the experiences of these phenomena (i.e., that such experiences are visible from the pupil), again hinting at the potential application to ASMR.

Indeed, Valtakari et al. (2019) sought to investigate ASMR via eye-tracking. The researchers aimed to measure pupillary diameter while inducing ASMR to assess whether the diameter of the pupil is a marker for the response (i.e., do ASMR experiences correspond with pupillary changes). The researchers recruited a relatively large sample size (N = 91) including self-reported ASMR-sensitive (N = 37) and non-ASMR-sensitive (N = 35) individuals, as well as those who were unsure (N = 19). The entire sample was presented with one ASMR-eliciting video and one non-ASMR-eliciting control while the diameter of their pupils was being measured. Considering that in the previous physiological study, Poerio et al. (2018) analysed their data on a general level (i.e., over the course of an ASMR video) and that on a specific level, ASMR sensations have only been associated with neural activity, the researchers analysed their data on both a general and specific level (the latter was enabled due to the implementation of a button press when participants supposedly experienced ASMR sensations).

At the general level, no significant differences were reported. However, ASMR somatosensation was reported to result in increased pupillary diameter at the specific level. The authors suggested their finding is indicative of the significance of ASMR somatosensation where they posited that these sensations are likely at the core of ASMR experiences. Here they argued that ASMR somatosensation potentially results in the physiologically arousing aspect to ASMR observed in increased SCL (previously) and pupil dilation (presently) as opposed to the relaxing sensation that may result from a more general effect reflected in the previously reported reduced HR.

Despite their relatively large sample and use of a control group, their ‘unsure’ sample in this study is heterogeneous and does not reflect either an ASMR-sensitive or control population, which raises problems when interpreting this study. Also, the control non-ASMR-eliciting video was dissimilar to their ASMR-eliciting video in that it had no sound at all thus making comparisons more difficult. Presentation of a video with similar stimuli but different properties (e.g., quiet versus loud speech) would have generally been more appropriate.

Unlike the disparity between the HR and SCL findings, the results of the eye tracking have been consistent with other perceptual phenomena. This may discourage physiology (overall) as a viable individual difference for ASMR. Regardless, the next step is continuing research and/or replications where the application of eye-tracking as a potential screening protocol (similar to that proposed for HR and SCL) or its combination with functional imaging could be possible research areas. While HR and SCL would be the more ideal candidates for ASMR screening protocol since they are more easily accessible, eye-tracking in scanner seems more feasible where a similar button press design could still be used since one fMRI study (Lochte et al., 2018) incorporated button presses to some success hence (eye-tracking) results could be analysed at both the general and specific level while also measuring brain activity via fMRI.

3.3. Summarising the Neurophysiological Profile of ASMR

ASMR research is progressing towards more objective research with more and more functional imaging and physiological methodologies being utilised as investigatory mediums. As explicated throughout this chapter, future research should look to continue investigating ASMR via these methods but would be wise to pinpoint and rectify previous issues where possible. Also, an investigation of the brain regions associated with audition and theorised involvement of neurotransmitters, and the implementation of previously unused methodologies would supplement current understandings of the mechanisms underlying ASMR, in locating potential regions of interest, and to help distinguish ASMR from other perceptual phenomena.

Still, the subjective research should not be dismissed. In fact, it may aid objective investigations. For instance, survey research on the phenomenological characteristics of the phenomenon can develop our understanding of the properties of eliciting stimuli which may aid in the development of effective ASMR-eliciting stimuli to be used in objective research while also helping theorise potential explanations for study findings (e.g., how ASMR modulates connections among brain regions) as well as study design (e.g., functional investigations of the brain regions associated with audition as Smith et al., 2019a attempted, *see* 3.1.1.). Others could look to develop our understanding of the somatic distribution of ASMR sensations with somatosensation key to the response, while there is still ongoing comparison between ASMR and other similar perceptual phenomena. The following two chapters detail three such studies conducted as part of this thesis. Collectively, these investigate the association of ASMR with MTS and misophonia, as well as the prevalence, phenomenological characteristics, and somatic distribution.

CHAPTER 4: ASMR and Mirror-Touch Synaesthesia

4.1. Abstract

This study compares and contrasts ASMR and mirror-touch synaesthesia (MTS). There exists a single study to have conducted a joint investigation of ASMR and synaesthesia, specifically between ASMR and MTS with co-occurrence suggested. MTS is a synaesthetic variant conceptually similar to ASMR. Research suggests they are characterised by somatosensation and elicitation via visual and/or auditory stimuli, while they may also share a similar personality and empathic profile.

The purpose of this study was to investigate the personality and empathy profiles of ASMR and MTS, and the potential association between the two phenomena. In this study, 86 participants took part in an online survey which consisted of an adapted version of an MTS visual validation task (Ward et al., 2018) comprising of 8 videos depicting touch, a novel measure of ASMR, and standardised measures of personality (International Personality Item Pool/IPIP; Goldberg, 1992), and empathy (Interpersonal Reactivity Index/IRI; Davis, 1980). Results revealed that ASMR and MTS shared a similar personality and empathy profile, specifically elevated openness to experience, fantasising, and empathic concern. There were also differences. Enhanced agreeableness and low extraversion were associated with MTS, while enhanced perspective taking was associated with ASMR. Also, the results revealed a positive association between ASMR and MTS with 80% of the present sample who self-reported as MT synaesthetes also reporting as ASMR-sensitive. The reason behind this association, however, is yet to be determined though similarities in phenomenology (e.g., inducing stimuli), sharing a similar personality and empathy profile, and sharing a similar neural profile, were discussed.

4.2. Introduction

4.2.1. A Reintroduction to ASMR and Synaesthesia

As outlined throughout Chapter 2, ASMR is a relatively recent description of a perceptual phenomenon that has undergone a rise in research in recent years. The phenomenon has been described as a pleasant experience, encompassing a somatosensory (tactile) tingling sensation and a feeling of relaxation typically reported to be emotionally positive, triggered via a range of audiovisual stimuli (Barratt & Davis, 2015; Poerio, 2016). To note, the somatosensation experienced is often described to have a specific somatic distribution primary to the scalp and neck, also spreading in a downwards fashion to the secondary shoulders, back, and limbs (Barratt & Davis, 2015; Smith et al., 2017). In terms of the eliciting stimuli, previous survey research has consistently reported human-centric movement and behaviour ranging from whispered speech and finger/nail tapping to object manipulation (e.g., crinkling sounds) and personal attention roleplays as inducers (*refer to* 2.3.). While reported as audiovisual in nature, the stimuli are generally a lot more complex with underlying auditory, spatial, visual, and interpersonal properties to consider (*for a complete overview, refer to* 2.4.).

ASMR has also been attributed to a specific personality and empathy profile (Fredborg et al., 2017; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; *see* 2.5.). With ASMR research on the rise, studies have also utilised objective research methodologies including physiological parameters (*see* 3.2.) and neuroimaging (*see* 3.1.1.; 3.1.2.) to deepen current understandings of the response, particularly the potential mechanisms underpinning ASMR sensations. However, exploration of understudied phenomena like ASMR requires the identification of what separates it from other atypical sensory associations (Smith, Fredborg & Kornelsen, 2019b). Both frisson and misophonia have been investigated alongside ASMR (Barratt et al., 2017; del Campo & Kehle, 2016; Kovacevich & Huron, 2019; McErlean & Banissy, 2018; Scofield, 2019; *see also* 2.6.3.; 2.6.4.). The association between ASMR and synaesthesia has had less direct exploration.

Synaesthesia refers to a blending of the senses, where perceiving a property from one stimulus (the *inducer*) involuntarily elicits a second percept in another non-stimulated sensory modality (the *concurrent*) (Banissy, Jonas & Cohen, 2014; Chiou & Rich, 2014; Smith et al., 2019b; Weiss, Zilles & Fink, 2005). Theoretically, synaesthesia can occur within or between any of the senses (Mulvenna & Walsh, 2005) and there is a minimum of 60 known synaesthetic variations (Banissy et al., 2014). A common example is grapheme-colour synaesthesia (Hänggi, Wotruba & Jäncke, 2011; Hupé, Bordier & Dojat, 2012) where certain colours (termed 'photisms') are perceived in response to seeing a letter, word and/or number (termed 'graphemes') (Jäncke et al., 2009; Smilek, Dixon & Merikle, 2003). As in ASMR research, synaesthesia investigations are not limited to phenomenology, extending to personality and empathy trait associations and objective measures such as physiology and neuroimaging. However, the two phenomena have not been directly compared.

4.2.2. Comparison of ASMR and Synaesthesia

Barratt and Davis (2015) suggested a link between ASMR and synaesthesia. They outlined the phenomenological similarity of the two, detailing that ASMR seemed to follow a synaesthetic pattern in terms of an inducer-concurrent relationship and the predictability of the response (*see* 2.6.2.). The authors also suggested that ASMR may represent a form of sound-emotion synaesthesia due to the emotionally positive and relaxing sensation that is typically elicited in response to auditory or audiovisual stimulation.

The researchers asked participants to self-report whether they recognised themselves to be synaesthetes and to specify the form experienced. The consistency of these reports was then assessed in a follow-up approximately 4 weeks later. This assumption that the two perceptual phenomena are linked was based on the reported 5.9% prevalence of synaesthesia in their ASMR-sensitive sample relative to a previously reported 4.4% prevalence rate in the general population (Simner et al. 2006). However, this was not significantly different, the verification measures utilised relied solely on self-report (even in the follow-up interview). The prevalence of synaesthesia is always higher in instances where the measure is self-report (McErlean & Banissy, 2017) and so, whether the 5.9% were indeed synaesthetic is potentially questionable.

Fuelling this scepticism further, only a small number of participants who reported as synaesthetes listed the synaesthesia variant that they experienced. Considering general criteria for synaesthesia, individuals who self-report as synaesthetic but fail to specify the variant they experience are not considered synaesthetes (*see* Chun & Hupé, 2013). For the participants who did specify their variant, several subtypes were reported including grapheme-colour, grapheme-personality, time-space and pain-gustatory. Interestingly though, there was no mention of auditory-tactile or sound-emotion synaesthesia, potentially implying that ASMR is distinct but may co-occur with synaesthesia or that synaesthetes in general (i.e., regardless of the variant) are more likely to be ASMR-sensitive. In light of this, similar findings can be drawn from the literatures of both ASMR and misophonia where an ASMR-sensitive sample reported on their sensitivity to misophonia (Barratt et al., 2017) and vice vera (Rouw & Erfanian, 2018). In line with this, Barratt and Davis (2015) did go on to suggest that ASMR and misophonia, may represent two ends of the same spectrum of '*synaesthesia-like emotional responses*' and subsequent ASMR-misophonia studies have since drawn on this concept (*covered in* 2.6.4.).

Individuals with synaesthesia have been identified as having an atypical personality and empathic profile (opposed to non-synaesthetes), characterised by higher levels of openness to experience, neuroticism, positive and disorganised schizotypy, absorption, and fantasising, and lower levels of agreeableness and conscientiousness (Banissy et al., 2012; 2013; Chun & Hupé, 2016; Rouw & Scholte, 2016). McErlean and Banissy (2017) investigated the personality and empathic profiles of ASMR, whether ASMR follows a synaesthetic pattern in this regard, and if individual differences in personality and empathy are associated with ASMR (*refer to* 2.5.).

The ASMR-sensitive sample scored higher on openness to experience, fantasising, and empathic concern, and lower on conscientiousness. This was mostly consistent with another personality study on ASMR (Fredborg et al., 2017; *again, for a complete review, refer to* 2.5.) as well as the outlined synaesthesia research. Although ASMR and synaesthesia do appear to share a similar personality and empathic profile, the two phenomena have not been compared on either factor.

As touched on previously (*in* 2.5.), there is a synaesthetic variant that may link to ASMR in a similar way to how Barratt and Davis (2015) suggested sound-emotion synaesthesia, while also being relevant to personality and especially empathy investigations. The variant in question is mirror-touch synaesthesia, or MTS.

4.2.3. An Overview of Mirror-Touch Synaesthesia

MT synaesthetes consciously experience overt tactile sensations on their body elicited from observing another individual being touched/hurt and often on the same observed bodily location (Banissy & Ward, 2007; Banissy et al., 2011; Bolognini, Rossetti, Fusaro, Vallar & Miniussi, 2014; Ward & Banissy, 2015). First documented in a single case fMRI study, Blakemore, Bristow, Bird, Frith and Ward (2005) reported increased brain activity in neural networks during observations of touch to a human face. This was reported in a sample of 12 control non-synaesthetes but enhanced in the synaesthete. Particularly, the synaesthete displayed increased activity in the somatosensory cortices (SI and SII), left premotor cortex, and bilateral anterior insular cortex; the latter was specific to them. This network of brain regions can be termed the 'mirror-touch network' (Banissy, Kadosh, Maus, Walsh & Ward, 2009). Thus, Blakemore et al. (2005) interpreted the hyper-excitability of this mirror-touch network as a neural correlate of MTS.

Spatial representations are important in categorising MTS. Based on spatial mapping between observed and induced (i.e., MTS) touch, MTS has been divided into two spatial subtypes: specular and anatomical (Banissy et al., 2009). Specular MTS is more common and refers to a mirror-like elicitation of the response where for instance, observing an individual touch their left cheek generates the sensation in their right cheek (Banissy et al., 2009; Banissy & Ward, 2009; Holle, Banissy & Ward, 2013). Anatomical MTS is the rarer opposite, observed touch is mapped anatomically, in the identical bodily region (Banissy et al., 2009; Banissy & Ward, 2013; Holle et al., 2013). Both subtypes are reported to be automatic, consistent, and present from childhood (Banissy & Ward, 2009).

Relative to other synaesthetic variants, Martin, Cleghorn and Ward (2017) stated that an interpersonal nature, *consciously* sharing self-other bodily sensations, is a defining aspect of MTS. Within the umbrella of MTS, there are two prominent models to consider, threshold and self-other. Threshold Theory explains MTS with regard to atypical hyper-excitability of the mirror-touch network that 'passes the threshold' of typical neural activity in regions associated with somatosensory mirroring (Ward & Banissy, 2015). This largely drew on the outlined research of Blakemore and colleagues (2005). Despite identifying possible neural correlates of MTS, the theory fails to account for what contributes to MT synaesthetes displaying cortical hyper-excitability in the first place. Within this, it fails to account for structural brain differences outside the proposed network (Ward & Banissy, 2015), such as those associated with mentalising and self-other processing which may result in disinhibition of typical neural activity in regions associated with somatosensory mirroring (Holle et al., 2013).

In contrast, Self-Other Theory explains MTS with regard to faulty self-other processing (Banissy & Ward, 2013; Ward & Banissy, 2015). The atypical mechanism underpinning this theory is suggested to act as a gate for determining whether cognition is self or other -relevant, and is thus associated with a 'blurring' of self-other boundaries (Martin et al., 2017). Neuroimaging research has identified candidate brain regions associated with this atypical self-other processing including the medial prefrontal cortex (mPFC), inferior parietal lobule, temporoparietal parietal junction (TPJ), and anterior insula (Banissy & Ward, 2013; Maister, Banissy & Tsakiris, 2013; Northoff, Qin & Feinberg, 2011). Collectively, these regions have been linked to several domains of self-other processing such as self-face recognition, body ownership, self-other representations, perspective taking, empathy, and have structural connections to the mirror-touch network (*see* Banissy & Ward, 2013). The role of this system appears to be embedded in social cognition.

Banissy and Ward (2013) considered that differences in neural networks underlying self-other processing may contribute to broader traits in MTS such as empathy. Ward, Schnakenberg and Banissy (2018) stated that MTS can be regarded as a form of empathic response. Previous research has reported heightened empathy in MT synaesthetes (e.g., Banissy & Ward, 2007; Ioumpa et al., 2019; Ward et al., 2019).

As outlined above (*and in* 2.5.), personality and empathic research on both ASMR and synaesthesia have associated the phenomena with atypical personality and empathy profiles. Of these, both phenomena have been characterised by higher levels of openness to experience, fantasising and absorption and lower levels of conscientiousness. A similar trend, particularly heightened openness to experience can also be found in the personality literature of another perceptual phenomenon in frisson (Colver & El-Alayli, 2016; Nusbaum & Silvia, 2011; Nusbaum et al., 2014; Silvia & Nusbaum, 2011; *see* 2.6.3.). While MTS has dedicated research investigating the empathy profile which is typically associated with elevated empathic concern and fantasising (Ioumpa et al., 2019; Ward et al., 2018), to date, no personality research has been conducted. MTS, however, has been reported to have a high occurrence with other forms of synaesthesia (Ward, 2019), implying that it may be possible for MTS to also have characteristic personality traits.

In fact, a recent study jointly investigated ASMR and MTS (Gillmeister, Succi, Romei & Poerio, 2022). Specifically, the authors investigated whether MTS experiences are higher in ASMR. They suggested an association between ASMR and MTS over other synaesthetic variants based mainly on the tactile sensation characteristic of both phenomena, while also suggesting their relation based on shared socio-cognitive profiles characterised by empathy and emotion, developmental origins, and neural profiles. Compared to controls, their ASMR-sensitive sample were reported to have more frequent and intense vicarious touch experiences (i.e., ASMR somatosensation) and a greater incidence of MTS (6.5%). This way, ASMR and MTS were suggested to co-occur, and while the authors could not explain why, they did suggest a shared underlying neural profile (involved in tactile processing).

Thus, the current study aimed to investigate the personality and empathy profiles of ASMR and MTS, and the relationship between these phenomena. Within this, this study is also currently the first to investigate the personality traits attributable to MTS and is the first study to associate the two phenomena based on personality and empathy. A series of behavioural questionnaires were thus employed to explore these profiles as well as any similarities and differences between the two phenomena.

Hypotheses: that the ASMR-sensitive individuals would score more highly on the personality and empathy traits consistent with the previous research, particularly higher on openness to experience, fantasising, and empathic concern and lower on conscientiousness (1); that the MT synaesthetes would score higher on the empathy traits consistent with the previous research, particularly higher on fantasising and empathic concern (2); that the MT synaesthetes would score higher on the personality traits consistent with the broader synaesthesia personality research, particularly higher openness to experience and lower conscientiousness (3); and that ASMR and MTS would be associated based on the traits reported (i.e., share similar personality and empathic profiles) (4).

4.3. Methodology

4.3.1. Contributions

The mirror-touch aspect of this study was designed by a master's student in which it was combined with an adapted version of a measure of ASMR of my design. The student also collected the data. To note, the present study consisted of two parts: the phenomenological characteristics of MTS (1), as well as the personality and empathy profiles (measured via two readily available questionnaires) attributable to both MTS and ASMR and the association of these perceptual phenomena (2). Only the data relevant to ASMR was used in this study (i.e., the personality and empathy findings of both phenomena and their association) which I analysed.

4.3.2. Participants

4.3.2.1. Power Analysis. Using, G*Power, an a priori power analysis was conducted to determine the number of participants needed to achieve statistical power of .8 when using multiple linear regression analyses (Cohen, 1992; Faul, Erdfelder, Lang, & Buchner, 2007). Considering previously reported effect sizes from similar studies (e.g., Baron-Cohen, Robson, Lai & Allison, 2016; Ioumpa et al., 2019), a moderate effect size (f = 0.20) and conventional alpha level (.05) were used to calculate an adequate sample size (N = 86).

4.3.2.2. Recruitment. A volunteer sample of 86 participants (53 female, 29 male, 4 transgender/non-binary; *M* = 29; *SD* = 11.17) completed the survey. Participants were recruited to partake in the survey via several online platforms.

As a means to obtain a more generalised sample that did not consist of solely ASMR-sensitive and synaesthetic populations, the survey link was posted on, and participants were recruited from a survey exchange group on Facebook. Also, to ensure that at least a fraction of the sample was specialised (i.e., ASMR-sensitive and/or synaesthetic) due to the ASMR and MTS focus of the study, the survey link was also posted on the forum site Reddit (specifically, two subreddits: 'Synaesthesia'; https://www.reddit.com/r/Synesthesia/ and 'ASMR, Sounds that feel good'; https://www.reddit.com/r/asmr/) as well as the blog site 'ASMR University' (https://asmruniversity.com/). Volunteers were eligible to take part in the online study if they met the following criteria: were over 18 years old, fluent in English, and were right-handed. Informed consent was obtained from all participants. Ethical approval was granted from the UCL Research Ethics Committee, in accordance with the declaration of Helsinki (Project ID Number: 1584/003).

4.3.3. Materials

4.3.3.1. ASMR Scale-A. This questionnaire is a novel 144-item measure of the phenomenological and demographic characteristics of ASMR (75), frisson (26), misophonia (20), and synaesthesia (11), and other aspects related to these phenomena (12). The ASMR items in this questionnaire built on the pre-existing ASMR Checklist (Fredborg et al., 2017), questions and research areas from other ASMR-driven survey research (e.g., Barratt et al., 2017), and Hostler et al.'s criteria (2019) for studies measuring state ASMR via questionnaire measures (frequency and time course of ASMR somatosensation, intensity, somatic distribution, and emotional responses). The misophonia, frisson, and synaesthesia items were similarly based on pre-existing questionnaires and questions/research areas from previous research (e.g., Harrison & Loui, 2014; Wu et al., 2014). Participants would be asked to rate how much they agreed with the statements via a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) with a neutral option as a midpoint. All included questions can be found in the appendix (Appendix A.8.).

4.3.3.1. ASMR Scale-B. This questionnaire is a novel 7-item measure of ASMR phenomenological characteristics, selected from the larger but unused 144-item ASMR Scale-A described above (4.3.3.1.). Similarly, for the ASMR Scale-B, participants were asked to rate how much they agreed with the statements via a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) with a neutral option as a midpoint. Post statements, participants were also given a description of ASMR and were asked (Y/N) if they thought themselves as being sensitive to ASMR. All included questions can be found in the appendix (Appendix A.4.). The reliability and validity of the ASMR scale was assessed below (4.3.5.1.). *Any further reference to the ASMR Scale or ASMR Scale scores will be in reference to the ASMR Scale-B*.

4.3.3.2. International Personality Item Pool (IPIP). The IPIP Big-Five personality factor markers is an open-sourced measure of the Big-Five personality traits: openness to experience/O, conscientiousness/C, extraversion/E, agreeableness/A, and neuroticism/N (Goldberg, 1992). The presently used version of the IPIP is the ‘shorter’ 50-item equivalent to the 100-item ‘larger’ IPIP whereby each of the five factors has 10 items. Participants were asked to read and rate how much they related to each item via a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) with a neutral option as a midpoint (*see* Appendix A.5.). To note, the 50-item IPIP has been found to have good internal consistency (α = .84) as well as concurrent validity (Gow, Whiteman, Pattie & Deary, 2005).

4.3.3.3. Interpersonal Reactivity Index (IRI). The IRI is a well-established, multidimensional measure of trait empathy (Davis, 1980). The questionnaire consists of 28 items, separated into four 7-item subscales: perspective taking/PT, fantasising/F, empathic concern/EC, and personal distress/PD. To note, both PT and F are typically considered to reflect cognitive components of empathy, while both EC and PD reflect affective components (Beven et al., 2004; De Corte et al., 2007). Participants were asked to rate how well each item described them via a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) with a neutral option as a midpoint (*see* Appendix A.6.). The IRI has been utilised across several populations and found to have good internal reliability and validity (Davis, 1980; 1983).

4.3.3.4. MTS Visual Validation Task. The present MTS visual validation task is an adapted (albeit reduced) version of the MTS visual validation task developed by Ward et al. (2018) which was a novel screening protocol for MTS. Unlike the original (30 videos depicting touch, itch, and pain), the current version consisted of 8 videos solely depicting touch. Of these, three manipulations, based on the original and previous research, were present: depiction of a real versus fake hand, spatial representation, and hand orientation. Thus, half of the videos depicted touch to a real human hand (versus a rubber hand); were egocentric (i.e., first-person) versus allocentric (third person); and depiction of the palm versus dorsum (of the hand). The hand models were both Caucasian females.

Following the presentation of each individual video, participants were asked to report (Y/N) whether they experienced somatosensation (a feeling of touch). If they responded no, they would be presented with the next video. If, however, they responded yes, they were prompted to answer a potential two further questions around their somatosensory experience. The first of which was to assess the location of somatosensation (whether it was more generalised or localised to a specific location – notably, the same part of the body or a different part). If the participant answered with either a generalised sensation or with the sensation being localised to a different part of the body (from the body area presented in the video), they would be presented with the next video. If, however, they answered with the same body part, they were prompted with the second question which asked which side of the body they felt the somatosensation (left or right) then they were presented with the next video. This continued until all of the 8 videos and post-video questions had been completed. Post statements, participants were also given a description of MTS and were asked (Y/N) if they thought themselves as being MT synaesthetes. This task paradigm and the post-video questions can be found in the appendix (Appendix A.7.).

4.3.4. Task and Procedure

Participants completed an online questionnaire, developed on, and hosted via the survey software and platform Qualtrics (Qualtrics, Provo, UT) and accessed via a link posted on several social media groups. Prior to beginning the questionnaire, participants were presented with the study information sheet (*see* Appendix A.1.), informed consent form (*see* Appendix A.2.), and demographic questions on their age, sex, ethnicity, and handedness. All participants were at least 18 years of age and right-handed and provided informed consent (via checkbox). The survey duration was approximately 30min (*M* = 30.52min).

Following this, participants were presented with the MTS visual validation task. Again, this task consisted of 8 videos, presented randomly whereby after each video, participants were asked (via yes/no checkboxes) whether they had experienced tactile somatosensation in response to viewing the presented stimuli. If they answered 'yes', they were prompted to answer further questions pertaining the somatosensation experienced. Once all 8 videos and subsequent questions has been completed, participants were provided with a brief description of misophonia and were asked if they considered themselves to be a MT synaesthete. Next, participants were presented with and completed the IRI, IPIP and ASMR scale. Following the latter, they were provided with a brief description of ASMR and asked if they considered themselves to be sensitive to ASMR. Upon completion, a debrief form (*see* Appendix A.3.) was presented and participants were thanked for their time. To gauge further participant questions and/or their thoughts surrounding the research, a comment box was included.

4.3.5. Data Analyses

All analyses were carried out in SPSS (version 26) and MATLAB (version R2020b). Since the ASMR scale was novel, preliminary statistical analyses were carried out to assess construct validity and internal consistency.

4.3.5.1. Statistical Assessment of the ASMR Scale. A principal components analysis (PCA) was carried out to assess the construct validity of the 7-item questionnaire. The Kaiser-Meyer-Olkin (KMO) measure (KMO = .85) and Bartlett's test of Sphericity ($p < .0001$) indicated that the data was likely factorizable, while a single component was identified to explain 56% of the total variance. This suggested that the items likely measure a single latent trait/construct and that the scale does possess construct validity. Also, Cronbach's alpha was carried out to assess internal consistency, of which, was present and relatively high ($\alpha = .86$).

4.3.5.2. Demographics. Descriptive statistics were run, followed by a Pearson's bivariate correlation analysis to assess whether the demographic variables of age, sex and ethnicity influenced the dependent variable, participants' self-reported intensity of somatosensation elicited in response to the MTS visual validation task (i.e., MTS intensity). This way, if found to be significant, they would be used as control variables.

4.3.5.3. Personality and Empathy Profiles of MTS. Five linear regression analyses were run for each subscale of personality, and likewise four linear regression analyses for each subscale of empathy. These were carried out to assess the effect of specific personality and empathic traits on MTS intensity. Also, since ASMR and MTS are correlated, a partial correlation between MTS, personality and empathy, while filtering out ASMR as a means to control for ASMR when assessing MTS.

4.3.5.4. Personality and Empathy Profiles of ASMR. Similar to 4.3.5.3., five linear regression analyses were run for each subscale of personality, and four linear regression analyses for each subscale of empathy. Similarly, these assessed the effect of specific personality and empathic traits on ASMR. Also, since ASMR and MTS are correlated, a partial correlation between ASMR, personality and empathy, while filtering out MTS as a means to control for MTS when assessing MTS.

4.3.5.5. Association between ASMR and MTS. A standard linear regression was run whereby MTS intensity scores were regressed on the mean ASMR scale scores. This was carried out to assess whether ASMR is associated with MTS. Also, a Fisher's exact test was carried out as a means to confirm whether there was an association between ASMR and MTS self-report measures (i.e., when participants were asked to indicate whether they identified themselves as sensitive to ASMR and/or MTS).

4.4. Results

4.4.1. Demographics

The Pearson's bivariate correlation revealed that the three demographic variables (age, sex, ethnicity) did not significantly influence MTS intensity scores (since $p > .122$) thus, they were not included as control variables (Table 1).

Table 1

Demographic characteristics and correlations with MTS intensity (N = 86)

Demographic Characteristic	Participants (N = 86)	*p*
Age (years)		.977
M (SD)	29 (11.17)	
Range	19-66	
Sex		.122
Male	53 (33.7%)	
Female	29 (61.6%)	
Other	4 (4.7%)	
Ethnicity		.998
Asian	14 (16.3%)	
Caucasian	62 (72.1%)	
Mixed Race	3 (3.5%)	
Other	4 (4.7%)	
Prefer not to say	3 (3.5%)	

Note. For the variables *Sex* and *Ethnicity*, counts are presented with percentages in parentheses.

4.4.2. The Effect of Personality on MTS

The five linear regression analyses revealed that openness to experience, agreeableness and extraversion were significantly associated with MTS intensity. Specifically, openness explained 6% of the variance in MTS intensity, while agreeableness and extraversion explained 6% and 7% respectively. Also, openness and agreeableness were positively related with MTS intensity, but not extraversion (Table 2).

Table 2

A series of linear regression analyses for each personality domain with MTS intensity as the outcome variable

Models	*B*	95% CI for B		*SE B*	β	R^2
		LL	UL			
Reg 1						.06*
Constant	-1.72	-4.45	1.04	1.34		
Openness (O)	.08*	.01	.16	.04	.25*	
Reg 2						.02
Constant	2.01***	.86	3.17	.58		
Conscientiousness (C)	-.02	-.06	.02	.02	-.12	
Reg 3						.06*
Constant	-.97	-3.70	1.22	1.10		
Agreeableness (A)	.06*	.01	.12	.03	.24*	
Reg 4						.07*
Constant	3.37**	1.70	5.05	.85		
Extraversion (E)	-.06	-.11	.11	.20	-.26*	
Reg 5						.00

Constant	1.5*	.21	2.70	.63	
Neuroticism (N)	-.01	-.04	.04	.02	-.01

Note. Reg (1 to 5) = individual linear regression models for each personality domain; *B* = unstandardised regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; β = standardised coefficient; R^2 = coefficient of determination.

*p<.05. **p<.01. ***p<.001

4.4.3. The Effect of Empathy on MTS

The four linear regression analyses revealed that both EC and F were significantly associated with MTS intensity. EC explained 17% of the variance in MTS intensity, while F explained 11%. Both predictors demonstrated a strong positive relationship with MTS intensity (Table 3).

Table 3

A series of linear regression analyses for each empathy domain with MTS intensity as the outcome variable

Models	*B*	95% CI for B		*SE B*	β	R^2
		LL	UL			
Reg 1						.17***
Constant	-1.31	-2.81	.19	.75		
Empathic Concern (EC)	.16***	.08	.23	.04	.41***	
Reg 2						.11***
Constant	-1.34	-3.13	.45	.90		
Fantasising (F)	.16***	.07	.25	.05	.35***	
Reg 3						.01
Constant	1.06	-1.5	2.28	.61		
Personal Distress (PD)	.046	-.04	1.3	.04	.11	
Reg 4						.02
Constant	.16	-2.07	2.39	1.12		
Perspective Taking (PT)	.08	-0.3	.19	.06	.15	

Note. Reg (1 to 4) = individual linear regression models for each empathy domain; *B* = unstandardised regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; β = standardised coefficient; R^2 = coefficient of determination.

***p<.001

4.4.4. Partial Correlation between MTS, Personality, and Empathy

A partial correlation was run to determine the relationship between MTS (intensity scores) and personality and empathy (trait domains) whilst controlling for ASMR (Scale scores). There was a positive partial correlation between MTS intensity scores (3.53 ± 2.79) and fantasising (19.23 ± 5.03) while controlling for ASMR Scale scores (24.28 ± 6.15), which was statistically significant, $r(83) = .359$, $N = 86$, $p = .001$. However, zero-order correlations showed that there was a statistically significant, positive correlation between MTS intensity scores and fantasising ($r(84) = .410$, $n = 86$, $p = .001$), indicating that ASMR Scale scores had little influence in controlling for the relationship between MTS intensity scores and fantasising. Figure 1 displays the positive relationship between MTS intensity scores and fantasising.

There was also a positive partial correlation between MTS intensity scores (3.53 ± 2.79) and empathic concern (19.21 ± 4.27) while controlling for ASMR Scale scores (24.28 ± 6.15), $r(83) = .250$, $N = 86$, $p = .021$. However, zero-order correlations showed that there was a statistically significant, positive correlation between MTS intensity scores and fantasising ($r(84) = .293$, $n = 86$, $p = .006$), indicating that ASMR Scale scores had little influence in controlling for the relationship between MTS intensity scores and empathic concern. Figure 2 displays the positive relationship between MTS intensity scores and empathic concern.

Interestingly, zero-order correlations revealed a statistically significant, positive correlation between MTS intensity scores (24.28 ± 6.15) and agreeableness (39.19 ± 5.74) ($r(84) = .237$, $n = 86$, $p = .028$). However, this did not survive partial correlation, $r(83) = .201$, $N = 86$, $p = .066$, indicating that MTS intensity scores influenced control for this relationship. Similarly, zero-order correlations revealed a statistically significant, positive correlation between MTS intensity scores (24.28 ± 6.15) and openness to experience (37.99 ± 4.35) (r(84) = .279, n = 86, p = .009). However, this did not survive partial correlation, r(83) = .212, N = 86, p = .052, indicating that MTS intensity scores influenced control for this relationship.

Figure 1

Relationship between MTS intensity scores and fantasising

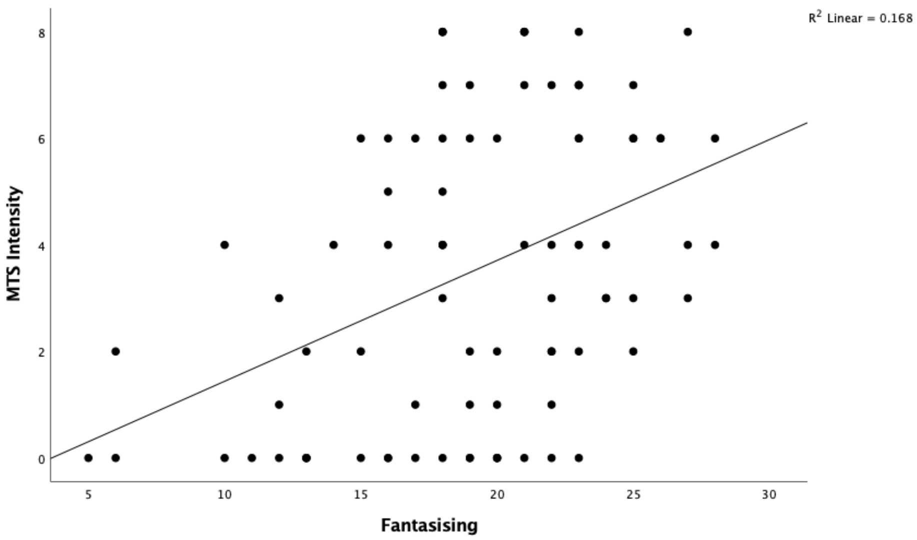
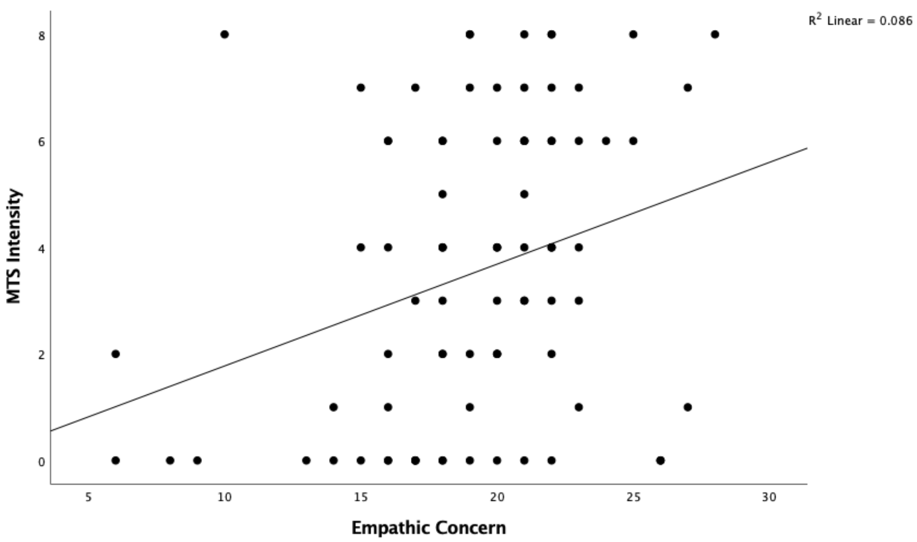


Figure 2

Relationship between MTS intensity scores and empathic concern



4.4.5. The Effect of Personality on ASMR

The standard linear regression analyses revealed that only openness to experience was significantly associated with ASMR Scale scores, where the domain explained 14% of the variance in ASMR scale scores. Also, openness demonstrated a strong positive relationship with ASMR scale scores (Table 4).

Table 4

A series of linear regression analyses for each personality domain with ASMR scale as the outcome variable

Models	*B*	95% CI for B		*SE B*	β	R^2
		LL	UL			
Reg 1						.14***
Constant	.59	-.97	2.14	.78		
Openness (O)	.08***	.04	.12	.02	.36***	
Reg 2						.00
Constant	3.45***	2.78	4.12	.34		
Conscientiousness (C)	.00	-.02	.02	.01	.01	
Reg 3						.04
Constant	2.32***	1.03	3.62	.65		
Agreeableness (A)	.03	-.003	.06	.02	.19	
Reg 4						.01
Constant	3.81***	2.80	4.83	.51		
Extraversion (E)	-.01	-.04	.02	.02	-.08	
Reg 5						.01
Constant	3.10***	2.38	3.81	.36		
Neuroticism (N)	.01	-.01	.04	.01	.12	

Note. Reg (1 to 5) = individual linear regression models for each personality domain; *B* = unstandardised regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; β = standardised coefficient; R^2 = coefficient of determination.

***p<.001

4.4.6. The Effect of Empathy on ASMR

The linear regression analyses revealed that EC, F, and PT were significantly associated with the ASMR scale scores. Specifically, F and PT each explained 12% of the variance in ASMR scale scores, while EC explained 6%. Also, all three predictors demonstrated a positive relationship with ASMR scale scores (Table 5).

Table 5

A series of linear regression analyses for each empathy domain with ASMR scale as the outcome variable

Models	*B*	95% CI for B		*SE B*	β	R^2
		LL	UL			
Reg 1						.06*
Constant	2.51***	1.66	3.36	.43		
Empathic Concern (EC)	.05*	.01	.09	.02	.24*	
Reg 2						.12***
Constant	2.30***	1.59	3.01	.36		
Fantasising (F)	.06***	.02	.10	.02	.35***	
Reg 3						.00
Constant	3.38***	2.81	3.94	.28		
Personal Distress (PD)	.01	-.03	.05	.02	.04	
Reg 4						
Constant	1.85***	.88	2.82	.45		.12***
Perspective Taking (PT)	.08***	.03	.13	.02	.34***	

Note. Reg (1 to 4) = individual linear regression models for each empathy domain; *B* = unstandardised regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; β = standardised coefficient; R^2 = coefficient of determination.

*p<.05. **p<.01. ***p<.001

4.4.7. Partial Correlation between ASMR, Personality, and Empathy

A partial correlation was run to determine the relationship between ASMR (Scale scores) and personality and empathy (trait domains) whilst controlling for MTS (intensity scores). There was a positive partial correlation between ASMR Scale scores (24.28 ± 6.15) and fantasising (19.23 ± 5.03) while controlling for MTS intensity scores (3.53 ± 2.79), which was statistically significant, r(83) = .283, N = 86, p = .009. However, zero-order correlations showed that there was a statistically significant, positive correlation between ASMR Scale scores and fantasising (r(84) = .348, n = 86, p = .001), indicating that MTS intensity scores had little influence in controlling for the relationship between ASMR Scale scores and fantasising. Figure 3 displays the positive relationship between MTS intensity scores and fantasising.

There was also a positive partial correlation between ASMR Scale scores (24.28 ± 6.15) and perspective taking (19.21 ± 4.27) while controlling for MTS intensity scores (3.53 ± 2.79), r(83) = .335, N = 86, p = .002. However, zero-order correlations showed that there was a statistically significant, positive correlation between ASMR Scale scores and perspective taking (r(84) = .345, n = 86, p = .001), indicating that MTS intensity scores had little influence in controlling for the relationship between ASMR Scale scores and empathic concern. Figure 4 displays the positive relationship between MTS intensity scores and perspective taking.

There was also a positive partial correlation between ASMR Scale scores (24.28 ± 6.15) and openness to experience (37.99 ± 4.35) while controlling for MTS intensity scores (3.53 ± 2.79), r(83) = .331, N = 86, p = .002. However, zero-order correlations showed that there was a statistically significant, positive correlation between ASMR Scale scores and openness to experience (r(84) =

.375, n = 86, p = .001), indicating that MTS intensity scores had little influence in controlling for the relationship between ASMR Scale scores and fantasising. Figure 5 displays the positive relationship between MTS intensity scores and fantasising.

Interestingly, zero-order correlations revealed a statistically significant, positive correlation between ASMR Scale scores (24.28 ± 6.15) and empathic concern (19.21 ± 4.27) (r(84) = .243, n = 86, p = .024). However, this did not survive partial correlation, r(83) = .186, N = 86, p = .088, indicating that MTS intensity scores influenced control for this relationship.

Figure 3

Relationship between ASMR Scale scores and fantasising

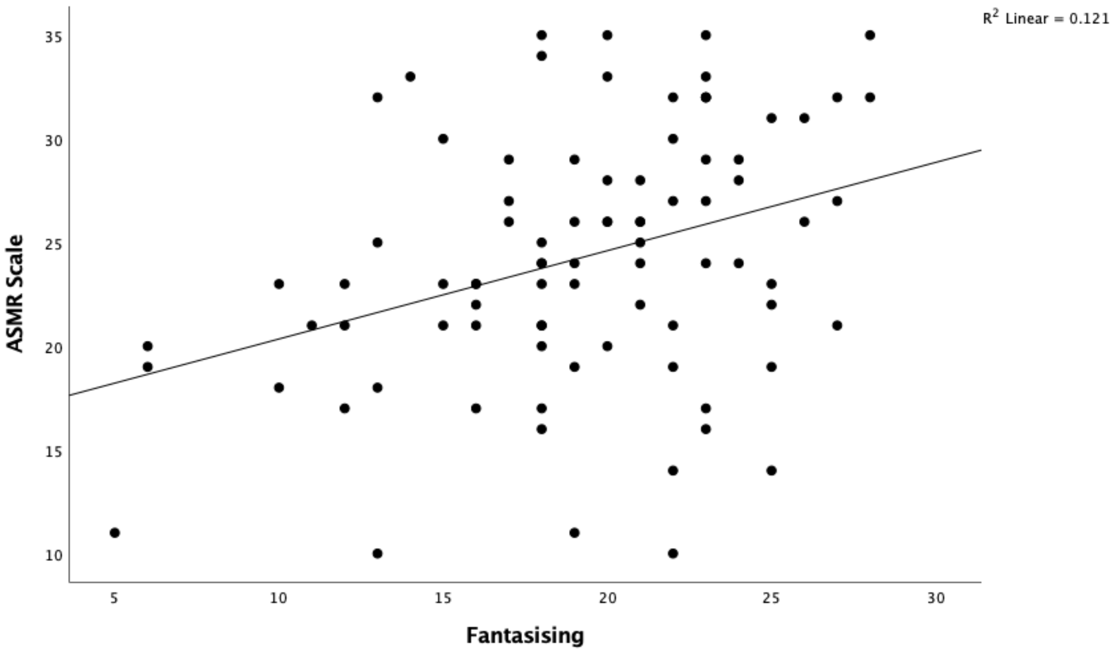


Figure 4

Relationship between ASMR Scale scores and perspective taking

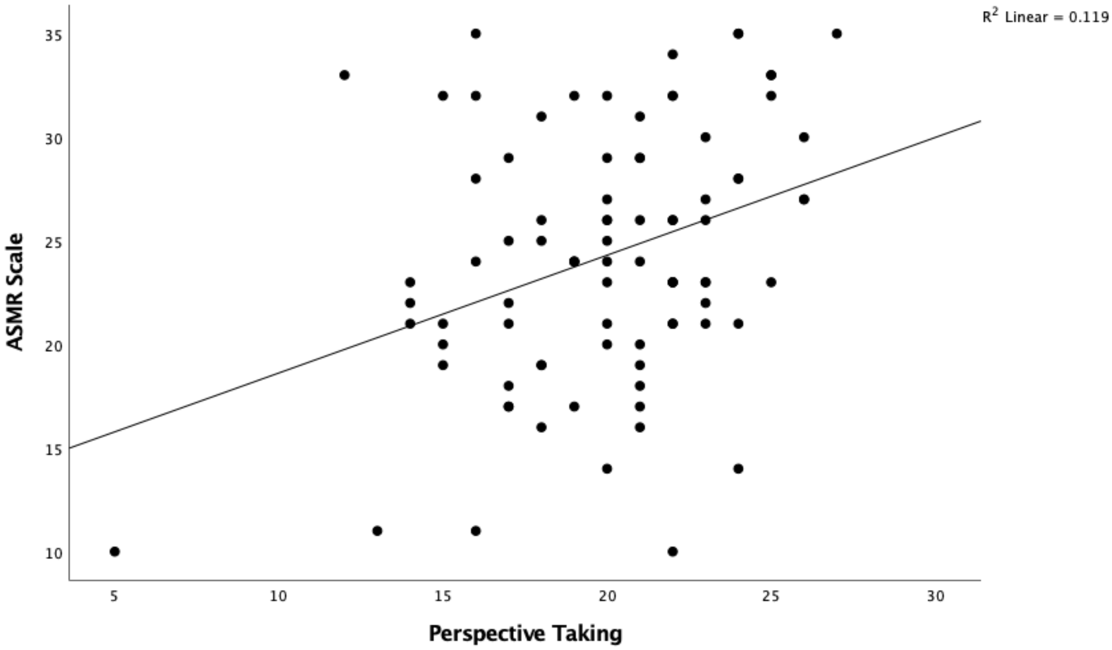
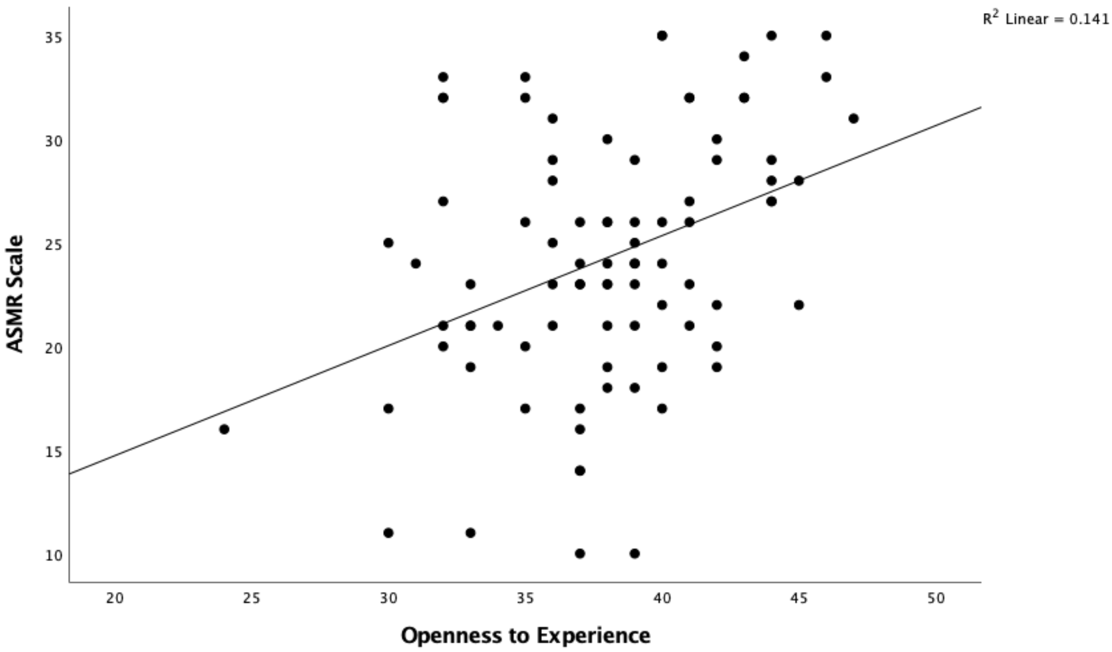


Figure 5

Relationship between ASMR Scale scores and openness to experience

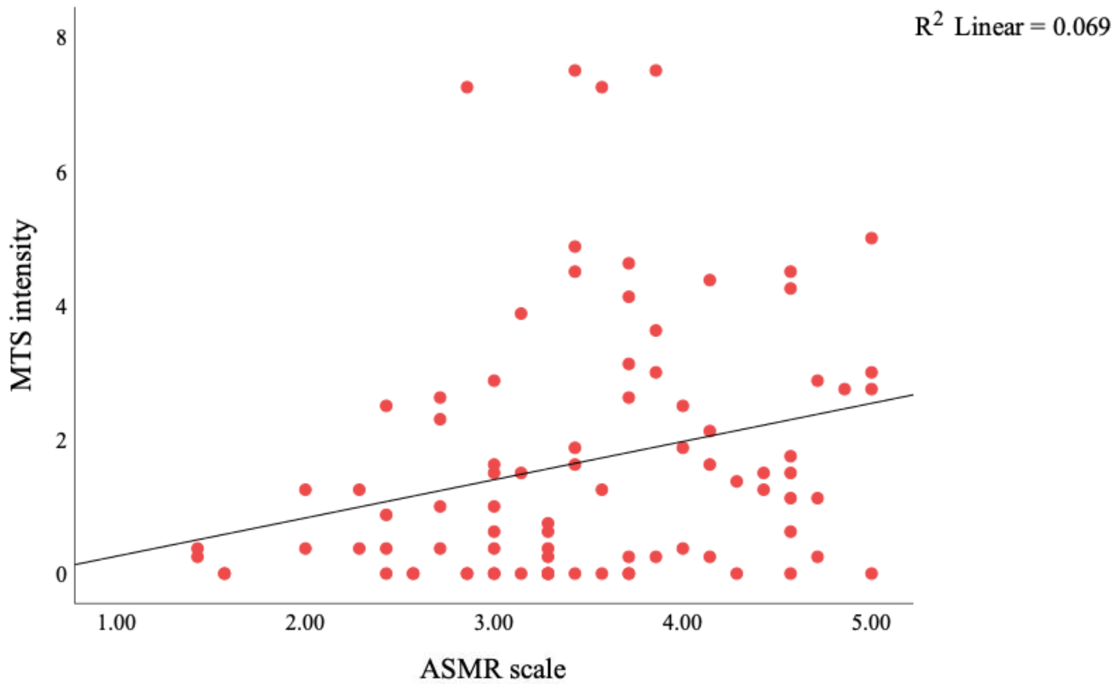


4.4.8. The Relationship between ASMR and MTS

The linear regression analysis established that the ASMR scale was a statistically significant predictor of MTS intensity, F(1, 84) = 11.85, p < .001. Specifically, the ASMR scale explained 11.8% of the variance in MTS intensity. Figure 6 displays the positive relationship between the mean ASMR scale scores and MTS intensity scores. Also, the Fisher's exact test showed that there was a significant association between self-reported ASMR and self-reported MTS (p <.001), wherein 80% (n = 32) of the participants who reported experiencing MTS also indicated that they experienced ASMR.

Figure 6

Relationship between the mean ASMR scale scores and MTS intensity scores



4.5. Discussion

The current study sought to investigate the personality and empathy profiles of two similar perceptual, sensory phenomena, MTS and ASMR. A series of behavioural questionnaires were employed to explore these profiles as well as any similarities and differences between the two phenomena.

4.5.1. Personality Profile of MTS

This study was the first to investigate the personality traits attributable to MTS. Research has previously investigated the personality traits characterised by synaesthesia, and MTS is a synaesthetic variant reported to have a high occurrence with other forms of this phenomenon (Ward, 2019). The broader synaesthetic literature has associated the phenomenon with an atypical personality profile, characterised by heightened levels of openness to experience, neuroticism, positive and disorganised schizotypy, and absorption, and lower levels of agreeableness and conscientiousness (Banissy et al., 2012; 2013; Chun & Hupé, 2016; Rouw & Scholte, 2016). Of these, only elevated openness to experience and lower conscientiousness have shown consistency.

Again, the results revealed that only openness to experience and agreeableness were positively associated with MTS intensity scores, and that extraversion was negatively associated. In context, the personality profile of MTS can be interpreted as being associated with elevated openness to experience and agreeableness, and reduced extraversion. Interestingly, compared to the existing research, only openness to experience showed consistency. To note however, as is the trend (and to an extent, bias) within the synaesthetic literature, the bulk of the research has come from grapheme-colour synaesthetes thus one must bear in mind that there will likely be differences between the current and pre-existing personality findings based on the synaesthetic variant investigated.

In terms of openness to experience, it is one of two heightened traits that has shown consistency within the synaesthetic literature. It is also the only trait to have shown consistency in the wider literature on other similar perceptual phenomena such as frisson (Colver & El-Alayli, 2016; McCrae, 2007; Nusbaum & Silvia, 2011; Nusbaum et al., 2014; Silvia & Nusbaum, 2011) and ASMR (Fredborg et al., 2017; McErlean & Banissy, 2017). Descriptions of openness to experience have referred to how the trait is reflected in intellectual curiosity and a preference for novelty/variety (Komarraju et al., 2011; Roccas et al., 2002). Imaginative propensity also makes up part of this trait and it is based on this, that the empathic trait of fantasising is typically described to be conceptually similar. Fantasising has been described as the tendency to imaginatively identify with fictious characters and situations and is a cognitive component of empathy (Beven et al., 2004; De Corte et al., 2007). In fact, research on both synaesthesia (Banissy et al., 2013; Chun & Hupé, 2016) and ASMR (McErlean & Banissy, 2017) have grouped the two traits, seemingly based on the sub-facet of openness to experience that is imaginative propensity. Since this trait was also reported as elevated in the current study, it seems appropriate to group the two and suggest that MTS is associated with elevated fantasising and openness to experience. Perhaps more specifically, that MTS is associated with a tendency to tap into one's imagination which may increase the likelihood of experiencing MTS.

Despite consistency, there is a possibility that participants may already score high on openness to experience due to their willingness to take part in the research. Thus, it may be difficult to justify this trait as underlying MTS. However, research that has recruited clinically synaesthetic samples does report elevated openness to experience (e.g., Chun & Hupé, 2016; Rouw & Scholte, 2016).

Future research could investigate elevated openness to experience via measuring a more nuanced sub-facet of the trait or a similar personality construct that does not come under the confines of the traditional Big-Five. As mentioned earlier, absorption may fit such a description. Absorption is a personality trait that is conceptually similar to openness to experience and the grouped empathic trait, fantasising. The trait refers to the tendency to become deeply immersed in sensory/mystical experiences (Sirois, 2014; Witthöft et al., 2008). Heightened absorption, as noted above, has been found in past personality-driven synaesthesia research (*see* Chun & Hupé, 2016) while the association between another perceptual phenomenon in ASMR and absorption propensity has been discussed (McErlean & Banissy, 2017; Roberts et al., 2019) and reported (McErlean & Osborne-Ford, 2020). Perhaps then, similar findings may extend to MT synaesthetes in future.

MTS was also associated with elevated agreeableness. This contradicted a previous finding reporting lower agreeableness (Banissy et al., 2013). In a review on the personality literature on synaesthesia, Chun and Hupé (2016) argued that the reduced agreeableness was in fact more likely sample specific since Banissy et al. (2017) recruited their controls from both volunteers and *known acquaintances* while their synaesthetic sample were volunteers only. This way, controls may have had a propensity to higher agreeableness. Clearly, future research specifically on agreeableness is necessary to come to a surer understanding though mixed findings regarding this trait appear commonplace among the personality literature of other perceptual phenomena such as frisson (*refer to* 2.6.3.).

For reduced extraversion, this is consistent with a more recent study (Rinaldi et al., 2020) that explained how extraversion was masked in other personality-based synaesthesia research (e.g., Banissy et al., 2013; Chun & Hupé, 2016; Rouw & Scholte, 2016) due to their participant recruitment methods having relied on individuals who were self-motivated to take part in their studies (i.e., those who are already likely to score high on extraversion). Rinaldi et al. (2020) instead recruited young synaesthetes whose dominance (an element of extraversion reported to increase with age; Caspi et al., 2005) is underdeveloped. However, neither of these two factors (recruitment method or underdeveloped dominance) apply to the present findings. The recruitment method was the same as the synaesthesia studies that did not report on extraversion, and the current sample did not consist entirely of youth.

Participants in online samples are possibly more introverted (i.e., low extraversion), as introversion has been identified as a psychological predictor of internet usage (Wilson, Fornasier, & White, 2010). ASMR has been linked to lower extraversion (Fredborg et al., 2017); the researchers suggested that (pre-existing) introversion may increase the likelihood of experiencing ASMR (1), or that introversion may be a result of experiencing ASMR (2). This may also be the case with MTS. While any of these explanations could be feasible, one way to address which is more likely, as Rinaldi et al. (2020) suggested, is by testing extraversion specifically, with behavioural and/or social manipulations.

Interestingly, neither conscientiousness nor neuroticism were significantly associated with MTS intensity scores in either direction, despite being previously linked to synaesthesia. As specified earlier, this may be down to differences in the variants of synaesthesia investigated (i.e., MTS in the present study versus other forms of synaesthesia, mostly grapheme-colour, in previous studies). Also, the chosen measure of personality may have also had an impact. The BFI is the dominant measure of personality used in previous research (e.g., Banissy et al., 2013), while the present study used the IPIP (due to resource availability). Nevertheless, further research on the personality profile of MTS, especially on more nuanced sub-facets, would be beneficial to reach a clearer understanding of the personality profile of this variant in future since this is the first iteration of such a study.

4.5.2. Empathy Profile of MTS

The results showed that only empathic concern and fantasising were positively associated with MTS intensity scores. These results are consistent with the previous MTS literature (Banissy & Ward, 2007; Ioumpa et al., 2019; Ward et al., 2018) but also parallel the reported empathy findings for ASMR.

Previous MTS research has described the empathy profile, finding elevated fantasising and empathic concern in MT synaesthetes. It is also found in ASMR (McErlean & Banissy, 2017). As outlined above (4.5.1.), fantasising is often associated and grouped with openness to experience and was outlined to be associated with MTS. Empathic concern is typically described as a tendency to experience feelings of concern toward others (Beven et al., 2004; De Corte et al., 2007). When reporting elevated empathic concern within their sample of MT synaesthetes, Bolognini et al. (2014) explained that the conscious sharing of touch (which is central to MTS) may depend more on the affective components of empathy (i.e., empathic concern). This way, empathic concern may be higher in MT synaesthetes due to their ability to experience touch sensations analogous to the original sight of touch/hurt. Thus, MTS and empathy (especially through empathic concern) intertwine where they may be part of a similar mechanism where sensitivity (i.e., touch) is increased depending on the situation of other individuals (Ioumpa et al., 2019).

4.5.3. Personality Profile of ASMR

Research has previously investigated the personality traits associated with ASMR. The literature attributes ASMR with an atypical personality profile characterised by heightened levels of openness to experience, neuroticism and absorption, and lower conscientiousness, agreeableness, and extraversion (Fredborg, Clark & Smith, 2017; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020). Only elevated openness to experience, however, has shown consistency. Again, this holds true with other perceptual phenomena in both synaesthesia and frisson (*refer to* 4.5.1.). The current study only reported heightened openness to experience as predictive of ASMR scale scores.

Referring back to 4.5.1., openness to experience was again grouped with the conceptually similar empathic trait fantasising. It was suggested that MTS is associated with elevated fantasising and openness to experience and more specifically, that MTS is associated with a tendency to tap into one's imagination which may increase the likelihood of experiencing MTS. The same is suggested of ASMR. Taking this further, the imaginative propensity that makes up part of these traits, may link to the interpersonal theories of ASMR. ASMR media frequently makes use of speech (e.g., directed speech, use of personal pronouns, scripted speech), props and/or backdrops in typical personal attention videos to essentially transport the viewer-listener to the constructed 'scene' which is shared between the host who developed and recorded the content and the avid viewer-lister who is consuming it. Indeed, in reporting heightened openness to experience and fantasising (grouped), McErlean and Banissy (2017) detailed that having a heightened tendency to fantasise and ability to 'imaginatively transpose' oneself into a fictional/virtual reality may be involved in eliciting ASMR. One must stress, however, that these theories are exactly that, theoretical and the potential methodological confound of how it may be difficult to justify openness to experience as a trait (underlying ASMR and MTS) still needs addressing.

Alongside openness to experience (and fantasising), the conceptually similar personality trait absorption may have also shown significance if measured. As touched on in 4.5.1. (*and earlier in* 2.5.), the association between ASMR and absorption propensity has previously been discussed (McErlean & Banissy, 2017; Roberts et al., 2019) and reported (McErlean & Osborne-Ford, 2020).

Being correlational, neither the present nor previous findings are able to confirm a predisposition between these traits and sensitivity to ASMR (or MTS). Likewise, it is unclear whether having such a sensitivity (to ASMR and/or MTS) increases an individual's propensity for the trait, be it absorption or in this case, openness to experience. In fact, too little is known about the phenomenology of ASMR (or MTS) while the screening protocol to measure ASMR-sensitivity is close to non-existent without discounting self-report. It is important thus, to focus on such matters before crafting such interpretations.

None of the remaining Big-Five traits were significantly associated with (predicting) ASMR scale scores in either direction. This is interesting since the prior research has reported on them and consistency between the present and previous findings was predicted. Why this is the case, however, is unclear. One could argue however, the greater focus on MTS within the experimental paradigm was an influencing factor.

Also, one should acknowledge that there were trait differences between the two phenomena with elevated agreeableness and reduced extraversion significantly associated with MTS and not ASMR within the present sample. Similar to the perspective taking trait divide outlined below (*in* 4.5.4.), one may infer a possible difference in the empathic profiles of the two phenomena. Considering the prior ASMR-personality literature however, this is highly tentative and should be considered with caution. Instead, the differences between phenomena and compared to previous personality research on both ASMR (and synaesthesia) may be a product of methodology. Similar to 4.5.1., this takes into account how the prior ASMR-personality research (Fredborg et al., 2017; McErlean & Banissy, 2017) utilised a different measure of the Big-Five trait domains, the BFI (John et al., 1991) versus the presently used IPIP. Ultimately, further research on the personality profile of ASMR, with perhaps particular focus on individual personality traits or more nuanced sub-facets may better deepen current understanding – perhaps eliminating non-consistent traits.

4.5.4. Empathy Profile of ASMR

To date, only one study has investigated the empathic traits associated with ASMR, attributing it with heightened fantasising and empathic concern (McErlean & Banissy, 2017). This does, however, hold true with synaesthesia, particularly MTS. The current study reported heightened fantasising, empathic concern and perspective taking as predictive of the ASMR scale scores.

Similar to the above discussion on MTS, fantasising was similarly outlined and explained alongside openness to experience (4.5.1.; 4.5.3.). For elevated empathic concern, this is consistent with McErlean and Banissy (2017) who suggested ASMR may be associated with heightened sympathy for distressed individuals. While this is fair when considering descriptions of the trait, the reasoning does not appear to apply or relate to ASMR. Instead, one may look to the MTS literature.

As outlined above, such research suggested that empathic concern may be higher in MT synaesthetes due to their ability to experience touch sensations analogous to the original sight of touch/hurt (4.5.2.). Again, MTS and empathy (especially through empathic concern) may be part of a similar mechanism where sensitivity is increased depending on the situation of other individuals (Ioumpa et al., 2019). This could also apply to ASMR in a more general sense where sensitive individuals experience ASMR somatosensation which can increase in intensity depending on the ASMR stimuli, or rather, the individual (i.e., host) who developed the stimuli. This may also build on the interpersonal nature of ASMR as described in terms of openness to experience, fantasising and absorption.

Perhaps, in terms of the current study, the MTS visual task may have also had an influence on the present ASMR-sensitive participants. These individuals may have responded to the MTS video task and experienced the somatosensory response of ASMR in a similar way to a typical personal attention roleplay ASMR video (since the task depicted personal attention in the form of hand movements and touch). However, the MTS video task was not designed to elicit ASMR and therefore not specifically an ASMR stimulus per se. Also, the concept that solely visual stimuli can elicit ASMR is still highly speculative (*see* Barratt et al., 2017) with the only available evidence being a single ASMR study (Kovacevich & Huron, 2019) or anecdotal accounts. The association between empathic concern and ASMR thus, is an area in need of elaboration.

Lastly, for elevated perspective taking, this is a finding that was not reported by McErlean and Banissy (2017). It does, however, seemingly tie in with the provided explanations for openness to experience and fantasising.

Perspective taking has been referred to a tendency to adopt the psychological perspective of another individual (Beven et al., 2004; De Corte et al., 2007). Interestingly, this again relates to the aforementioned interpersonal theories of ASMR (4.5.3.), with particular emphasis on the fact that roleplays are one of the most popular ASMR stimuli in eliciting ASMR (Barratt & Davis, 2015; McErlean & Banissy, 2017), and the fact that during these roleplays, the viewer-listener can become imaginatively immersed in the video and feel as if they are truly part of it. While this is currently still speculative, future investigations may provide further insight, especially if ASMR stimuli (and specifically, those in the style of 'personal attention') are presented, perhaps even alongside the ASMR scale or similar measure such as an adapted version of Fredborg et al.'s (2017) ASMR Checklist. What is interesting though, is the fact that perspective taking is where the ASMR and MTS findings vary with the trait presently being exclusive to ASMR. This suggests the trait may be a potential difference between the two phenomena. This too is enough to warrant further study, especially since fantasising and empathic concern appear to be consistent across phenomena.

4.5.5. ASMR and MTS

The results indicated that elevated openness to experience, fantasising, and empathic concern were predictive of both MTS intensity and ASMR scale -scores. Again, these are traits that have shown consistency with the literatures of both phenomena. Disregarding the present personality differences which are tentative, perspective taking was positively associated with ASMR and MTS but significantly so with ASMR alone hinting at a possible differentiation between the phenomena. Regardless, the current findings established consistency with the existing personality and empathy research as predicted (bar conscientiousness), and that in general, both phenomena possessed relatively similar personality and empathic profiles.

As outlined above when discussing the comparison of ASMR and synaesthesia in general (*in* 4.2.2.), the phenomena have been suggested to share phenomenological characteristics. Arguably, this can extend to MTS. Even without acknowledging MTS as a synaesthetic variant, the central visuo-somatosensory interaction being attributable to both phenomena and sharing an inducer-concurrent relationship (with visual stimuli acting as the inducer and somatosensation as the concurrent), as well as the similarity in their personality and empathic profiles paint the two in a shared likeness. This is boosted when considering the presently reported association between the two phenomena and how 80% of the sample who self-reported as MT synaesthetes also self-reported as ASMR-sensitive. A similar trend has also been reported between ASMR and another perceptual phenomenon in misophonia with ASMR-sensitive individuals self-reporting as misophonic (Barratt et al., 2017) and vice versa (Rouw & Erfanian, 2018). The reason behind the association of ASMR and other perceptual phenomena, however, is the subject of debate.

There are several theoretical explanations for this association. One possibility is rather broad, that the association lends itself to the (phenomenological) similarities between the two phenomena. Indeed, this may be exemplified by the presently incorporated MTS visual validation task. As discussed above (*in* 4.5.4.), although the task was foregrounded in MTS, it may have influenced those sensitive to ASMR whereby they may have responded to the task in a similar way to engaging in ASMR media due to the depiction of personal attention (i.e., hand movements). The drawback, however, is that the task was devoid of sound accompanying the actions and audition – sound is central to ASMR (*see* 2.4.2.).

There are anecdotal accounts of ASMR-sensitive individuals reportedly experiencing ASMR somatosensation from solely visual stimuli and media specifically tailored for this preference. In fact, a thematic analysis run in a prior ASMR study has reported on visual ASMR stimuli eliciting the response (Kovacevich & Huron, 2019). This explanation is tentative. In contrast, the auditory component of ASMR stimuli is often outlined to play a larger role in the elicitation and intensity of ASMR experiences (*see* 2.4.2.; 2.4.3.) despite the almost inextricable 'audiovisual' descriptor that accompanies ASMR definitions. More so, previous survey research that explored visual ASMR stimulus properties reported highly mixed results (Barratt et al., 2017). This same study also went so far to conclude that auditory components of ASMR stimuli are effective at eliciting the response without the need to visually see the object of the sound's origin. Further, a preliminary study utilising a test-retest paradigm (consisting of presenting solely auditory ASMR stimuli) to indicate whether non-ASMR-sensitive individuals could reliably experience ASMR after a 2-week break, reported high reliability (Koumura et al., 2019). It is rather difficult to justify the influence of the solely visual MTS task on ASMR in the present study. Hence, research with the focus of exploring the phenomenological characteristics would not go amiss and even benefit the more objective research.

Alternatively, the ASMR-MTS association may be attributable to sharing a similar personality and empathic profile. In a previous personality focused ASMR study, Fredborg et al. (2017) wanted to identify the factors underlying the phenomenon. They outlined how the neuroimaging research (specifically atypical functional connectivity) represents one such factor and indeed, this carries over to present neuroimaging research on ASMR. The authors however, introduced the idea of personality traits also playing a role and reported differences between an ASMR-sensitive and control group in this regard (refer to 2.5., 4.2.). Although it is difficult to assume that ASMR experiences (and MTS) are modulated by personality and empathic traits, as the researchers concluded, they may simply contribute to ASMR experiences in some way.

Drawing on Gillmeister et al.'s (2022) reasoning for the co-occurrence of ASMR and MTS, an explanation may be found in a shared neural profile. The two phenomena may share a similar neural profile that has influenced the development of a comparable personality and empathic profile between phenomena as well as an increased tendency to experience the two responses. Looking to the functional imaging findings, research on both ASMR and synaesthesia in general have reported similarities in brain activations. For instance, resting-state fMRI research have observed atypical functional connectivity of resting-state networks, expressly the DMN where a 'blending' of such networks is implied (Smith et al., 2017; 2019b; Dovern et al., 2012; *see also* 3.1.1.). This suggests that individuals who are sensitive to the investigated phenomenon (i.e., ASMR/synaesthesia) may exhibit a diminished ability to supress multisensory experiences. Similar findings are present in studies on other atypical sensory experiences such as auditory verbal hallucinations (*see* Alderson-Day et al., 2015) and psychedelic drugs (Roseman et al., 2014), and other perceptual phenomena like misophonia (Kumar et al., 2017).

Another parallel can be found in atypical thalamic activity (reduced functional connectivity). This has been reported in two fMRI studies on ASMR (Smith et al., 2017; 2019a) which was linked to two cases of acquired synaesthesia as a result of a thalamic infarct (Beauchamp & Ro, 2008; Schweizer et al., 2013). What bolsters this is the fact that the variants of synaesthesia acquired were auditory-tactile and sensory-emotional which are descriptively similar to the attributed sensations of ASMR (as well as misophonia). Presently, this has not been observed in functional imaging research on MTS but should not be discounted in future.

Referring back to the similarities in ASMR/MTS phenomenology is appropriate. The somatosensation elicited in both phenomena have an affinity for stimulation that involves human behaviour and movement/interaction. This was linked to empathic and interpersonal qualities attributed to both ASMR and MTS. The perceptual experience of touch from seeing/hearing other stimuli, may be due to self-other boundaries being more variable. Appropriately, the functional imaging literatures of both phenomena have reported on a shared finding in atypical activity in the network involved in self-other discrimination and empathic processing and within this, the recruitment of heightened insular activity (Blakemore et al., 2005; Holle et al., 2013; Lochte et al., 2018; Smith et al., 2017). Again, this similarly extends to misophonia (Kumar et al., 2017). While the shared findings may underlie both phenomena, it is worth noting that ASMR and MTS do not share an identical neural profile. This is especially true when considering the entirety of their neuroimaging literatures – that they (especially ASMR) report activations other than those currently outlined (*see* 3.1.1.). This way, it may be appropriate to suggest they merely share brain networks, something not uncommon considering that both phenomena encompass more than one sensory modality. Before arriving at such an inference, it is recommended to await further exploration of the neural aetiology of both phenomena, especially to better ensure the risk of reverse inference is as low as possible. Thus, ASMR and MTS are linked but the reason behind their association is yet to be confirmed.

4.5.6. Study Limitations

The lack of ASMR and MTS screening protocol is an issue. The recruited sample identified sensitivity to ASMR and MTS via self-report following the completion of the ASMR scale and MTS visual validation task questions, respectively. Therein lies the issue, the subjectiveness of utilising self-report measures when it comes to response sensitivity; the inability to detect whether a sample is truly representative of a specific population (i.e., ASMR-sensitive and/or synaesthetic to MT). Surprisingly however, this is not uncommon within the literatures of perceptual phenomena. In fact, using ASMR as an example, as previously outlined (*in* 3.1.1.; 3.1.2.), there is still no independent and standardised screening protocol in place to gauge ASMR-sensitivity. Much of the research have used self-report (*see* McErlean & Banissy, 2017) though attempts at developing screening protocol have begun to emerge with a preliminary set of measures (Hostler et al., 2019) and a recent attempt at classifying ASMR responders by experience via a subjective ASMR-Experience Questionnaire (AEQ; Swart et al., 2021). Alas, self-report is central to these also. Although this is the norm in ASMR research which is still relatively recent spanning around a decade’s worth of research, synaesthesia is well-established where consistency tests are commonplace. Saying this, however, MTS is a more recent form of synaesthesia and research has utilised self-report as a form of screening (e.g., Banissy et al., 2009; Chun & Hupé, 2013), not unlike the current study.

Following on, even though the MTS visual validation task was indeed originally a novel screening tool developed by Ward et al. (2018), the current version was a substantially reduced adaptation devoid of much of the detail the original possessed. In particular, the researchers recommended a cut-off (for

MTS screening measures) of 7, previously arguing that in a previous study (Baron-Cohen et al., 2016), the diagnostic cut-off employed was too low to detect differences (specifically in facial expression recognition or emotional reactivity). Since the present study adapted the MTS-VVT to only 8 measures, it is highly likely that the MTS measured within the sample is inaccurate. In both cases thus, it is hard to justify the current sample as truly ASMR-sensitive and/or MT synaesthetes away from self-report however, with this being commonplace in other similar studies on both phenomena, it is perhaps somewhat acceptable. Ideally though, it would be appropriate to further develop some kind of screening measure for sensitivity to both ASMR and MTS, perhaps by building on the existing research but more importantly, incorporating more objective measures such as physiology (*as discussed in* 3.1.1.; 3.2.). For ASMR, this may involve building on the ASMR Checklist (Fredborg et al., 2017) as previously done (e.g., Scofield, 2019) as well as the preliminary screening measures introduced above (Hostler et al., 2019; Roberts et al., 2019; Swart et al., 2021). Similarly for MTS, one may look to build on or simply include the full MTS visual validation task (Ward et al., 2018).

On that note, it is also appropriate to also highlight the testing batteries employed in the present study. First, while the IPIP and IRI are well-established measures of personality and empathy respectively, there is a downside in that they lack the ability to measure the more nuanced sub-facets of personality and empathy which may have led to differences in the results reported in the current study. This way, it is perhaps appropriate to recommend future research to include measures of personality and empathy that account for the sub-facets of the core trait domains. Also, despite the IPIP measuring the Big-Five domains of personality, it is not the measure previously employed in the existing personality studies for ASMR (Fredborg et al., 2017; McErlean & Banissy, 2017) or synaesthesia (Banissy et al., 2017). The BFI (John et al., 1991) is often presented in personality research and it may have been the better option for consistency and ruling out methodological differences. This may have also been the reason behind (reduced) conscientiousness not being reported in the current study. To note, the BFI was not used due to resource availability. It may have also been good to use the BFI since this was the first iteration of a study that investigated the personality profile of MTS. The IRI, however, is the opposite in this regard since it is the measure of choice for investigating the empathic profiles of both ASMR (McErlean & Banissy, 2017) and MTS (Banissy et al., 2013).

Second concerns the novel ASMR scale and the simplified MTS task incorporated within this study. While the ASMR scale was found to have both construct validity and internal consistency (*see* 4.3.5.1.), one could argue that compared to the current scope of understanding of the phenomenon, it was highly lacking, consisting of only 7 items. Moreover, the low item count may have been behind the ASMR Scale's construct validity and internal consistency. This may also apply to the 'watered down' version of the MTS visual validation task, that it was reduced to the point of being unable to account for several aspects of the phenomenon (unlike the original). If this is the case, it would ultimately question the currently reported personality and empathy findings as well as the association between the two phenomena. To note however, one could also claim that the measures could perhaps be deemed appropriate for the smaller sample of the present study (opposed to the, for instance, those recruited by Fredborg et al., 2017, and Ward et al., 2018). Regardless, while the results are promising and show a level of consistency with the prior findings, it may be best to approach them with more caution than other findings with a similar subjective nature.

Last, and perhaps most importantly, is an issue with the results. The current study used several linear regression analyses to analyse the data. This consisted of five linear regressions for each of the five personality domains on ASMR, and again for MTS, each put into their own regression models. Similarly, four linear regressions were conducted for each of the four empathy domains on ASMR, and again for MTS, with each put into two separate regression models (refer to 4.3.5.3-4.; 4.4.2-5.). These analyses were conducted to assess the effect of these personality and empathic trait domains on both ASMR and MTS. The issue, however, is ASMR and MTS are correlated meaning the present analyses cannot account for possible shared variance. This requires analyses to control for ASMR when assessing MTS (and vice versa) and/or analyses that assess shared variance to identify what may be driving similar personality and empathy profiles. To this end, partial correlations were run to filter out MTS when assessing ASMR (and vice versa). What was interesting were the differences between these correlations and the regression findings wherein the correlations revealed clear influences of MTS when assessing ASMR (and vice versa) with openness to experience and agreeableness in particular impacted. In future, shared variance must be considered.

4.5.7. Conclusion and Future Directions

Overall, this study sought to investigate the personality and empathic profiles of two similar perceptual phenomena, ASMR and MTS. It was hypothesised that both phenomena would have atypical personality and empathic profiles consistent with previous research, and that ASMR is associated with MTS. Both concepts were supported. Regarding the former, ASMR was specifically associated with elevated openness to experience, fantasising, empathic concern, and perspective taking. Similarly, MTS was associated with elevated openness to experience, agreeableness, fantasising, and empathic concern, as well as reduced extraversion.

This mostly showed consistency with the prior literatures, expressly heightened openness to experience, fantasising, and empathic concern. The differences in personality traits were suggested to reflect the comparison of ASMR and MTS and thus represent an individual difference in this respect, though the possible methodological confound of a differing personality measure between the present and past research (IPIP versus BFI) was also highlighted. The single empathic trait difference in elevated perspective taking in ASMR was similarly suggested to highlight a potential difference between ASMR and MTS. Personality and empathy clearly play a role in both phenomena, the profiles of which were linked to an association between ASMR and MTS. So, considering this association, a surprisingly high 80% of the current sample reported sensitivity to both ASMR and MTS, an effect similarly reported in ASMR-sensitive individuals reporting that they experience misophonia (Barratt et al., 2017) and vice versa (Rouw & Erfanian, 2018). Although the reason for the association is yet to be established, the current study introduced shared: phenomenology, personality/empathic profiles, and neural networks as possibilities.

Ultimately, this study has served as a catalyst for future research to further disambiguate the association between MTS and ASMR and the atypical personality and empathic profiles attributed to them. Throughout 4.5., future avenues of research were discussed including: general replication(s); personality/empathic research that focuses on more nuanced sub-facets of the core trait domains; the development of appropriate screening measures for ASMR and MTS sensitivity; research on the phenomenological characteristics of both phenomena with the aim of deepening current understanding of ASMR and MTS to then benefit more objective research; and further functional imaging investigation of both phenomena. The latter of which, combined with the more subjective self-report measures in joint investigations of ASMR and MTS, may lead to developing a deeper understanding of both phenomena individually as well as drawing more confident inferences pertaining the reasoning behind their association. This could similarly apply or aid in the development of similar studies that wish to explore perceptual associations (e.g., ASMR and misophonia).

CHAPTER 5: ASMR and Misophonia – Prevalence, Somatic Distribution and Phenomenological Characteristics

5.1. Abstract

This study compares and contrasts ASMR and misophonia. While scarce, ASMR and misophonia have previously been jointly investigated and suggested to co-occur, so too has the concept that they may be polar opposites. Their polarity, however, has been hampered by issues in the tangibility of responses and how there was supposedly no negative equivalent to ASMR somatosensation reported in the misophonia literature. While research has reported on and mapped the somatic distribution of ASMR somatosensation, misophonic sensations have been reported but are yet to be mapped. Surprisingly, there exists only one study to have investigated the prevalence rate of ASMR within the general population, while arguably, there is no equivalent in the misophonia literature. The present research thus consisted of two studies.

Study-1 explored the prevalence and somatic distribution (as well as phenomenological characteristics) of ASMR and misophonia in the general population. In this study, 91 participants from the general population partook in an online survey where they were presented with 24 ASMR-eliciting, misophonic and control sounds followed by questions concerning their experiences to these sounds and later, novel questionnaires on and around both phenomena. Results revealed a range of findings. First was that both ASMR and misophonia were highly prevalent suggesting possible universality but should be taken lightly. Within this, the solely auditory stimuli were not only found to elicit their respective response but also exhibited idiosyncrasy. Second, both ASMR somatosensation and misophonic sensations were topographically mapped and displayed a similar somatic distribution. Last, question responses highlighted consistency with the literature on the phenomenological characteristics for both ASMR and

misophonia, while also providing insight into considerations for factors to control for those looking to develop effective ASMR and misophonic stimuli. It was suggested that at the stimulus level, sound can generate ASMR or misophonia across different participants wherein the highlighted differences between the phenomena may lead to this response specificity.

Study-2 explored the somatic distribution of ASMR somatosensation and misophonic sensations in an ASMR-sensitive sample. In this study, 47 ASMR-sensitive participants partook in an online survey where they were presented with the same ASMR-eliciting and misophonic sounds (but not controls) but alongside body maps (for participants to map potential somatosensation during stimulus presentation) and was followed by the same questions concerning their experiences to these sounds. Results were highly consistent with Study-1.

5.2. Introduction

5.2.1. A Reintroduction to ASMR and Misophonia

Again, as touched on throughout Chapter 2, ASMR is a relatively recent description of a perceptual phenomenon that has seen a gradual and steady rise in research over the past few years. The phenomenon has been described as a pleasant experience that encompasses a somatosensory (tactile) tingling sensation and feeling of relaxation typically reported to be emotionally positive, triggered via a range of audiovisual stimuli (Barratt & Davis, 2015; Poerio, 2016; *see* 2.3.). In particular, the somatosensation elicited has been described as having a specific somatic distribution primary to the scalp and neck that may spread downwards to the secondary shoulders, back, and limbs (Barratt & Davis, 2015; Smith et al., 2017).

As outlined in Chapter 2, ASMR investigations have utilised both subjective and objective research methodologies, from survey research on the phenomenological characteristics and the personality and empathic profile, to the neural and physiological profiles. These studies seemingly reflect the growing scientific interest in the phenomenon but also attempt to extend current understandings of the response, predominantly the potential mechanisms behind ASMR sensations, and highlight potential individual differences attributable to the response and comparable to other similar perceptual phenomena. It is based on the underlying phenomenological characteristics and the aforementioned three profiles, that ASMR has been compared against other similar perceptual phenomena including synaesthesia (e.g., Barratt & Davis, 2015), frisson (e.g., del Campo & Kehle, 2016; Kovacevich & Huron, 2019) and misophonia (e.g., Barratt et al., 2017; McErlean & Banissy, 2018; Scofield, 2019). This time, misophonia is of the most interest being a form of sensory experience mostly associated with sound not unlike ASMR.

So, as outlined above (*in* 2.6.4.), misophonia is another example of a perceptual phenomenon, one typically described as an abnormally strong sensitivity to particular sounds that are accompanied by unpleasant emotional reactions and autonomic arousal (Cavanna & Seri, 2015; Edelstein et al., 2013; Jastreboff & Jastreboff, 2002; Taylor, 2017). Similar to ASMR, despite auditory stimuli representing the key misophonic inducer, the response has been shown to be elicited via cues from other sensory modalities such as visual stimuli (Cavanna & Seri, 2015; Taylor, 2017), as well as having a social component (Edelstein et al., 2013).

Again, similar to ASMR, Investigations into misophonia have also utilised both subjective and objective research methodologies, from survey research on the phenomenological characteristics, to the neural and physiological profiles. Similar to the ASMR counterparts to these findings, such studies reflect the growing scientific interest in the phenomenon and attempt to further current understandings (i.e., revealing potential mechanisms underlying misophonic sensations) and highlight potential individual differences attributable to the response.

As was the case in Chapter 4 regarding the ASMR-synaesthesia relationship, one may be able to gauge a sense of similarity between ASMR and (in this case) misophonia based on reported phenomenological characteristics, and the findings from personality, empathic, physiological and neuroimaging investigations. Once more, one can argue that there is not enough in the way of joint investigations to confirm their proposed similarity. Although the two are seemingly distinct physiologically (*see* 2.6.4.), the reported neuroimaging findings from fMRI investigations (*refer to* 2.6.4.) suggests there is reason enough to pursue their joint investigation, with both subjective and objective exploration being appropriate.

5.2.2. Comparison of ASMR and Misophonia and Phenomenological Similarities

Research has commented on and investigated the relationship between ASMR and misophonia (e.g., Barratt & Davis, 2015; Barratt et al., 2017; McErlean & Banissy, 2018; Rouw & Erfanian, 2018; Scofield, 2019; *for a complete overview, refer to* 2.6.4.). Briefly, Barratt and Davis (2015) were the first to introduce the potential association between the two, highlighting a few phenomenological similarities including the inducing stimuli originating from human-centric movement and behaviour, as well as responses being automatic, unexplained by previously learned associations, and having some consistency. It was based on these that led the researchers to link the two to synaesthesia, introducing their concept that the two phenomena may represent two ends of a spectrum of *experience* but was hampered by issues in terms of the tangibility of concurrents (since ASMR also elicits somatosensation) and how the researchers could not identify a negative equivalent to ASMR somatosensation within the misophonia literature.

Building on the proposed ASMR-misophonia relationship, Barratt et al. (2017) gave the example of *mouth sounds* to highlight the idiosyncratic relation between the two responses. These types of sound (e.g., chewing, crunching), perhaps more appropriately under the umbrella of ‘orofacial sounds’, have been found to elicit the associated sensations of both responses in sensitive individuals. Also, 43% of their ASMR-sensitive sample self-reported previously experiencing misophonia which coincides with a large-scale misophonia study that found 49% of their misophonic sample self-reported that they had experienced ASMR (Rouw & Erfanian, 2018). This seemingly implied that ASMR and misophonia are likely associated and can co-occur but did not explain how or why this may be the case.

To this end, McErlean and Banissy (2018) administered the MQ (Wu et al., 2014) to ASMR-sensitive participants and controls to establish whether ASMR is associated with increased levels of misophonia. Their ASMR-sensitive sample scored higher on all three scales of the MQ, suggesting that ASMR-sensitive individuals may display increased levels of misophonia symptomology. Extending on this, Scofield (2019) administered adapted versions of the ASMR Checklist (Fredborg et al., 2017) and the MQ (Wu et al., 2014). Results revealed weak but significant correlations between all the measured variables which was suggested to be indicative of a relationship between stronger tendencies to experience ASMR and higher levels of misophonia and was thus consistent with the prior research. Also reporting on types of auditory stimuli to trigger both perceptual responses, Scofield found whispering to be the strongest ASMR inducer and eating sounds as the strongest misophonic inducer which was consistent with the previous literature (*refer to* 2.3.).

While the above research has provided insight into the association between ASMR and misophonia, the scope of understanding is still arguably limited. Based on this research, both phenomena have been suggested to co-occur and represent opposite ends of the same spectrum of experience, one in which specific stimuli (namely, mouth sounds) have been shown to highlight their idiosyncrasy. Phenomenological similarities between the two phenomena have also been suggested in the form of the eliciting stimuli for both responses originating from human-centric movement and behaviour, and that the responses to such stimuli are unexplained by previously learned associations, are automatic, and have some consistency.

Indeed, the literatures of both phenomena have identified that the stimuli that elicit ASMR and misophonic responses originate from human-centric movement and behaviour (*refer to the beginning of* 5.2.2.; 2.3.). It is worth noting though, that non-human centric stimuli also trigger the two responses (*refer to the beginning of* 5.2.2.; 2.3.). Also, even considering the fact that the two responses share inducing stimuli (e.g., mouth sounds), the bulk of such inducers differ substantially, especially when considering their underlying sensory properties. An example here is that while ASMR stimuli archetypally have a lower spectral centre of gravity (Koumura et al., 2019), misophonic stimuli can vary but are usually the opposite (*for examples, see* 2.6.4.).

Next, both phenomena have been reported as automatic (Barratt & Davis, 2015; Edelstein et al., 2013; Fredborg et al., 2017). Similarly, the concept that the two phenomena were described as unexplained by previously learned associations seemingly alludes to automaticity. It is worth noting again, however, whether ASMR is *consistently* automatic is questionable when considering the reported average ASMR onset time of 59.54s with a 0-90s range (Smith et al., 2017).

Finally, both responses have *some* consistency. This relates to the predictable and individualistic nature of the two phenomena. Looking at the ASMR findings, those sensitive to the response report experiencing ASMR sensations from multiple stimuli but can be considered individualistic in terms of stimulus intensity (i.e., in one experiencer, one stimulus may generate more intense ASMR sensations than another stimulus, and this may not be the same when compared to another experiencer). This way, while experiencers will typically report varying accounts of intensity to particular stimuli (when compared to other experiencers), the response intensity to a given stimulus may be somewhat consistent to the individual. The percentage differences in survey research on ASMR-eliciting stimuli (*refer to* 2.3.) seemingly alludes to this impression.

Individualism also relates to the concept of predictability, that the same stimulus consistently leads to the same responses and ASMR has previously been described as such (Smith & Snider, 2019). The same can be said of misophonia since an individual's ability to experience the response has been described to vary from person to person, specific to different types of stimuli (Cavanna & Seri, 2015; Rouw & Erfanian, 2018), and more generally, that the phenomenon itself has been described as consistent (Edelstein et al., 2013).

Overall, the above discussion has shown that there are similarities in ASMR and misophonia phenomenology. Yet, phenomenological investigation is still rather lacking in both literatures. This is echoed within the misophonia literature where reviews have referred to the need to focus on exploring the phenomenology of misophonia in future (e.g., Cavanna & Seri, 2015; Edelstein et al., 2013; Wu et al., 2014). The same, of course, can be said of ASMR. While the objective research is clearly beneficial when investigating the potential underpinnings of both responses (*see* 2.6.4.; 3.1.; 3.2.), there is arguably not enough information regarding the phenomenological characteristics within the research similar to how there should be more emphasis placed on stimulus properties (*as discussed in* 2.4.). Considering how such information is undeniably useful to the objective research (e.g., in study and stimulus design), a greater emphasis should be placed on the more subjective phenomenological investigations.

5.2.3. Prevalence and Somatic Distribution – Study Application

For both ASMR and misophonia, there exist two areas that would bolster current phenomenological characteristics, ASMR and misophonia *prevalence rates* (from the general population) and the *somatic distribution* of ASMR and misophonic sensations.

Prevalence research on misophonia is scarce but on the rise (Naylor, Caimino, Scutt, Hoare & Baguley, 2021). From previous misophonia research, the prevalence in the general population has been estimated to be 3.2% (Jastreboff & Jastreboff, 2014). This was based on a 3.5% prevalence rate of decreased sound tolerance (DST) in the general population wherein an estimated 92% of DST patients are thought to be misophonic. Since this was just an estimation, and one based on another condition, it should be approached with caution. Other studies, however, have reported prevalence rates of 19.9% (Wu et al., 2014) and 20% (Zhou, Wu & Storch, 2017) and interestingly, these percentages were relatively close despite the research presenting different misophonia questionnaires and recruiting samples from two differing cultural groups (American versus Chinese undergraduates, respectively). More recently though, similar studies have reported comparatively mixed prevalence rates including 8.5-12.96% (Siepsiak, Sobczak, Bohaterewicz, Cichocki & Dragan, 2020), 12.8% (Kılıç, Öz, Avanoğlu & Aksoy, 2021) and even 49.1% (Naylor et al., 2021). Yet, one cannot discount the likelihood of methodology playing a role in the mixedness of these rates such as the measure of prevalence employed as well as the number of participants recruited and the population they represent. Regarding the latter, is apparent that in most cases, undergraduates or clinical patients are recruited and arguably, these clearly do not represent the general population but rather a minor subset thus questioning the current prevalence rates on a whole.

Until recently, there was no data on the prevalence rate of ASMR. Poerio et al. (2022b) were the first to investigate the prevalence of ASMR. Specifically, they investigated the prevalence rate of synaesthesia in ASMR, but also suggested an approximate 20% ASMR-sensitivity in the general population. This is consistent with a previous suggestion that ASMR may be highly prevalent in the general population (McErlean & Banissy, 2018). While the reported prevalence rate is relatively high, one may have expected a higher rate within the general population. This is in consideration of the frequency of ASMR media situated online (*refer to* 2.2.) and in marketing / advertisement (Baek, Jang & Chae 2018; Bode, 2019; Chae, Baek, Jang & Sung, 2021; Spence, 2020) making ASMR noticeable, and the fact that another study (Koumura et al., 2019) showed preliminary evidence for ASMR-insensitive individuals being able to experience ASMR somatosensation whose somatic distribution mostly matched that of a previous ASMR-sensitive sample (Barratt & Davis, 2015). As outlined above (*and in* 2.6.4.), ASMR and misophonia have been jointly investigated in the fairly recent past with some findings suggesting the potential cooccurrence of the two. It would be interesting then, to jointly investigate the prevalence of both phenomena in the general population to assess potential universality of ASMR and misophonia.

Somatosensation is highly characteristic and arguably the defining quality of ASMR. So much so, in fact, that descriptions of ASMR are rarely devoid of mentioning somatosensation as well as the somatic distribution of these touch sensations. Misophonia and those sensitive to the response on the other hand, has been suggested by one study (Barratt & Davis, 2015) as not having a (negative) equivalent to ASMR somatosensation, giving the example of numbness/irritation. This is not to say that somatosensation is specific to ASMR though.

Excluding general anecdotal accounts, research that has investigated misophonic physical responses can be identified within the literature. For instance, survey research has reported on the accompanying physical reactions (Dozier, 2015; Edelstein et al., 2013; Rouw & Erfanian, 2018; Schwartz et al., 2011). From a more objective standpoint, there are several examples of studies that have reported on heightened physiological responses (Edelstein et al., 2013; Kumar et al., 2017), while Edelstein et al. (2013) also highlighted the influence of pharmacological agents on misophonic symptomology (e.g., caffeine intensifies, alcohol decreases). In fact, a more recent paper on the phenomenology of misophonia reports on body areas attributed to sites of physical responses (Dozier & Morrison, 2017), not unlike the ASMR counterparts to such research (Barratt & Davis, 2015; Koumura et al., 2019; Swart et al., 2021). Specifically, the authors drew on the existing concept that the physical response may instead be masked by the emotional response to misophonia, while the physical response may be the initial sensation that influences emotional arousal. True, the authors were the first to provide evidence of perceived physical responses to auditory and visual stimuli with the shoulders, arms and hands, neck, chest, back, abdomen, and jaw being the most frequently reported (in order of frequency) but was highly individualistic to the individual. The existing research has possibly acted as evidence to infer the link between misophonia and somatosensation, a negative equivalent at that.

As for the ASMR literature, there are presently three examples of research that investigated ASMR somatosensation. Already, this is rather meagre for something that represents a huge part of the phenomenon. In both examples, figures were drawn to represent areas wherein touch sensations were felt in response to ASMR-eliciting stimuli in both ASMR-sensitive (Barratt & Davis, 2015; Swart et al., 2021) and non-ASMR-sensitive (Koumura et al., 2019) samples. It is the work of Barratt and Davis (2015) that is typically cited across ASMR research when studies describe the phenomenon and is perhaps the reason for the lack of research on, again, what appears to be a key aspect of the response. While these studies have not specifically focused on mapping the somatic distribution of ASMR somatosensation, they have provided an insight for future work.

As previously outlined, Barratt and Davis (2015) developed an exploratory questionnaire on demographics and characteristics thought to be relevant to ASMR. One section in particular was focused on 'location'. Location was included since the researchers wanted to identify the location of ASMR somatosensation wherein subjects were asked to indicate where on their body the touch sensation of ASMR typically originated, whether it consistently originated in the reported area, and whether the sensation spread with intensity and if so, the area(s) it spread to.

Thus, the researchers reported that ASMR somatosensation typically originated towards the back of the scalp, progressing down the line of the spine, spreading outwards to the shoulders (but only in some cases) while the lower back and limbs were also reported in some but were dependent on stimulus intensity which is highly individualistic. Specifically, 63% of their ASMR-sensitive sample reported ASMR somatosensation as originating in a consistent bodily area (back of the head: 41%, shoulders: 29%) versus 27% reporting variance. For those who reported consistency, in the instances when the stimulus was considered to be intense (again, specific to each ASMR experiencer), the touch sensation was reported to extend down the line of the spine (50%), arms (25%) and legs (21%). Subsequently, this was mapped onto a figure (a body map) illustrating the ‘common path’ of ASMR somatosensation.

A second more recent attempt can be found in Koumura et al. (2019). Unlike Barratt and Davis (2015), this study was task-based but also consisted of a sample of individuals who were described as never viewing any ASMR-eliciting video (i.e., potentially non-ASMR-sensitive). The most relevant aspect of their design in relation to the somatic distribution of ASMR somatosensation were their post-experiment interviews. The researchers reported 90% of their sample experienced the touch sensation of ASMR during their experimental task despite reporting the sample had never viewed ASMR media prior to participation. Essentially, this is interesting as it suggests ASMR may indeed be relatively more common. Since somatosensation was elicited in the majority of their sample, interviews took place post experiment. Each participant was asked to report where on the body their ASMR originated and whether it spread to other areas. Based on these interviews, the researchers visualised ASMR somatosensation on areas of the body (illustrated via body map).

Specifically, the response was reported to originate mainly on the ears and their vicinities (59%), the neck (44%), the shoulders (44%), the spine/back (30%) and the arms (15%) (but not the legs). Thus, not only have the authors shown that (essentially) non-ASMR-sensitive individuals can experience the response but that the somatic distribution is also mostly consistent with that reported by ASMR-sensitive individuals (Barratt & Davis, 2015). This on its own, opens up discussions on ASMR prevalence which, as noted, has still not been reported on but would be a driving force for investigating it. Yet, whether their sample truly had not viewed ASMR media prior to taking part in the study is questionable considering the popularity of the response in recent years, the prevalence of ASMR media circulating online (*again, see* 2.2.), and its use in marketing / advertisement (Baek et al., 2018; Bode, 2019; Chae et al., 2021; Spence, 2020). The fact that their sample age ranged from 18-23 (with an average of 20.6) also adds to this possibility.

Most recently, as part of their AEQ, Swart et al. (2021) asked a series of questions on ASMR somatosensation and its somatic distribution to participants who reported on experiencing ASMR somatosensation. They key question with regards to mapping the somatic distribution, however, was where they felt ASMR somatosensation which was then indicated (by participants) via body map. Unlike the two previous studies however, the authors recorded these responses as 'head or body tingles', thereby lacking specificity. While this may be the case, their design did enable participants to map their own ASMR somatosensation and did report some specificity outside the generalised head and body such as the neck therefore, showing consistency with the existing literature.

Ultimately, these studies have successfully reported on the bodily areas in which ASMR somatosensation is typically felt, areas in which appear to show consistency in both ASMR-sensitive and non-ASMR-sensitive individuals. The findings are also consistent with another similar perceptual condition in frisson. Experiencing frisson has been reported on the scalp, neck, spine, and limbs, typically originating at the back of neck, and spreading down the back (Konečni et al., 2007; Nusbaum, & Silvia, 2011).

Focusing specifically on the association between ASMR and misophonia thus, a design implementing and focusing on both prevalence and somatic distribution would be beneficial for the literatures of ASMR and misophonia. More so, identifying the relationship between the two phenomena would be theoretically important in highlighting non-auditory representations of sound. Briefly, such a design would consist of recruiting members of the general population (versus specialised samples such as ASMR-sensitive and misophonic individuals) and the presentation of auditory stimuli including ASMR-eliciting, misophonic and control sounds. This would be proceeded by a set of questions based on the presented sounds including identifying the phenomenon the sound was meant to elicit (ASMR, misophonia, control), the pleasantness of the sound, and if they experienced either ASMR or misophonia (or neither) from the presented sound along with the reported frequency, intensity and somatic distribution. Also, if participants identified themselves as ASMR-sensitive or misophonic, they could then be presented with questionnaires on the nature of the two phenomena.

Regarding ASMR, it has now been a few years since a study on the somatic distribution of ASMR somatosensation has been conducted (Barratt & Davis, 2015; Koumura et al., 2019; Swart et al., 2021) while the data on the prevalence of this phenomenon is preliminary (Poerio et al., 2022b). As for misophonia, although somatic distribution has been reported on, this was a single study that presented both auditory and visual stimuli while the areas were not mapped onto body maps as they have been for ASMR. This way, conducting such an investigation (at least in terms of presenting solely auditory stimuli and topographically mapping misophonic sensations to body areas) would be a first for misophonia. This way, results from a joint investigation may better address the suggested co-occurrence and concept that the two represent opposing ends of the same spectrum of experience.

As for prevalence, there is the issue of the current misophonia studies having recruited exclusively undergraduate students or patients, neither of which can be said to be representative of the general population. Further, questionnaires on the nature of the two responses would gauge ASMR and misophonic sensitivity while also providing information on the phenomenological characteristics of both responses which would also enable comparisons to previous findings (*refer to* 2.3.; 2.4.; 5.2.2.). This makes up 'Study-1'.

Going a step further, applying solely the somatic distribution design to specifically ASMR-sensitive populations would provide better insight into how and where ASMR somatosensation is felt from the perspective of individuals who regularly engage in ASMR media but also whether such individuals would be prone to 'physical' misophonic sensations resulting from misophonic stimulation. This makes up 'Study-2'. Collectively, the current study thus represents a unique opportunity to explore the prevalence and somatic distribution (as well as typical phenomenology) of ASMR and misophonic sensations and the potential similarities and differences between the responses.

Study-1 Hypotheses: that the prevalence rate of ASMR in the general population will show consistency with the previously reported approximate 20% prevalence rate (1); that the prevalence rate of misophonia will be highly prevalent in the general population (2); that solely auditory ASMR-eliciting and misophonic stimuli will elicit the responses they were meant to elicit but that specific sounds (specifically orofacial sounds) will be idiosyncratic (3); that the somatic distribution of ASMR somatosensation (from the ASMR-eliciting stimuli) will be reflected in the (composite) heatmaps which will be similar to previous reports (especially reports of the scalp, neck, shoulders, back, and limbs) (4); that misophonic sensations (from the misophonic stimuli) will be reflected in the (composite) heatmaps which will be similar to previous reports (especially reports of the shoulders, arms, neck, chest, back, abdomen, and jaw) (5). I will also be interested in specific factors associated with the eliciting stimuli of both responses (pleasantness, frequency, and intensity) as well as the question/questionnaire responses on ASMR and misophonia, especially in relation to prior findings.

Study-2 Hypotheses: that the prevalence of ASMR in the present ASMR-sensitive population will be higher than the existing prevalence rate of ASMR in the general population (1); that the prevalence rate of misophonia will show consistency with Study-1 (2); that the second Study-1 hypothesis will be met for the present study with some sounds eliciting the alternate response (with the pen clicking stimulus showing consistency with Study-1 in this regard) and orofacial sounds being the main driver of idiosyncrasy, consistent with Study-1 and the existing literature (3), that the background question findings will be consistent with Study-1 (4); that the somatic distribution of ASMR somatosensation (from the ASMR-eliciting stimuli) in ASMR-sensitive individuals will be reflected in the (composite) heatmaps which will be similar to previous reports and those reported in Study-1 (5); that these ASMR-sensitive participants will report experiencing misophonic sensations (from the misophonic stimuli) (6) which will be reflected in the (composite) heatmaps and will be similar to those reported in Study-1 with orofacial regions similarly being more frequently reported for misophonic sensations (7). I will also be interested in specific factors associated with the eliciting stimuli of both responses (pleasantness, frequency, and intensity), and how the associated somatosensation of both phenomena may differ (i.e., within the ASMR-sensitive sample) but also when compared to the findings from Study-1.

STUDY-1

5.3. Methodology

5.3.1. Contributions

I designed the present study. While I developed the measure of ASMR (ADCQ), a master's student assisted in developing the measure of misophonia (MDCQ). The same student assisted in editing the stimuli while they also collected the data and assisted in data analysis (*particularly* 5.3.5.1-5.). My supervisor helped record the audio. Also, regarding the analysis of the somatic distribution data, I designed the heatmap figures utilised to present this data.

5.3.2. Participants

5.3.2.1. Recruitment. A volunteer sample of 91 participants (32 male, 55 female, 3 non-binary, 1 transgender; *M* = 28.18; *SD* = 10.18; range = 18-68) completed the survey. To note, this was a subset of the original 475 participants who began the study, of which, the majority (384) had to be removed from the study and all subsequent analyses for various reasons: failing to complete the study (N = 295), failing the headphone screening (N = 84), and experiencing issues during data collection (N = 5). Participants were recruited to partake in the survey via several online platforms. In order to obtain a more generalised sample that did not consist of solely ASMR-sensitive and misophonic populations, the majority of participants were recruited via the survey platform, Prolific (prolific.co). Also, to ensure that at least a fraction of the sample was specialised (i.e., ASMR-sensitive) to guarantee that at the very least, questionnaires specific to ASMR-sensitivity would yield some responses, the survey link was posted on the forum site Reddit, particularly on the ASMR subreddit 'ASMR. Sounds that feel good' (https://www.reddit.com/r/asmr/). To reaffirm, this group made up a smaller number of the recruited sample. To note, the same was not done for misophonic sample recruitment based on the pre-existing data on the prevalence of misophonia in that a misophonic sample from the recruited participants was expected. Volunteers were eligible to take part in the online study if they met the following criteria: were over 18 years old, fluent in English, and had access to ear/headphones (assessed via online screening tests). Informed consent was obtained from all participants. Ethical approval was granted from the UCL Research Ethics Committee, in accordance with the declaration of Helsinki (Project ID Number: 1584/003).

5.3.3. Materials

5.3.3.1. ASMR Demographics and Characteristics Questionnaire (ADCQ). This questionnaire built on and adapted the pre-existing ASMR Checklist (Fredborg et al., 2017), as well as drawing on questions and research areas from other ASMR-driven survey research (e.g., Barratt et al., 2017) and adhering to the criteria set out by Hostler et al. (2019) for studies measuring state ASMR via questionnaire measures (frequency and time course of ASMR somatosensation, intensity, somatic distribution, and emotional responses) and was developed as a measure of the demographic and phenomenological characteristics associated with ASMR. In order to accommodate and allow comparisons with the previous examples (and the criteria), the questionnaire consists of a mix of question types including yes/no/DK questions, open questions, multiple choice, and a 5-point 20-item Likert scale (that ranged from 1 = strongly disagree, to 5 = strongly agree, with a neutral option as a midpoint). All included questions can be found below (Appendix B.8.). The reliability and validity of the ADCQ (based on the Likert-based questions specifically) was assessed below (*see* 5.3.5.1.).

5.3.3.2. Misophonia Demographics and Characteristics Questionnaire (MDCQ). Like the ADCQ, this questionnaire built on and adapted pre-existing misophonia questionnaires including the MQ (Wu et al., 2014), the Amsterdam Misophonia Scale (A-MISO-S; Schröder, Vulink & Denys, 2013), MisoQuest (Siepsiak, Śliwerski & Dragan, 2020), and the Duke Misophonia Questionnaire (Rosenthal et al., 2021) as well as trying to match several key areas of interest (e.g., somatic distribution, and stimulus properties [auditory and spatial]) as the ADCQ to enable comparisons. Similarly, this questionnaire was developed as a measure of the demographic and phenomenological characteristics associated with misophonia. As with the ADCQ, to accommodate and allow comparisons with the previous examples, the MCCQ also consists of a mix of question types including yes/no/DK questions, open questions, multiple choice, and two (one 6-item and one 7-item) 5-point Likert scales (that ranged from 1 = strongly disagree, to 5 = strongly agree, with a neutral option as a midpoint). All included questions can be found below (Appendix B.9.). The reliability and validity of the MDCQ (based on the Likert-based questions specifically) was assessed below (*see* 5.3.5.1.).

5.3.3.3. Stimulus Development. Since the survey incorporated a sound stimulation task, the stimuli presented consisted solely of auditory stimuli.

Previous research has alluded to the seemingly more prominent role of audition in both ASMR and misophonic inducing stimuli opposed to other sensory properties such as visuals (*refer to* 2.4.; 2.6.4.). Thus, the sounds presented in this study were recorded by the same individual, on a binaural microphone (Sennheiser AMBEO Smart Binaural microphones). The use of a binaural microphone was in consideration of survey research that reported such a preference among ASMR-sensitive individuals (Barratt et al., 2017), but also to preserve the spatial properties of the sounds recorded since it is possible that an interaction between audition and somatosensation may relate to the ability to localise sound in the space around the head (Koumura et al., 2019), while hosts typically use binaural microphones to record the ASMR media they post online. The stimuli were recorded in a natural, echoic environment, to maintain stimulus realism, another previously reported preference (Barratt et al., 2017; Smith et al., 2017).

These stimuli were then edited on the audio software Audacity (version 3.0.2) to ensure that each audio was around 2min in duration (M = 1.96) which was based on both preferences for stimuli that are short in duration (Barratt et al., 2017) and the finding that the average onset time for ASMR somatosensation is 59.54s with a range of 0-90s (Smith et al., 2017). This was achieved via trimming, looping, combining audio clips, and volume adjustments (both increasing and decreasing). This resulted in a total of 24 audio files: 8 belonging to a category of sounds identified as ASMR-eliciting, 8 to a category of sounds identified as misophonic, and 8 controls.

Previous survey research has reported on and listed the stimuli likely to elicit ASMR (e.g., Barratt & Davis, 2015; Barratt et al., 2017; Fredborg et al., 2017; Kovacevich & Huron, 2019; McErlean & Banissy, 2017; McErlean &

Osborne-Ford, 2020; Poerio et al., 2018; *see also* 2.3.) and misophonia (*see* Cavanna & Seri, 2015; Edelstein et al., 2013; Rouw & Erfanian, 2018; Taylor, 2017; Wu et al., 2014; *see also* 2.6.4.). This, alongside general browsing of ASMR media on online platforms such as YouTube (https://www.youtube.com/) and anecdotal accounts of ASMR and misophonia inducers reported on forums such as Reddit (https://www.reddit.com/), were used to identify appropriate stimuli. It is important to note that some sounds (e.g., orofacial sounds such as chewing), according to the literature (Barratt et al., 2017) and anecdotal accounts, may elicit one or both phenomena and such sounds were included as a means to assess their idiosyncrasy. Control sounds were chosen based on acoustic differences compared to typical ASMR sounds (e.g., typical voiced speech versus whispering) while also acknowledging whether the sounds chosen were distinctly not those reported to trigger misophonia.

Thus, ASMR sounds consisted of whispered speech (reading goldfinch facts), crinkling, hair brushing, keyboard typing, page turning, scissor snipping, finger tapping, and light scraping/scratching. Next, misophonic sounds consisted of metal scraping (on ceramic), nail filing, pen clicking, Velcro, polystyrene (scraping), and a few orofacial sounds including chewing (gum) and two eating/crunching sounds (of crisps and an apple). Finally, control sounds consisted of non-whispered typical speech (goldfinch facts), opening/closing doors/drawers, two instances of ambient noises (outdoor noise recorded at and around a shopping centre), unrolling and ripping wrapping paper, an appliance sound (turning on/off a fan), water sounds (hand washing and toilet flushing), and white noise (generated on Audacity). A brief description of each stimulus is provided in Appendix B.10.

5.3.3.4. Headphone Screening and Binaural Beat Test. The use of ear/headphones is the norm when consuming ASMR media, as recommended by hosts of ASMR content found online and evident in the survey research (e.g., Barratt & Davis, 2015). Also, there is a lack of control when conducting auditory-related research online. Considering this, the application of some kind of screening measure was key, made more of a necessity with the current study being situated online. Hence, the readily available 'Efficient Headphone Screen' (Milne et al., 2020; https://gorilla.sc/openmaterials/100917) was incorporated into the study design. Briefly, this is an online headphone screening test that is based on dichotic pitch whereby participants are presented with three white noise sounds, each separated by a silent gap. Of these, one has a faint hidden tone within it and participants are tasked with correctly identifying the white noise sound with the tone (via checkbox). The efficacy of this screening measure has been demonstrated by Milne et al. (2020), reporting an 80% detection rate of headphone use and false-positive rate of 20%.

They also showed that the efficacy is increased (with the false-positive rate lowering to 7%) when the headphone screening test is accompanied by a binaural beat test (gorilla.sc). Similar to the headphone screening, participants are presented with three tones, each separated by a silent gap. Of these, one has a faint smooth tone within it and participants are tasked with correctly identifying the smooth tone (via checkbox). This too, was included in the design, following the headphone screening.

5.3.4. Task and Procedure

Participants completed an online questionnaire, developed on the survey software Gorilla (gorilla.sc) and hosted via the survey platform Prolific

(prolific.co). The survey was either accessed via users on Prolific or via a link posted on several social media groups. Prior to beginning the task, participants were presented with the study information sheet and informed consent form (*see* Appendix B.1.; B.2.). All participants were at least 18 years of age and provided informed consent (via checkbox). Also, due to the auditory nature of the task, participants then underwent headphone screening (the 'Efficient Headphone Screen'; Milne et al., 2020) and an accompanying binaural beat test. The survey duration was approximately 1hr 20min (*M* = 80min).

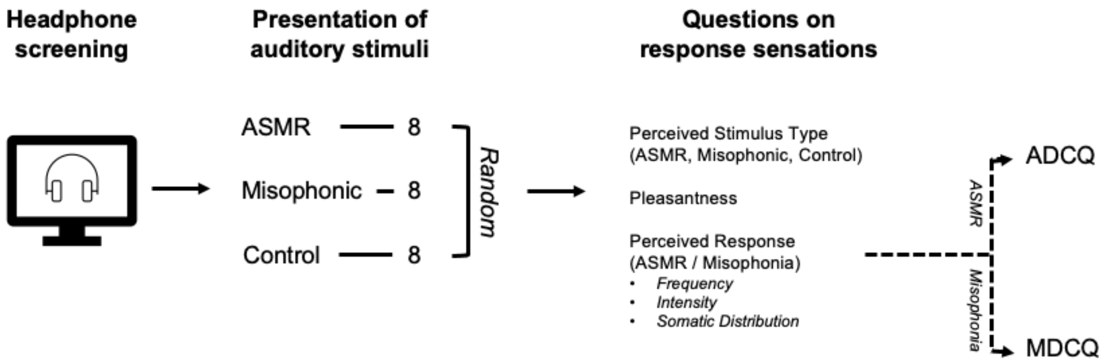
Following this came a description and example of the auditory task to follow to provide participants with a degree of familiarity on what was expected of them. This was succeeded by the complete auditory task which consisted of randomly presenting a total of 24 auditory stimuli consisting of 8 ASMR-eliciting, 8 misophonic and 8 control sounds. Once a participant had listened to the presented audio, they would be prompted to answer a set of questions based on the audio they heard. First was reporting whether they experienced ASMR, misophonia or neither. To note, the descriptions of both phenomena were present at all times (at the top of each screen). Then, there would be questions on the pleasantness of the sound (5-point Likert ranging from very unpleasant to very pleasant with a neither un/pleasant midpoint), and if they experienced the sensations of either ASMR or misophonia in response to the sound presented, the intensity of the response (5-point Likert ranging from 1-5 where 1 = very mild, 5 = very intense), the frequency of ASMR/misophonic sensations (5-point Likert ranging from 1-5 where 1 = none of the time, 5 = all of the time), and the somatic distribution (open-ended). These questions were based on Hostler et al.'s (2019) criteria. This would continue until all the audio clips had been listened to and the questions on each had been completed.

Next, participants were asked a set of background questions (*see* Appendix B.6.). First came demographic information in the form of age and sex. Then, background questions on ASMR: if they themselves believed to have previously experienced ASMR; and if they did, the stimulus they believed to trigger ASMR sensations most (of the following options: whispering, tapping, crinkling/crisp sounds, scratching, brushing, personal attention [roleplays], mouth sounds, other [open]); if there was a stimulus they thought rarely or never triggers their ASMR (of the following options: whispering, tapping, crinkling/crisp sounds, scratching, brushing, personal attention [roleplays], mouth sounds, other [open]); and if they regularly consume ASMR media (to gauge familiarity with the phenomenon). For the questions on misophonia, participants were asked if they themselves believed to have previously experienced it; and if so, the sound or sounds that trigger its occurrence (via comment box); and if there was an ASMR stimulus that triggered their misophonia (via comment box). The remaining questions asked participants if they thought they ever experience synaesthesia (based on a provided description of the phenomenon); and if they would consider themselves to be ‘open to new experiences’. The latter question was based on ASMR-sensitive, synaesthetic and frisson-sensitive participants from previous studies consistently scoring high on the personality trait openness.

If participants responded ‘yes’ (via checkbox) to the question asking if they believed to have previously experienced misophonia, they would be prompted to complete the MDCQ. Similarly, if participants responded ‘yes’ to regularly consuming ASMR media, they would be prompted to complete the ADCQ. If they responded ‘yes’ (via checkbox) to both specific questions, they would be prompted to complete both questionnaires. These two questions essentially screened for sensitivity to ASMR and misophonia. Upon completion, participants were thanked for their time. An illustration of the task is provided in Figure 1.

Figure 1

Illustration of the Study-1 task paradigm



5.3.5. Data Analyses

The current study is a mixed-methods design. All quantitative data analyses were carried out in Microsoft Excel and SPSS (version 27). Since the ADCQ and MDCQ were novel, preliminary statistical analyses were carried out to assess construct validity and internal consistency. Exploratory heatmaps were developed on Microsoft PowerPoint. Qualitative analyses were carried out in Microsoft Excel and transcribed in Microsoft Word.

5.3.5.1. Statistical Assessment of the ADCQ and the MDCQ. Two confirmatory factor analyses (CFA) were carried out as measures to assess the construct validity of both questionnaires (specifically, based on the set of Likert questions from both questionnaires). For the ADCQ, the Kaiser-Meyer-Olkin (KMO) measure (KMO = .506) and Bartlett's test of Sphericity ($p < .001$) indicated that while the data was likely factorizable, the 20-item questionnaire suffered from multi-collinearity due to the fact that the determinant (7.44e-9) was below the recommended value of .000001. Attempting to rectify this via removal of items that were too highly correlated (i.e., > .08) only reduced the KMO such that the data was no longer factorizable. To note, this is all likely a case of the sample size (n = 26) being too small to warrant a CFA though the 20-item Likert ADCQ data should still be approached with caution. Also, Cronbach's alpha was carried out to assess internal consistency, of which revealed poor internal consistency (α = .57) and would require the removal of 10 items (7, 8, 11, 12, 13, 14, 15, 16, 19, 20) to reach a significant alpha level (of .80). Again, this data should be approached with caution.

For the MDCQ, the KMO measure (KMO = .550) and Bartlett's test of Sphericity (p < .0001) indicated the data was likely factorizable and that the determinant (.020) suggested there were no issues of multi-collinearity and that the 13-item questionnaire possesses construct validity. Saying this, when Cronbach's alpha was carried out to assess internal consistency, it, as was the case for the ADCQ, revealed poor internal consistency (α = .43) and would require the removal of all but five items (7, 9, 10, 11, 12) to reach a significant alpha level (of .71). So, this data should also be approached with caution.

5.3.5.2. Demographics. Descriptive statistics were run, followed by a Pearson's bivariate correlation analysis to assess whether the demographic variables of age and sex influenced the dependent variables, (self-reported) ASMR / misophonic -sensitivity (and within this, frequency, intensity, pleasantness). This way, if found to be significant, they would be used as control variables.

Data Analyses – Prevalence Task

To note, the data set used in this set of analyses was comprised solely of participant responses to the questions associated with the prevalence task (pleasantness, intensity, frequency, and somatic distribution).

5.3.5.3. Developing preliminary prevalence rates for ASMR and misophonia. Participant responses on whether they experienced ASMR, misophonia or neither following the presentation of the 24 stimuli were filtered and descriptive statistics of frequency were conducted. Preliminary prevalence rates were then developed based on this. Specifically, this was the percentage of participants who experienced each response on at least one occasion. This was then repeated for those who experienced each response: >5, >10, and >15 times. Thus, this provided the preliminary prevalence rates for these responses and gave insight into how it relates to the number of times the phenomena are experienced.

5.3.5.4. Frequency statistics for ASMR and misophonia responses based on stimulus type. Similar to 5.3.5.3., participant responses on whether they experienced ASMR, misophonia or neither were filtered, this time by stimuli, and descriptive statistics of frequency were performed. Percentages of each response following each stimulus were developed based on this. This was done to determine whether there is a response (ASMR, misophonia, neither) that is predominantly elicited by a specific type of stimulus (ASMR, misophonic, control -sounds) and to the extent to which the stimuli are idiosyncratic (i.e., a stimulus that is able to elicit both phenomena, in this case, ASMR and misophonia) expressly since idiosyncratic relations between ASMR and misophonia have been reported for a specific stimulus in mouth sounds (in general) but could be possible for other stimuli. Upon developing the percentages, a chi square analysis was conducted as a means to test whether the types of stimuli (ASMR, misophonic, and control -sounds) were significantly different in their ability to elicit the response they were meant to elicit (i.e., whether each type of stimulus produced significantly different patterns of responses).

5.3.5.5. Analysing response associations based on post-task Likert data. Typically, the literatures of both ASMR and misophonia attribute the responses with a degree of pleasantness. On the one hand, ASMR is commonly regarded as pleasant, while misophonia is the opposite. This way, ASMR stimuli (in this case, solely ASMR audio) would be deemed as pleasant and misophonic stimuli (again, sounds) as unpleasant. To date, this relationship between the type of response and perceived pleasantness has not been experimentally tested and so, analysing this relationship between the response type (in this case, ASMR or misophonia) and pleasantness score (from the pleasantness Likert scale scores) may either support or reject this theory. Collectively, a Kolmogorov-Smirnov test of normality (Neither: $D(1055)=.328$, $p<.001$; ASMR: $D(641)=.337$, $p<.001$; Misophonia: $D(488)=.298$, $p<.001$) and Levene's test of homogeneity of variance ($F(2,2181)=9.038$, $p<.001$) showed that the data did not meet the assumptions of normal distribution and homogeneity of variance. This meant there was a need to employ non-parametric tests therefore, a Kruskal-Wallis test was applied to analyse the outlined relationship. Moreover, to further examine the association between response type and pleasantness (scores) for specifically both phenomena, Mann-Whitney U tests were also carried out.

Second, similar to pleasantness, neither frequency nor intensity have been the focus of investigation in the literatures of both ASMR and misophonia, meaning that current understandings of these factors separately as well as if or how they are associated is scarce. If in the event that the two (frequency and intensity) are indeed associated, it would likely be in the form of a positive correlation whereby the more ASMR or misophonia is experienced (frequency), the more intense the experiences would be (intensity). Similar to pleasantness, two Kolmogorov-Smirnov tests of normality were run, one on frequency and intensity scores for ASMR (Frequency: D(605)=.185, p<.001; Intensity: D(605)=.170, p<.001) and likewise for misophonia (Frequency: D(469)=.196, p<.001; Intensity: D(469)=.195, p<.001). As was the case for pleasantness, neither frequency nor intensity followed a normal distribution for either response (both ASMR and misophonia) hence the need to employ non-parametric tests. Thus, a Spearman's correlation was used to compare frequency and intensity scores (from the frequency and intensity Likert scale scores, respectively) for both ASMR and misophonia responses.

Third, to explore the relationship between ASMR and misophonia, whether there is a significant correlation between: the number of experiences for each response (per participant, ASMR-misophonia), and the intensity to which they are experienced (per participant, ASMR intensity-misophonia intensity), were tested. For misophonic experiences alone, a Kolmogorov-Smirnov test of normality revealed again that the data was not normally distributed (Misophonia: D(91)=.119, p=.003; ASMR: D(91)=.084, p=.142) hence a non-parametric test in the form of a Spearman's correlation was run to test the outlined relationship. More so, as a confirmatory measure of said relation between ASMR and misophonia, whether the intensity to which each response is felt (using medians) is correlated was explored. Once again, a Kolmogorov-Smirnov test of normality revealed that the intensity data was not normally distributed (ASMR Intensity: $D(78)=.185$, $p<.001$; Misophonia Intensity: $D(78)=.174$, $p<.001$) thus another Spearman's correlation was run (whereby medians versus means were used to test such relationships).

5.3.5.6. Mapping the somatic distribution of ASMR somatosensation and misophonic sensations based on the prevalence task stimuli. In order to map the somatic distribution of both ASMR somatosensation and potentially misophonic (somatosensory) sensations within the entire sample, as one of the post-stimulus questions, participants were asked to report the bodily location(s) in which they experienced either sensation, if at all. This was left open-ended and provided data on the somatic distribution of both sensations for each of the 24 presented stimuli. Similar to previous ASMR research that mapped the somatic distribution of ASMR somatosensation (Barratt & Davis, 2015; Koumura et al., 2019; Swart et al., 2021), the reported areas were collectively mapped onto body map figures (termed 'heatmaps') for both ASMR somatosensation and misophonic sensations. Reported areas were coloured per the frequency to which they were reported (>50, 20-50, 10-20, <10). Also, paired-samples t-tests were run for key body areas (i.e., those with a frequency of >10) for both ASMR somatosensation and misophonic sensations as a means to compare the somatic distribution data for the two responses. To note, since this data consisted of totals (for each body area for each response type), the sample sizes vary per analysis.

Data Analyses – Background Questions

To note, the data set used in this set of analyses was comprised solely of participant responses to the background questions (on ASMR, misophonia, synaesthesia, and openness to experience).

5.3.5.7. Background Questions. Similar to previous research (e.g., Barratt et al., 2017; Barratt & Davis, 2015), descriptive statistics of frequency were conducted on the background questions data (on the yes/no/DK / unsure, multiple choice, and open question responses). Specifically, these frequency statistics were transformed into percentages as a means to enable comparisons with prior findings.

Data Analyses – ADCQ and MDCQ

To note, since the participant screening measures for ASMR and misophonia employed in the present study was based on responses to two questions within the background questions (ASMR: answering yes to regular engagement in ASMR media; misophonia: answering yes to having previously experienced misophonia), two subsets made up the ASMR-sensitive (n = 26) and misophonic (n = 84) samples of the present study and all subsequent analyses of ADCQ and MDCQ data was specifically based on these subsets.

5.3.5.8. Aspects of the ADCQ. Similar to previous research (e.g., Barratt et al., 2017; Barratt & Davis, 2015), descriptive statistics of frequency were conducted on the ADCQ data (on the yes/no/NA, multiple choice, open, and Likert-based question responses). Specifically, these frequency statistics were transformed into percentages as a means to enable comparisons with prior findings as well as providing novel information surrounding response demographics and phenomenological characteristics which could be pursued in future. Thus, such results were categorised into groups based on the area of which they typically come under (based on the previous literature). The set of yes/no/DK, multiple choice, and open questions were grouped in this way (referred to as ADCQ question set 1, *see* Appendix B.11), and separately, the 20-item ADCQ Likert scale questions were also grouped in this way (referred to as ADCQ question set 2, *see* Appendix B.12).

5.3.5.9. Aspects of the MDCQ. Likewise with 5.3.5.8., descriptive statistics of frequency were conducted on the MDCQ data (on the yes/no/NA, multiple choice, open, and Likert-based question responses). Specifically, these frequency statistics were transformed into percentages as a means to enable comparisons with prior findings as well as providing novel information surrounding response demographics and phenomenological characteristics which could be pursued in future. Again, like 5.3.5.8., such results were categorised into groups based on the area of which they typically come under (based on the previous literature). The set of yes/no/DK, multiple choice, and open questions were grouped in this way (referred to as MDCQ question set 1, *see* Appendix B.13), and separately, the MDCQ 13-item Likert scale questions were also grouped in this way (referred to as MDCQ question set 2, *see* Appendix B.14).

5.3.5.10. Mapping the somatic distribution of ASMR somatosensation in ASMR-sensitive participants based on the ADCQ. As outlined in 5.3.5.6., in order to define the somatic distribution of one of the (arguably the primary) sensations characteristic of the phenomenon, ASMR somatosensation, sensitive participants were asked to report the bodily location in which the touch sensation of ASMR typically originates, whether it consistently originated in the reported area, if the sensation spread to another area(s) and report the area(s) (if so), and whether the sensation spread with intensity (i.e., the more intense the ASMR stimulus becomes, the more it spreads). Similar to previous research (Barratt & Davis, 2015; Koumura et al., 2019; Swart et al., 2021), the reported areas as a collective were mapped onto heatmaps. Specific to the current study, the areas of origin and spread were mapped. Reported areas of origin were each pinpointed while areas of spread were coloured per the frequency to which they were reported (>5 or 5/<5). To note, because only a subset of the sample was deemed to be ASMR-sensitive (via self-report) (n = 26), the illustrated heatmaps were based on these participants alone.

5.3.5.11. Mapping the somatic distribution of misophonic sensations in misophonic participants based on the MDCQ. Similar to ASMR somatosensation, to define the somatic distribution of misophonic (somatosensory) sensations, participants were asked if they experienced bodily sensations in response to misophonic stimulation, to report the bodily location in which any such misophonic sensations typically originates, and if the sensation spread to another area(s) and report the area(s) if it did spread. As was the case with 5.3.5.10., the reported areas were also mapped onto body map figures and again, specific to the current study, the areas of origin and spread were mapped. Likewise, reported areas of origin were each pinpointed while areas of spread were coloured per the frequency to which they were reported (>5 or 5/<5). The illustrated heatmaps were based solely on the subset of the sample that was deemed to be misophonic (via self-report) (n = 84).

5.3.5.12. Thematic analyses of the ADCQ and MDCQ. Due to the inclusion of several open-ended questions within both the ADCQ and MDCQ as well as giving participants the chance to discuss their experiences of both ASMR and misophonia (via singular comment boxes), two thematic analyses (TA) was conducted to provide insight into particular topics within these two phenomena and the general experiences and thoughts of individuals sensitive to them.

5.4. Results

5.4.1. Demographics

The Pearson's bivariate correlation revealed that the two demographic variables of age and sex did not significantly influence the number of ASMR or misophonic responses. Consequently, they were not used as control variables (Table 1).

Table 1

Demographic characteristics and correlations with ASMR and misophonic sensitivity (N = 91)

Demographic Characteristic	Participants (N = 91)	Correlation with ASMR (*p*)	Correlation with Misophonia (*p*)
Age (years)		.250	.820
M (*SD*)	28.18 (10.18)		
Range	18-68		
Sex		.523	.119
Male	55 (60.40%)		
Female	32 (35.20%)		
Non-binary	3 (3.30%)		
Transgender	1 (1.10%)		

Note. For Sex, counts are presented with percentages in parentheses.

Results – Prevalence

5.4.2. Prevalence – Developing Preliminary Prevalence Rates for ASMR and Misophonia

The descriptive statistics of frequency revealed that 89.01% of the entire sample (N = 91) reported experiencing ASMR on at least one occasion, while 94.51% reported experiencing misophonia on at least one occasion. When taken further by specifically using those who reported experiencing each phenomenon more often, reductions were prevalent for both responses, reductions in which were greater the more often participants reported experiencing each phenomenon. For ASMR, 58.24% experienced the phenomenon >5 times, 25.27% >10 times, and 7.69% >15 times. A similar downward trend was present for misophonia with 45.05% experiencing the phenomenon >5 times, 10.99% >10 times, and 1.10% >15 times.

5.4.3. Prevalence – Frequencies for ASMR and Misophonia Responses based on Stimulus Type

The descriptive statistics of frequency revealed that each of the 24 stimuli were idiosyncratic in that they were found to elicit either response in at least one participant. The frequency of reports on each stimulus is provided in Table 2 (*and illustrated in* Appendix C.3.). More so, a chi square analysis revealed that the observed frequencies of each response differed significantly from the expected frequencies, depending on the type of stimulus (χ^2 (4, 91) = 278.480, p < .001). ASMR responses were more frequent than expected for ASMR-eliciting stimuli while misophonic or neither -responses were less frequent for ASMR-eliciting stimuli. The same was true for misophonic responses for misophonic stimuli, and neither -responses for control stimuli.

Table 2

Preliminary prevalence rates of each response for each of the 24 stimuli (N = 91)

Stimuli	Prevalence (%)		
	ASMR	Misophonia	Control
ASMR Stimuli			
Whispered Speech	68.13%	12.09%	19.78%
Crinkling	38.46%	15.38%	46.15%
Hair Brushing	45.05%	7.69%	47.25%
Keyboard Typing	34.07%	4.40%	61.54%
Page Turning	27.47%	21.98%	50.55%
Scissor Snipping	41.76%	19.78%	38.46%
Tapping	48.35%	10.99%	40.66%
Light Scraping/Scratching	36.26%	17.58%	46.15%
Misophonic Stimuli			
Metal Scraping	4.40%	62.64%	32.97%
Nail Filing	31.87%	28.57%	39.56%
Pen Clicking	35.16%	6.59%	58.24%
Velcro	18.68%	29.67%	51.65%
Polystyrene Scraping	6.59%	73.63%	19.78%
Chewing (gum)	16.48%	47.25%	36.26%

Eating/Crunching (crisps)	17.58%	34.07%	48.35%
Eating/Crunching (apple)	23.08%	45.05%	31.87%
Control Stimuli			
Non-Whispered Speech	31.87%	3.30%	64.84%
Opening doors/drawers etc.	13.19%	26.37%	60.44%
Ambient Noises 1	26.37%	9.89%	63.74%
Ambient Noises 2	26.37%	4.40%	69.23%
Wrapping Paper	26.37%	19.78%	53.85%
Appliance Sound	35.16%	8.79%	56.04%
Water Sounds	26.37%	14.29%	59.34%
White Noise	25.27%	12.09%	62.64%

5.4.4. Response Associations

5.4.4.1. Response–Pleasantness. The Kruskal-Wallis test revealed a significant effect of response type on pleasantness scores ($H(2) = 1320.292$, $p < .001$). Taken further, for ASMR, the Mann-Whitney U test revealed that pleasantness scores were significantly higher (even post Bonferroni correction) for ASMR responses (Mdn = 4) than for no response (Mdn = 3) ($U = 93849$, $z = -26.804$, $p < .001$). In stark contrast, for misophonia, the Mann-Whitney U test revealed that pleasantness scores were significantly lower (again, even post Bonferroni correction) for misophonia responses (Mdn = 2), compared to no response (Mdn = 3) ($U = 56958.5$, $z = -26.242$, $p < .001$).

5.4.4.2. Frequency–Intensity. For ASMR, the Spearman's correlation revealed a significant positive correlation between frequency and intensity scores when experiencing ASMR (r_s (605) = .608, $p < .001$). A similar trend was found for misophonia whereby the Spearman's correlation revealed a significant positive correlation between frequency and intensity scores when experiencing misophonia (r_s (469) = .625, $p < .001$) (*see* Figures 2-3.).

5.4.4.3. ASMR–Misophonia. Regarding the number of experiences of each response (ASMR and misophonia), the Spearman's correlation revealed no significant relationship between the number of times ASMR was experienced and the number of times misophonia was experienced (r_s (91) = .014, $p = .892$ n.s.). In contrast, regarding the intensity in which the responses were reportedly felt, the Spearman's correlation revealed a weak but significant relationship between ASMR and misophonia median intensity scores (r_s (78) = .339, $p = .002$) (*see* Figures 4-5.).

Figure 2

Relationship between the ASMR frequency scores and ASMR intensity scores

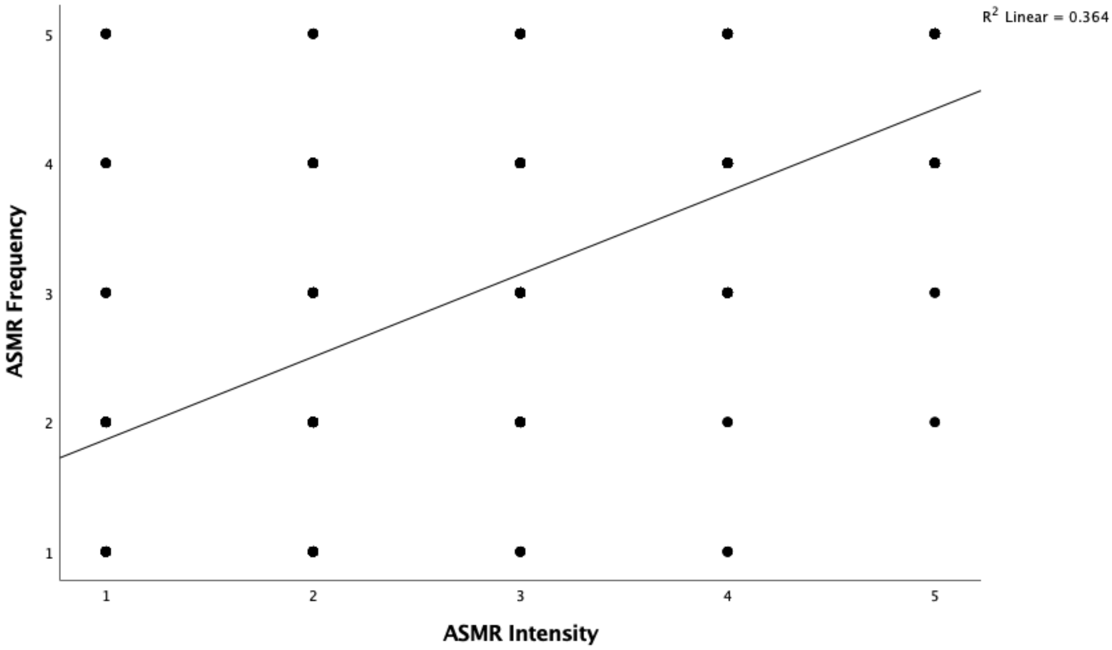


Figure 3

Relationship between the misophonia frequency scores and misophonia intensity scores

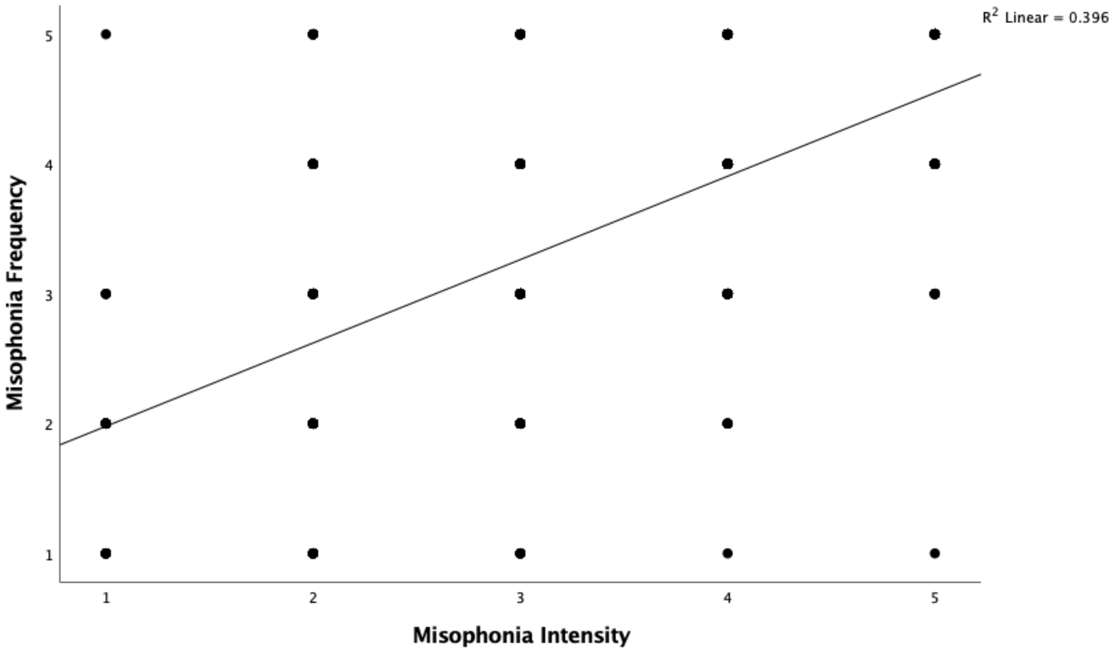


Figure 4

Relationship between the number of times ASMR was experienced (ASMR count) and the number of times misophonia was experienced (misophonia count)

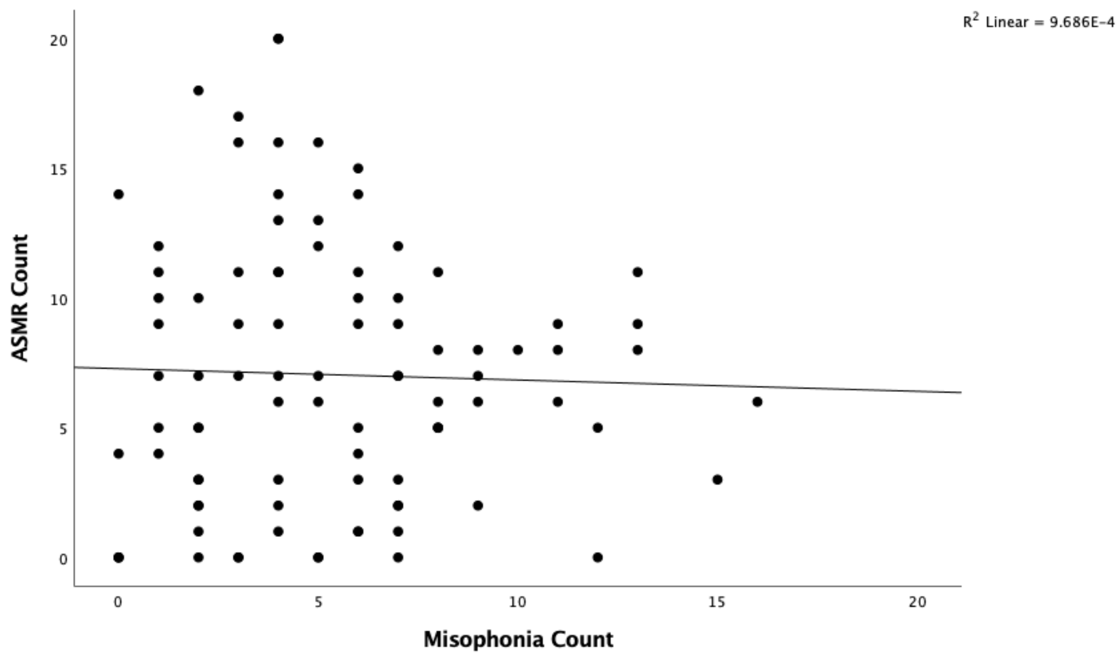
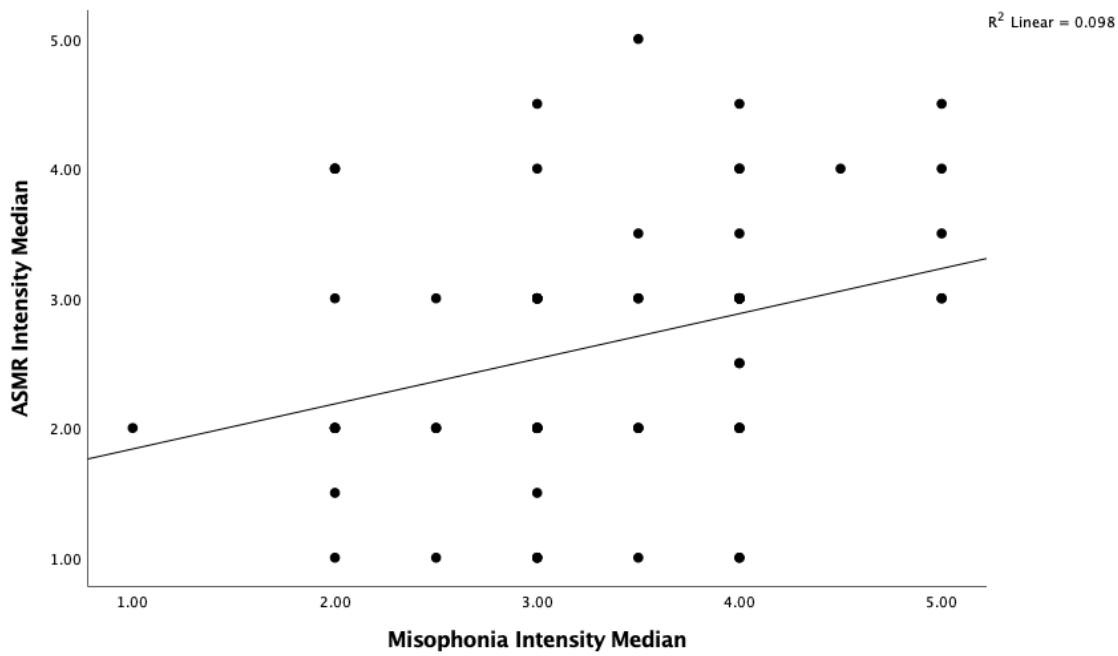


Figure 5

Relationship between the ASMR intensity scores (medians) and the misophonia intensity scores (medians)



5.4.5. Prevalence – Mapping the Somatic Distribution of ASMR Somatosensation and misophonic sensations on Heatmaps

Of the entire sample (N = 91), for the collective 24 presented stimuli, participants self-reported experiencing both ASMR somatosensation and misophonic sensations in several bodily regions. To note, since the question was open-ended, participants were able to report more than one response (in this case, body regions). For ASMR, the head (as a collective), neck/nape, shoulders, back, spine, and arms were the most frequent. For misophonia, the head (as a collective), neck/nape, shoulders, back, chest, and arms were the most frequent. The frequency of reports on each bodily area is provided in Table 3. An illustration of the areas reported by the entire sample is provided in Figure 6 (ASMR somatosensation) and Figure 7 (misophonic sensations).

Regarding these key areas, paired-samples t-tests enabled comparison between the somatic distribution findings for the two responses (ASMR/misophonia). For example, for the scalp, the mean was higher for ASMR ($M=1.0$, $SD=.001$) than misophonia ($M=.27$, $SD=.447$). The difference in means (difference = .730) was statistically significant, $t(62) = 12.952$, $p=.001$. Also, for the teeth, the mean was higher for misophonia ($M=1.0$, $SD=.001$) than ASMR ($M=.04$, $SD=.209$). The difference in means (difference = -.957) was statistically significant, $t(22) = -22.001$, $p=.001$. The remaining t-tests and accompanying heatmaps can be found in Appendix C.5.

Table 3

Reported areas for ASMR somatosensation and misophonic sensations in the entire sample based on the presented stimuli as a collective (N = 91)

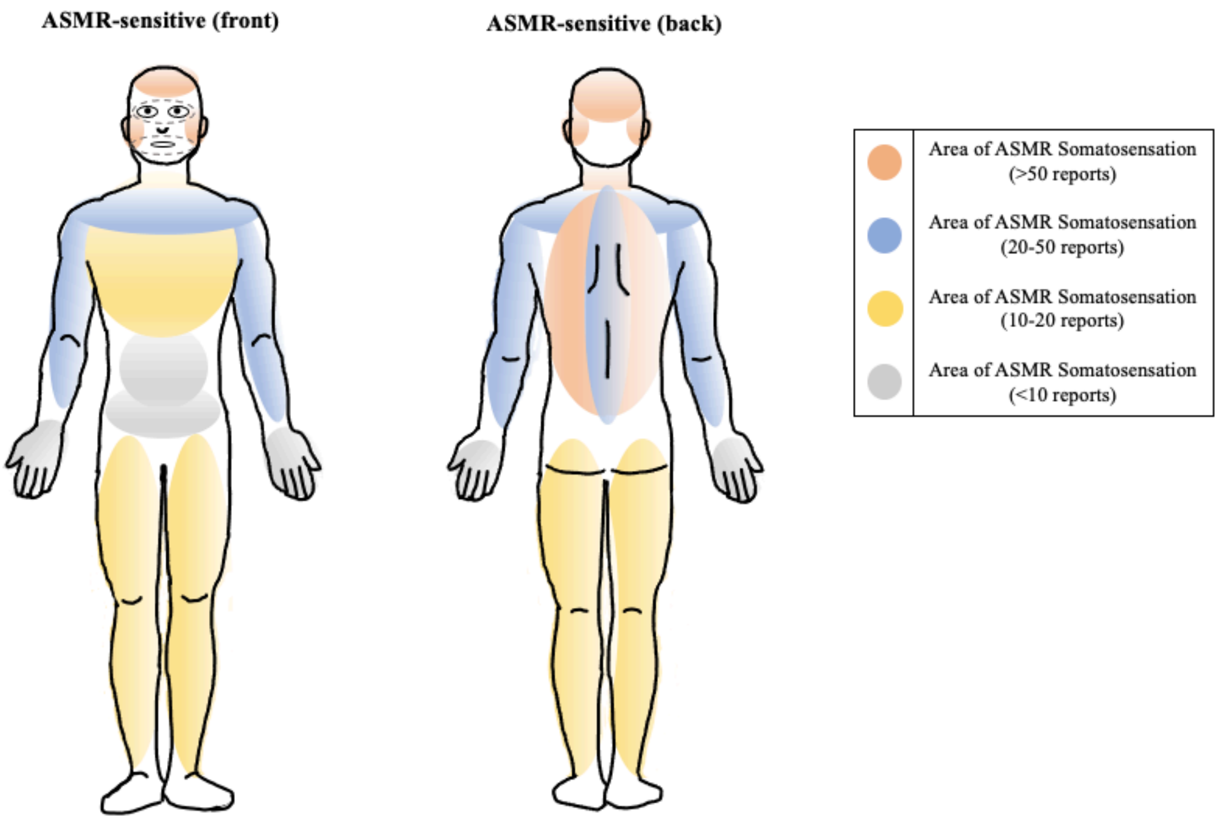
ASMR Somatosensation Body Area	Frequency (%)	Misophonic Sensation Body Area	Frequency (%)
Head (general)		Head (general)	
Head	75 (11.70%)	Head	55 (12.27%)
Scalp/Skull/Brain	63 (9.82%)	Scalp/Skull/Brain	17 (3.79%)
Face	8 (1.24%)	Face	12 (2.67%)
Eyes	2 (.31%)	Eyes	13 (2.90%)
Ears	126 (19.65%)	Ears	70 (15.62%)
Mouth (general)	4 (.62%)	Mouth (general)	11 (2.45%)
Mouth (teeth)	1 (.15%)	Mouth (teeth)	23 (5.13%)
Mouth (jaws)	5 (.78%)	Mouth (gums)	2 (.44%)
Neck/Nape	158 (24.64%)	Mouth (jaws)	12 (2.67%)
Shoulders	32 (4.99%)	Neck/Nape	75 (16.74%)
Back	57 (8.89%)	Throat	8 (1.78%)
Spine	21 (3.27%)	Shoulders	22 (4.91%)
Chest	15 (.31%)	Back	29 (6.47%)
Stomach/Gut/Abd.	2 (.31%)	Spine	10 (2.23%)
Pelvis	2 (.31%)	Chest	20 (4.46%)
Limbs		Stomach/Gut/Abd.	14 (3.12%)
Arms	39 (6.04%)	Pelvis	1 (.22%)
Hands	2 (.31%)	Limbs	
Fingers	3 (.46%)	Arms	24 (5.35%)

Legs	11 (1.71%)	Hands	4 (.89%)
		Fingers	1 (.22%)
		Legs	2 (.44%)
		Feet	1 (.22%)
		Toes	1 (.22%)

Note. Frequency refers to the number of times each body area was reported by the entire sample, and the percentages of these frequencies are reported in parentheses. These frequencies were based on total participant responses for each response (ASMR = 641; misophonia = 488) rather than the sample (since this resulted in responses over 100%).

Figure 6

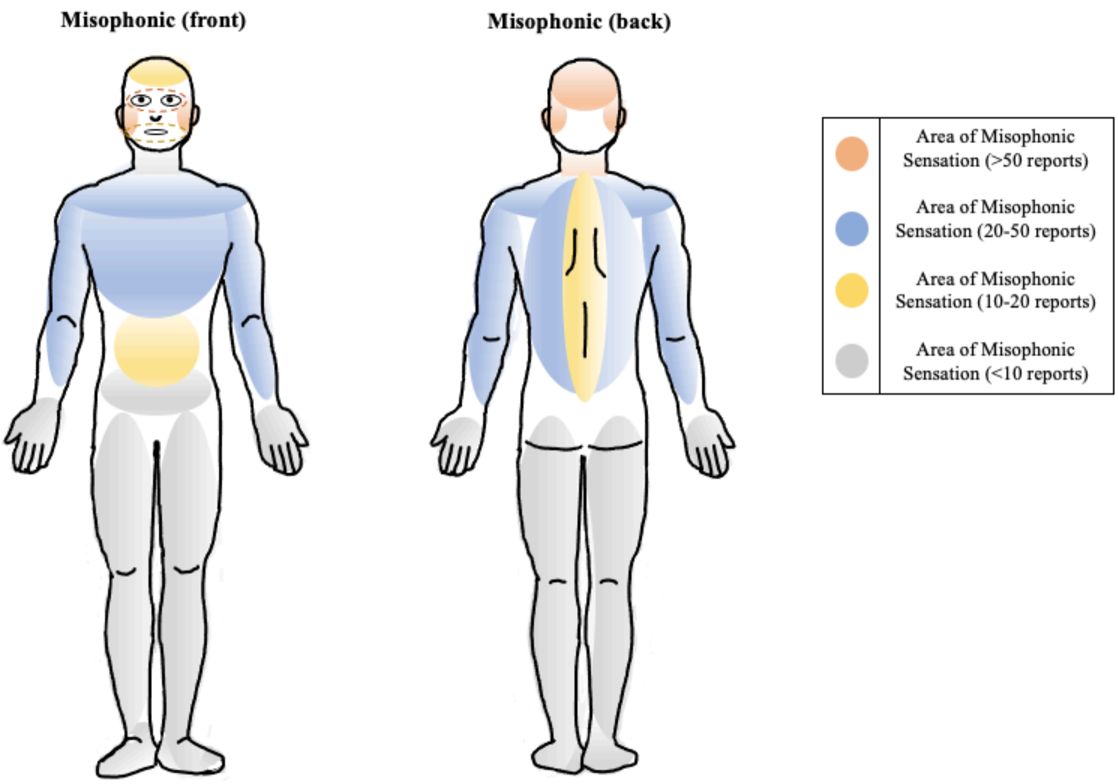
Mapping the somatic distribution of ASMR somatosensation in the whole sample



Note. An illustration of ASMR somatosensation (from both the front and back). The pale, transparent areas of differing colours represent the areas in which the sample as a whole reported to experience ASMR somatosensation from the presented 24 stimuli as a collective. Specifically, pale transparent orange areas represent those that had been reported more than 50 times; pale transparent blue areas for those reported between 20-50 times; pale transparent yellow areas for those reported between 10-20 times; and pale transparent grey areas and grey dashed outlines for those reported less than 10 times.

Figure 7

Mapping the somatic distribution of misophonic sensations in the whole sample



Note. An illustration of misophonic sensations (from both the front and back). The pale, transparent areas of differing colours represent the areas in which the sample as a whole reported to experience misophonic sensations from the presented 24 stimuli as a collective. Specifically, pale transparent orange areas and orange dashed outlines represent those that had been reported more than 50 times; pale transparent blue areas for those reported between 20-50 times; pale transparent yellow areas and yellow dashed outlines for those reported between 10-20 times; and pale transparent grey areas for those reported less than 10 times.

Results – Background Questions

Analysis of responses found that, of the entire sample (N = 91), 83.52% of participants (n = 76) self-reported as ASMR-sensitive (compared to 13.19% who reported as non-sensitive, and 3.30% who were unsure). Of this ASMR-sensitive subset, whispered speech (78.95%) and tapping (47.36%) were the most frequently reported ASMR-eliciting stimuli, while scratching and 'other' (a participant's own response) were the joint lowest. To note, the 'other' category consisted of naturalistic sounds, ambient noises, white noise, water sounds, typing, and page turning. Moreover, mouth sounds (52.63%) and crinkling/crisp sounds (46.05%) were the most frequently reported ASMR-eliciting stimuli to rarely/never elicit ASMR, while 'other' (a participant's own response) was the lowest. Again, to note, the 'other' category consisted of fast talking/scripted speech, and chewing. Further, despite the vast majority of the sample self-reporting as ASMR-sensitive, only 28.57% (n = 26) reported regular engagement in ASMR media (compared to 69.23% who disagreed, and 2.20% who were unsure). The frequency of reports on each stimulus is provided in Table 4.

Similarly, analysis of responses found that, of the entire sample (N = 91), 92.31% of participants (n = 84) self-reported as misophonic (compared to 7.69% who reported as non-sensitive). Of this misophonic subset, scratching/scraping (in general) (65.47%) and mouth sounds (in general) (54.76%) were the most frequently reported misophonia-eliciting stimuli. Also, 43.96% of this misophonic subset (n = 40) agreed that there were ASMR stimuli that triggered their misophonia (compared to 29.69% who disagreed, and 25.27% who were unsure). Mouth sounds (in general) and scratching/scraping (in general) were the most frequent, 70% and 32.50% respectively. The frequency of reports on each stimulus is provided in Table 5.

Last, of the entire sample (N = 91), only 25.27 self-reported as experiencing synaesthesia (compared to 52.75% who reported as non-synaesthetic, and 21.98% who were unsure), while a majority 94.51% (n = 86) self-reported as being open to new experiences (compared to 3.30% who reported as not being open to new experiences, and 2.20% who were unsure).

Table 4

ASMR stimuli reported to be most eliciting and rarely or never eliciting in the ASMR-sensitive sample (n = 76)

ASMR Stimulus (most eliciting)	Frequency (%)	ASMR Stimulus (rarely/never elicits)	Frequency (%)
Whispered Speech	60 (78.95%)	Mouth Sounds	40 (52.63%)
Tapping	36 (47.36%)	Crinkling/Crisp Sounds	35 (46.05%)
Brushing	29 (38.15%)	Scratching	34 (44.73%)
Personal Attention	24 (31.58%)	Tapping	24 (31.57%)
Mouth Sounds	21 (27.63%)	Brushing	24 (31.58%)
Crinkling/Crisp Sounds	15 (19.73%)	Personal Attention	22 (28.94%)
Scratching	12 (15.79%)	Whispered Speech	15 (19.73%)
Other	12 (15.79%)	Other	2 (2.63%)

Note. Stimuli in columns 1 and 3 are placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each ASMR stimulus was reported by the ASMR-sensitive sample and the percentages of these frequencies are reported in parentheses.

Table 5

Misophonia stimuli reported to be most eliciting and ASMR stimuli reported to elicit in the misophonic sample (n = 84)

Misophonic Stimulus – most eliciting (n = 84*)	Frequency (%)	ASMR Stimulus – elicits misophonia (n = 40**)	Frequency (%)
Scratching/Scraping (general)	55 (65.47%)	Mouth Sounds (general)	28 (70%)
Mouth Sounds (general)	46 (54.76%)	Scratching/Scraping (general)	13 (32.50%)
Polystyrene/Styrofoam	7 (8.33%)	Whispered Speech	6 (15%)
Screeching/Screaming/ Squeaking	7 (8.33%)	Tapping	3 (7.5%)
Whispered Speech	4 (4.76%)	Brushing	1 (2.5%)
Tapping	3 (3.57%)	Crinkling	1 (2.5%)
Rubbing	3 (3.57%)	Page Turning	1 (2.5%)
Ripping	3 (3.57%)	Breathing	1 (2.5%)
Loud Sounds (general)	3 (3.57%)		
High-pitched Sounds (general)	3 (3.57%)		

Ambient Noises (general)	3 (3.57%)
Brushing	2 (2.38%)
Breathing	2 (2.38%)
Animal Noises	2 (2.38%)
Repetition of a sound	2 (2.38%)
Page Turning	1 (1.19%)
Clicking	1 (1.19%)
Ticking	1 (1.19%)
Grinding	1 (1.19%)
Velcro	1 (1.19%)
Sniffing	1 (1.19%)
Snoring	1 (1.19%)
Opening/Closing Doors	1 (1.19%)
>1 person talking at once	1 (1.19%)

Note. Stimuli in columns 1 and 3 are placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each misophonic stimulus (column-1) and ASMR stimulus (column-3) was reported by the misophonic sample, and the percentages of these frequencies are reported in parentheses.

*Sample from the total misophonic sample who reported on misophonic stimuli (n = 84).

** Sample from the total misophonic sample who reported on ASMR stimuli that triggers their misophonia (n = 40).

Results – ADCQ

To reiterate, since the method of screening for ASMR-sensitivity employed was answering ‘yes’ to a background question on regular engagement in ASMR media, only the subset of participants who responded as such were prompted with the ADCQ and can therefore be considered the ASMR-sensitive sample within this study. All relevant analyses of the ADCQ data, therefore, is based on this subset of 26 participants. Also worth noting, since the ADCQ had multiple open-ended question, participants were able to report more than one response for these.

5.4.6. Aspects of the ADCQ

ADCQ Question Set 1.

5.4.6.1. Demographics and viewing habits. The average age in which participants (N= 26) discovered ASMR was 19.92 (SD = 7.54). In terms of viewing habits, based on the frequency statistics, participants varied in the number of days they engage in ASMR media per week (M = 4.15; SD = 1.98), as well as in the number of ASMR media engaged in per session of watching/listening to ASMR content (M = 2.48; SD = 1.23). More participants reported optimal duration of single ASMR media that was >10min long (11-20min = 30.77%; 21+min = 38.46%) compared to content that lasts under 10min (1-5min = 19.23%; 6-10min = 11.54%). As for the optimal number of ASMR stimuli (‘triggers’) per single ASMR media, this varied: 1 trigger (11.54%), 2 triggers (32.62%), 3 triggers (30.77%), and 4+ triggers (23.08%). The most frequent time of day for engaging in ASMR media was at night (prior to sleep), with 88.46% of participants reporting as such, while 11.53% reported they tended to engage in ASMR media during midday/afternoon, 3.84% during the day, and 11.53% while working/studying (in general). Following a similar trajectory, more than half the sample reported engaging in ASMR media while working, studying or similar (53.85%). Specifically, when those who agreed were asked to specify the accompanying task/activity, most reported engaging in ASMR media while working (23.07%) or studying (23.07%) in general, though others included leisure (reading: 7.69%; gaming: 3.84%) and therapeutic gain (relaxation/sleep: 15.38%; therapeutic in general: 7.69%).

5.4.6.2. ASMR somatosensation onset, frequency, and duration. The most frequent onset time of ASMR somatosensation to occur (into engagement in ASMR media) was 1-5min, with 46.15% of participants reporting as such, while 38.46% reported 0-1min, 15.38% reported 6-10min, and no participants reported either 10-20min or 20+min. Also, based on a scale of 1-5 (where the numbers indicated the frequency of ASMR somatosensation experienced), the frequency to which participants experience ASMR somatosensation (M = 3.31; SD = .88) varied: 1 (no responses), 2 (19.23%), 3 (38.46%), 4 (34.62%), and 5 (7.69%). As for the approximate duration of ASMR somatosensation, 30sec-1min and <10sec were the most frequently reported durations (each with 30.76%), while ‘other’ (a participant’s own response) was the least frequent. To note, the ‘other’ category consisted of two reports of ASMR somatosensation lasting the entire course of a stimulus, and another reporting seconds to tens of minutes. The frequency of reports on the duration of ASMR somatosensation can be found in Table 6.

Table 6

Reported duration of ASMR somatosensation from engaging in ASMR media (n = 26)

Duration of ASMR Somatosensation	Frequency (%)
>1min-3mins	2 (7.69%)
30sec-1min	8 (30.76%)
10sec-30sec	5 (19.23%)
<10sec	8 (30.76%)
Other	3 (11.53%)

Note. Frequency refers to the number of times each timeframe was reported by the ASMR-sensitive sample and the percentages of these frequencies are reported in parentheses.

5.4.6.3. Somatic distribution and frequency. When participants were asked about the bodily region(s) in which ASMR somatosensation originated, around the head (as a collective), neck, and the back/spine were the most frequent responses. More so, most of the sample (88.46%) agreed that ASMR somatosensation consistently originated in the reported area(s). Also, almost the entire sample (96.15%) agreed that ASMR somatosensation spread to other areas, the most frequently reported areas of spread being the head (as a collective), neck/nape, back, spine, and limbs (as a collective). When those who agreed that ASMR somatosensation spread, were asked to specify whether it spread with intensity, most agreed (84.62%). For more information and a table detailing the areas of origin and spread (and the frequencies per area), refer to 5.4.7. below.

5.4.6.4. ASMR outside. When participants were asked if they had previously experienced ASMR outside (i.e., ASMR in the real world compared to that elicited from ASMR media), most agreed (88.46%). Specifically, when those who agreed were asked to specify the stimulus that triggered their ASMR outside, whispered speech (30.43%) and observation (30.43%) were highest. Also, ambient noises, physical touch, music/film, hair (e.g., having one's hair touched or watching someone else touch/play with theirs or someone else's hair), mouth sounds, and naturalistic sounds were each reported on more than one occasion. The frequency of reports on each stimulus is provided in Table 7.

Table 7

Stimuli reported to elicit ASMR outside of ASMR media (n = 23)

ASMR Stimulus – Outside	Frequency (%)
Whispered Speech	7 (30.43%)
Watching/Listening to Others	7 (30.43%)
Ambient Noises	6 (26.08%)
Object Sounds	4 (17.39%)
Physical Touch	4 (17.39%)
Music/Film	4 (17.39%)
Hair (general)	3 (13.04%)
Mouth Sounds (general)	2 (8.69%)
Naturalistic Sounds	2 (8.69%)
Appliance Sounds	1 (4.34%)
Animal Noises	1 (4.34%)
Personal Attention	1 (4.34%)
Self-induced ASMR	1 (4.34%)

Note. Stimuli in column-1 is placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times stimulus was reported by the ASMR-sensitive sample who reported experiencing ASMR outside of ASMR media and the percentages of these frequencies are reported in parentheses.

5.4.6.5. Pleasure. When participants were asked how pleasurable they found ASMR experiences (based on a scale of 5-point Likert where 1 = very unpleasurable, 5 = very pleasurable, and 3 as a neutral midpoint), more than half the sample reported ASMR experiences as very pleasurable (65.38%), while

30.77% reported ASMR experiences as pleasurable, and surprisingly 3.85% as unpleasurable (*M* = 4.58; *SD* = .70).

5.4.6.6. Emotion. When participants were asked if they had experienced emotion(s) from engagement in ASMR media, more than half the sample agreed (69.23%). Specifically, when those who agreed were asked to specify the emotion(s) they felt, only two key emotions were reported, relaxation/calmness (88.88%) and happiness (27.77%).

ADCQ Question Set 2.

5.4.6.7. ASMR sensations. As part of the question responses from the 20-item Likert section of the ADCQ, almost the entire sample agreed that they experienced ASMR somatosensation from engaging in ASMR media, more than half of which strongly agreed (57.69%). The same could be said for experiencing relaxation from engaging in ASMR media and again, more than half the sample strongly agreed (73.07%). As for whether ASMR somatosensation originates in the same area(s), most participants agreed, this time, with the majority opting specifically for the ‘agree’ option (61.53%). Similarly, when probed on whether ASMR somatosensation spread with intensity, the majority agreed. The findings relevant to ASMR somatosensation are consistent with that of the prior questions on the somatic distribution of ASMR somatosensation from both the ADCQ (question set 1) and the prevalence task. The frequency of reports on each question grouped under this category (‘ASMR sensations’) is provided in Table 8.

Table 8

Responses to questions in the category 'ASMR sensations' of ADCQ question set 2 (n = 26)

	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)
Experiencing Somatosensation	0 (0%)	0 (0%)	1 (3.84%)	10 (38.46%)	15 (57.69%)
Experiencing Relaxation	0 (0%)	0 (0%)	1 (3.84%)	6 (23.07%)	19 (73.07%)
Somatosensation originates in the same area	0 (0%)	3 (11.53%)	3 (11.53%)	16 (61.53%)	4 (15.38%)
Somatosensation spreads with intensity	0 (0%)	2 (7.69%)	2 (7.69%)	10 (38.46%)	12 (46.15%)

Note. The exact worded questions can be found in items 1-2 and 19-20 in the Likert-based questions in Appendix B.8.

5.4.6.8. Sensory properties of ASMR stimuli. As part of the question responses from the 20-item Likert section of the ADCQ, when asked about whether the type of ASMR media (auditory, visual, and audiovisual) intensifies ASMR sensations, participant responses were mixed for auditory; more than half disagreed that visual stimuli intensify ASMR sensations, with 57.69% disagreeing; but the majority agreed that audiovisual stimuli do intensify ASMR sensations, with 53.84% strongly agreeing. More so, half the sample (50%) strongly agreed that the visual aspect in seeing where a sound originates is as important in experiencing ASMR as hearing the auditory aspect (i.e., the sound itself). For another visual aspect in whether directed attention of an ASMR host intensifies ASMR experiences, half the sample (50%) agreed it does. As for whether a proximal spatial location intensifies ASMR experiences, the majority of the sample agreed, with specifically 46.15% strongly agreeing with this concept. Further, when asked about the pitch of ASMR stimuli (sounds), the majority of the sample agreed that pitch can influence the intensity in which ASMR is experienced (42.30%), while whether lower or higher pitched ASMR intensify ASMR experiences received mixed responses. Last, when asked whether participants feel connected to an ASMR host while engaging in ASMR media, the majority of the sample agreed that they did (42.30%). The frequency of reports on each question grouped under this category (‘ASMR sensations’) is provided in Table 9.

Table 9

Responses to questions in the category 'Sensory properties of ASMR stimuli' of ADCQ question set 2 (n = 26)

	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)
Response sensations intensify from audio only ASMR stimuli	2 (7.69%)	10 (38.46%)	9 (34.61%)	2 (7.69%)	3 (11.53%)
Response sensations intensify from visual only ASMR stimuli	4 (15.38%)	15 (57.69%)	6 (23.07%)	1 (3.84%)	0 (0%)
Response sensations intensify from audiovisual ASMR stimuli	0 (0%)	0 (0%)	2 (7.69%)	14 (53.84%)	10 (38.46%)
Visuals are as important as audio in experiencing response sensations	1 (3.84%)	5 (19.23%)	3 (11.53%)	4 (15.38%)	13 (50%)

Response sensations intensify from proximal ASMR stimuli	0 (0%)	1 (3.84%)	2 (7.69%)	11 (42.30%)	12 (46.15%)
Pitch of ASMR stimuli affect the level of intensity	0 (0%)	5 (19.23%)	4 (15.38%)	11 (42.30%)	6 (23.07%)
Response sensations intensify from lower pitched sounds	1 (3.84%)	8 (30.76%)	7 (26.92%)	7 (26.92%)	3 (11.53%)
Response sensations intensify from higher pitched sounds	4 (15.38%)	7 (26.92%)	9 (34.61%)	5 (19.23%)	1 (3.84%)
Response sensations intensify from directed attention	2 (7.69%)	1 (3.84%)	7 (26.92%)	13 (50%)	3 (11.53%)
Feeling connected to the ASMR host	1 (3.84%)	6 (23.07%)	8 (30.76%)	11 (42.30%)	0 (0%)

Note. The exact worded questions can be found in items 3-10 and 17-18 in the Likert-based questions in Appendix B.8.

5.4.6.9. Equipment. As part of the question responses from the 20-item Likert section of the ADCQ, when asked about preferences for how ASMR stimuli are recorded, most participants reported that they regularly engage in binaurally recorded ASMR media, with 46.15% strongly agreeing; responses were more mixed for whether binaurally recorded ASMR media is seen as more effective in triggering ASMR than regularly recorded ASMR media (though more participants agreed as a collective than disagreed); and similar to this, responses were more mixed for whether binaurally recorded ASMR media intensify ASMR experiences (but again more participants agreed as a collective than disagreed). Also, when asked about ear/headphone usage, the majority of the sample agreed to wearing ear/headphones while engaging in ASMR media, with specifically 57.69% strongly agreeing; while the same applied to whether wearing ear/headphones while engaging in ASMR media is more effective in triggering ASMR experiences than not wearing them, with more than half the sample strongly agreeing with this concept (65.38%); and also applied to whether wearing ear/headphones intensify ASMR experiences, with more than half the sample strongly agreeing with this concept (61.53%). The frequency of reports on each question grouped under this category (‘Equipment’) is provided in Table 10.

Table 10

Responses to questions in the category 'Equipment' of ADCQ question set 2 (n = 26)

	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)
Regular engagement in binaural ASMR media	0 (0%)	3 (11.53%)	3 (11.53%)	8 (30.76%)	12 (46.15%)
Binaural ASMR media is more effective in eliciting ASMR	0 (0%)	3 (11.53%)	7 (26.92%)	7 (26.92%)	9 (34.61%)
Response sensations intensify from binaural ASMR media	0 (0%)	3 (11.53%)	7 (26.92%)	8 (30.76%)	8 (30.76%)
Wearing ear/ headphones while engaging in ASMR media	0 (0%)	1 (3.84%)	2 (7.69%)	8 (30.76%)	15 (57.69%)

Wearing ear/ headphones is more effective in eliciting ASMR	0 (0%)	1 (3.84%)	0 (0%)	8 (30.76%)	17 (65.38%)
Response sensations intensify from wearing ear/ headphones	0 (0%)	1 (3.84%)	1 (3.84%)	8 (30.76%)	16 (61.53%)

Note. The exact worded questions can be found in items 11-16 in the Likert-based questions in Appendix B.8.

5.4.7. ADCQ – Mapping the Somatic Distribution of ASMR Somatosensation on Heatmaps

The current ASMR-sensitive sample (n = 26) reported previously experiencing ASMR somatosensation. Specifically, that the experience of ASMR somatosensation originated mainly around the head (as a collective), neck/nape, and the back/spine but also in other areas including the shoulders, chest, and arms. To note, most participants (69.23%) reported more than one area of origin, implying that ASMR somatosensation originated in more than one bodily area. For the vast majority of this sample (88.46%), ASMR somatosensation consistently originated in the reported area versus those who disagreed (7.69%) or were unsure (3.85%). Moreover, ASMR somatosensation was reported to spread to other bodily areas by almost the entire sample (96.15% versus 3.85% who were unsure) and seemingly followed a downwards trajectory. The main areas in which the sensation spread included the head (as a collective), neck/nape, back, spine, and limbs (as a collective). Further, most participants agreed that their ASMR somatosensation spreads with intensity (84.62%) opposed to those who disagreed (11.54%) or were unsure (3.85%). The frequency of reports on each bodily area is provided in Table 11. An illustration of the areas of origin and spread reported by this ASMR-sensitive sample is provided in Figure 8.

Table 11

Reported areas of origin and spread for ASMR somatosensation in the ASMR-sensitive sample (n = 26)

Body Area – Origin (n = 26*)	Frequency (%)	Body Area – Spread (n = 25**)	Frequency (%)
Head (general)		Head (general)	
Head	10 (38.46%)	Head	6 (24%)
Scalp/Skull/Brain	8 (30.76%)	Scalp/Skull/Brain	2 (8%)
Face	1 (3.84%)	Ears	3 (12%)
Ears	6 (23.07%)	Neck/Nape	11 (44%)
Neck/Nape	13 (50%)	Shoulders	4 (16%)
Shoulders	2 (7.69%)	Back	10 (40%)
Back	5 (19.23%)	Spine	6 (24%)
Spine	2 (7.69%)	Chest	1 (4%)
Chest	1 (3.84%)	Stomach/Gut/Abd.	1 (4%)
Limbs		Limbs	
Arms	3 (11.53%)	Arms	12 (48%)
		Hands	1 (4%)
		Fingers	1 (4%)

	Legs	5 (20%)

Note. Frequency refers to the number of times each body area was reported by the ASMR-sensitive sample and the percentages of these frequencies are reported in parentheses.

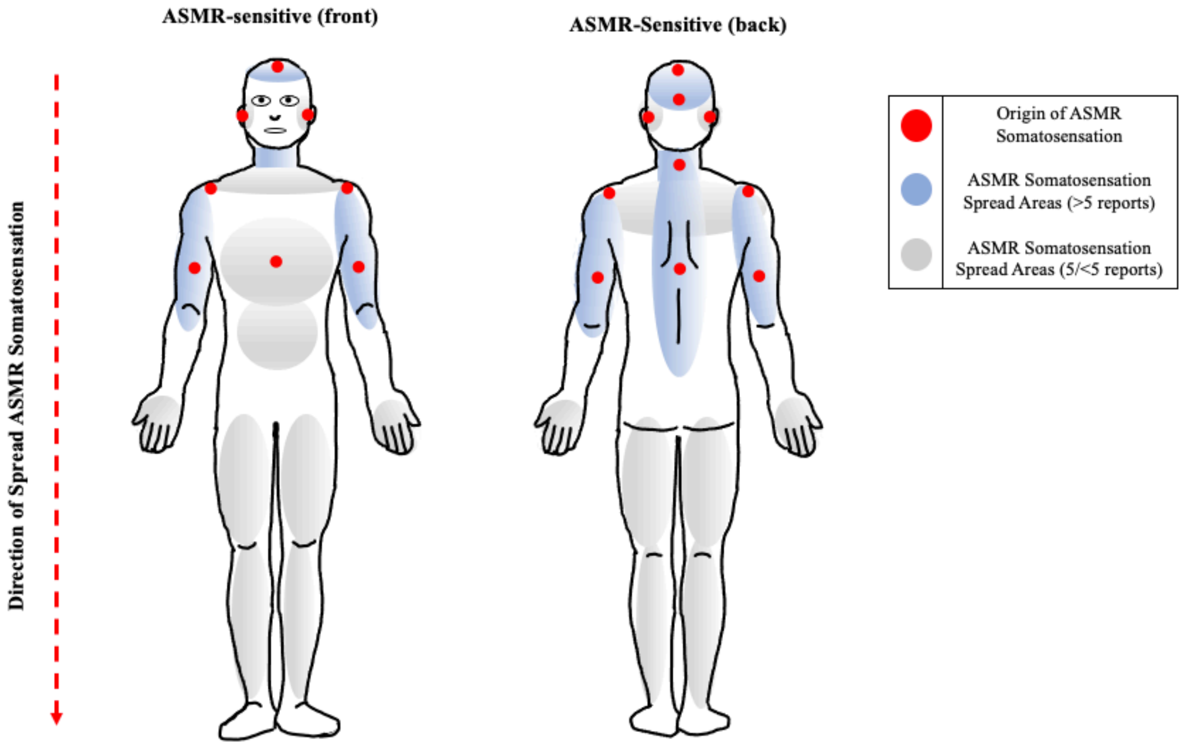
*Sample from the total ASMR-sensitive sample who reported on originating areas (n = 26).

** Sample from the total ASMR-sensitive sample who reported on the spread (n = 25).

Abd. = abdomen.

Figure 8

Mapping the somatic distribution of ASMR somatosensation of an ASMR-sensitive sample



Note. An illustration of ASMR somatosensation (from both the front and back). Red dots represent the areas in which ASMR somatosensation was reported to originate, while the pale, transparent areas represent the spread of ASMR somatosensation to other parts of the body. Specifically, pale transparent blue areas represent those that had been reported more than 5 times by the sensitive sample, while the pale transparent grey areas represent those that had been reported 5 times or less by the sensitive sample. ASMR somatosensation spread in a downwards fashion (represented by the red dashed line), and with spread with intensity. Although this diagram illustrates several singular points of origin, due to the individualistic nature of the phenomenon, it was necessary to include all reported points of origin.

5.4.8. ADCQ – Thematic Analysis

Seven primary themes were identified: age of onset and being unaware of a descriptive term and that others also experienced ASMR (1); accompanying movement (2); habituation (3); bilingualism (4); therapeutic utility (5); effect of medication (6); task limitations/improvements (7). Appendix C.1. lists the identified themes, the codes associated with these themes, a description explaining the codes and/or the themes, and example quotes taken from the many open-ended questions within the ADCQ.

Results – MDCQ

To reiterate, since the method of screening for sensitivity to misophonia employed was answering ‘yes’ to a background question on having previously experienced misophonia, only the subset of participants who responded as such were prompted with the MDCQ and can therefore be considered the misophonic sample within this study. All relevant analyses of the MDCQ data, therefore, is based on this subset of 84 participants. Also worth noting, since the MDCQ had multiple open-ended question, participants were able to report more than one response for these.

5.4.9. Aspects of the MDCQ

MDCQ question set 1 – categories.

5.4.9.1. Misophonic source, aversion, non-avoidance, and time. When participants were asked about the general source of their misophonia (of the following options: yourself, other people, animals, inanimate objects, or other), more than half the sample reported others (76.19%) and inanimate objects (65.47%) as the most frequent, while ‘other’ (a participant’s own response) was the least frequent. To note, the ‘other’ category was repetitive music. The frequency of reports on each stimulus is provided in Table 12. Also, when asked if participants had a specific person, animal, object, or action that triggered their misophonia, only 64.28% of the sample responded, with scraping being reported by half the sample (50%), while other specific triggering stimuli included mouth sounds, animals, polystyrene/Styrofoam (rubbing), humans (in general but also family), and a range of other stimuli (e.g., whispered speech, ambient noises, repetitive sounds). Again, the frequency of reports on each stimulus is provided in Table 13. Moreover, more than half the sample agreed that they feel aversion to sources of misophonic sounds (86.90%). Further, when participants were asked what they believe would be a consequence of being unable to avoid misophonic sounds, anger/rage was the most frequent response (32.14%), though several different 'consequences' were reported ranging from negative emotions, psychological and physical effects, as well as coping and habituation. Again, the frequency of reports on each (categorised) consequence is provided in Table 14. Last, half the sample (50%) reported never spending any time thinking about misophonic sounds (though just under half, 47.62%, reported thinking about misophonia 'a little' per day).

Table 12

Stimuli reported to be the source of participant's misophonia (n = 84)

Misophonic Stimulus	Frequency (%)
Other people	64 (76.19%)
Inanimate Objects	55 (65.47%)
Animals	10 (11.90%)
Yourself	3 (3.57%)
Other	1 (1.19%)

Note. Stimuli in column-1 is placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each categorised stimulus was reported by the misophonic sample who reported experiencing misophonia and the percentages of these frequencies are reported in parentheses.

Table 13

Specific stimuli reported to be the source of participant's misophonia (n = 54)

Misophonic Stimulus	Frequency (%)
Scraping	27 (50%)
Mouth Sounds	17 (31.48%)
Other	12 (22.22%)
Animals	6 (11.11%)
Polystyrene/Styrofoam	6 (11.11%)
Humans	
Family	5 (9.25%)
People (in general)	3 (5.55%)

Note. Stimuli in column-1 is placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each categorised stimulus was reported by the misophonic sample who reported experiencing misophonia and the percentages of these frequencies are reported in parentheses.

Table 14

Reported consequences of being unable to avoid misophonic sounds (n = 84)

Consequence	Frequency (%)
Anger/Rage	27 (32.14%)
Annoyance/Irritation	17 (20.23%)
Stress/Anxiety	14 (16.66%)
Coping	12 (14.28%)
Lack of Focus/Concentration	11 (13.09%)
Discomfort	11 (13.09%)
Crying	5 (5.95%)
Habituation	5 (5.95%)
Physical Pain	4 (4.76%)
Feeling Sick	1 (1.19%)
Muscle Tension	1 (1.19%)
Disgust	1 (1.19%)

Note. Stimuli in column-1 is placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each categorised consequence of being unable to avoid misophonic sounds was reported by the misophonic sample who reported experiencing misophonia and the percentages of these frequencies are reported in parentheses.

5.4.9.2. Somatic distribution of misophonic sensations. When participants were asked whether they experienced bodily sensations in response to misophonic stimulation, the majority of the sample agreed (70.24%). Of those who agreed, 63.09% reported the bodily region(s) in which they had experienced misophonic sensations in response to misophonic stimulation. In particular, the head (as a collective) and the neck/nape were the most frequent responses. Referring back to the 70.24%, 66.66% specified the sensation(s) felt during misophonic episodes, with involuntary movements (in general) as the most frequent. Also, of this sample, 39.06% agreed that their misophonic sensation(s) spread to other regions, the most frequently reported areas of spread being the head (as a collective), neck/nape, back, chest, and limbs (as a collective). For more information and tables detailing the areas of origin and spread (and the frequencies per area), and the specified sensations felt (and the frequencies per sensation felt), refer to 5.4.10. below.

5.4.9.3. Physical responses to misophonia. When participants were asked if they had experienced a physical response(s) from hearing a misophonic sound, a greater number of participants agreed (46.63%). Specifically, when those who agreed were asked to specify the physical response(s) they experienced, several were reported, with increased heart rate (28.20%) as the most frequent. Others included involuntary movements (in general) including shaking, shivering, trembling, twitching, and wincing, voluntary movements (in general) including cringing, clenching, itching, and teeth grinding, muscle tension, changes in breathing and body temperature, anxiety, feeling sick, physical pain (jaws hurting) and others. The frequency of reports on each (categorised) physical response is provided in Table 15.

Table 15

Reported physical responses in response to participant's misophonia (n = 39)

Physical Response	Frequency (%)
Increased Heart Rate	11 (28.20%)
Involuntary Movements (general)	10 (25.64%)
Voluntary Movements (general)	9 (23.07%)
Muscle Tension	7 (17.94%)
Changes in Breathing	7 (17.94%)
Anxiety	5 (12.82%)
Feeling Sick	2 (5.12%)
Other	2 (5.12%)
Physical Pain	1 (2.56%)
Changes in Body Temperature	1 (2.56%)

Note. Stimuli in column-1 is placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each categorised physical response was reported by the misophonic sample who reported experiencing misophonia and the percentages of these frequencies are reported in parentheses.

5.4.9.4. Emotion. When participants were asked if they had experienced emotion(s) from hearing a misophonic sound, the majority of the sample agreed (90.48%). Specifically, when those who agreed were asked to specify the emotion(s) they felt, several emotions were reported, with anger/rage (48.68%)

and annoyance/irritation (44.73%) being the most frequent, while others including discomfort, disgust, stress/anxiety, fear and feeling trapped were also each reported on more than one occasion. The frequency of reports on each (categorised) emotion is provided in Table 16.

Table 16

Reported emotions associated with misophonic sounds (n = 76)

Associated Emotion	Frequency (%)
Anger/Rage	37 (48.68%)
Annoyance/Irritation	34 (44.73%)
Discomfort	17 (22.36%)
Disgust	16 (21.05%)
Stress/Anxiety	13 (17.10%)
Fear	12 (15.78%)
Feeling Trapped	2 (2.63%)

Note. Stimuli in column-1 is placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each categorised emotion was reported by the misophonic sample who reported experiencing misophonia and the percentages of these frequencies are reported in parentheses.

MDCQ question set 2 – categories.

5.4.9.5. Sensory properties of misophonic stimuli. As part of the question responses from the 13-item Likert section of the MDCQ, when asked about the pitch of misophonic sounds, most participants agreed that the pitch of misophonic sounds affects the intensity of misophonia experienced, with the majority opting specifically for the ‘agree’ option (61.53%). Also, the majority of the sample disagreed that lower pitched sounds intensify misophonia (53.57%), while responses were mixed for higher pitched sounds but leaned more towards the agree end of the scale (30.95% agree; 38.10% strongly agree). More so, when asked about the spatial distance to which misophonic sounds are heard, most participants agreed that the distance from a sound influences the extent to which it is perceived as misophonic, with the majority opting specifically for the ‘agree’ option (48.81%). Also, most of the sample agreed that proximal misophonic sounds intensify misophonia, with more than half strongly agreeing (51.19%), while the opposite was true for distal misophonic sounds, with the majority opting for the ‘disagree’ option (46.43%). The frequency of reports on each question grouped under this category (‘Sensory properties of misophonic stimuli’) is provided in Table 17.

Table 17

Responses to questions in the category 'Sensory properties of misophonic stimuli' of MDCQ question set 2 (n = 84)

	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)
Pitch of misophonic sounds affect the level of intensity	3 (3.57%)	8 (9.52%)	11 (13.10%)	32 (40.48%)	28 (33.33%)
Response sensations intensify from lower pitched sounds	14 (16.67%)	45 (53.57%)	19 (22.62%)	6 (7.14%)	0 (0%)
Response sensations intensify from higher pitched sounds	3 (3.57%)	9 (10.71%)	14 (16.67%)	26 (30.95%)	32 (38.10%)
Spatial distance from misophonic sounds affect their perceived level of misophonia	2 (2.38%)	7 (8.33%)	7 (8.33%)	41 (48.81%)	27 (32.14%)

Response sensations intensify from proximal misophonic sounds	1 (1.19%)	0 (0%)	3 (3.57%)	37 (44.05%)	43 (51.19%)
Response sensations intensify from distal misophonic sounds	26 (30.95%)	39 (46.43%)	13 (15.48%)	5 (5.95%)	1 (1.19%)

Note. The exact worded questions can be found in items 1-6 of the first set of Likert-based questions in Appendix B.9.

5.4.9.6. Coping mechanisms for misophonia. As part of the question responses from the 13-item Likert section of the MDCQ, when asked about specific known methods of coping with misophonia, the majority of participants agreed with feeling the need to vacate a room when a misophonic stimulus is present, with half the sample (50%) opting for the 'agree' option. This was the case for both using other sounds to drown out the misophonic sounds (agree: 40.48%) and using alternative methods of drowning out misophonic sounds (agree: 41.67%) however, the method of avoiding certain activities/people to avoid risk of exposure to misophonic sounds was generally quite mixed. Also, when asked whether participants thought their reactions to misophonic sounds could be exaggerated, responses were mixed but leaned more towards the agree end of the scale (38.10% agree; 11.90% strongly agree). The same was true when participants were asked if misophonic sounds interfered with their social and/or work functioning (30.95% agree; 17.86% strongly agree), and when participants were asked if they felt that they have control over their misophonia (34.52% agree; 14.29% strongly agree). The frequency of reports on each question grouped under this category (‘Coping mechanisms for misophonia’) is provided in Table 18.

Table 18

Responses to questions in the category ‘Coping mechanisms for misophonia’ of MDCQ question set 2 (n = 84)

	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)
Exiting in the presence of a misophonic sound	2 (2.38%)	7 (8.33%)	7 (8.33%)	42 (50%)	26 (30.95%)
Reactions to misophonic sounds can be exaggerated	1 (1.19%)	25 (29.96%)	16 (19.05%)	32 (38.10%)	10 (11.90%)
Avoiding activities /people to lessen risk of exposure to misophonic stimuli	12 (14.29%)	29 (34.52%)	14 (16.67%)	21 (25%)	8 (9.52%)

Using other sounds to drown out misophonic sounds	3 (3.57%)	19 (22.62%)	12 (14.29%)	34 (40.48%)	16 (19.05%)
Using alternative methods to drown out misophonic sounds	3 (3.57%)	15 (17.86%)	6 (7.14%)	35 (41.67%)	25 (29.96%)
Misophonic sounds can interfere with social/work functioning	11 (13.10%)	21 (25%)	11 (13.10%)	26 (30.95%)	15 (17.86%)
Feeling control over misophonia	5 (5.95%)	19 (22.62%)	19 (22.62%)	29 (34.52%)	12 (14.29%)

Note. The exact worded questions can be found in items 1-7 of the second set of Likert-based questions in Appendix B.9.

5.4.10. MDCQ – Mapping the Somatic Distribution of Misophonic Sensations on Heatmaps

Of the current misophonic sample (n = 84), 70.24% (n = 59) agreed that they experienced bodily sensations in response to misophonic stimulation compared to those who disagreed (23.81%) or were unsure (5.95%). Of the 59 participants, 63.09% (n = 53) reported the bodily region(s) in which they had previously experienced misophonic sensations in response to misophonic stimulation. Specifically, misophonic sensations originated mainly around the head (as a collective), neck/nape, back/spine, as well as the arms but also in other areas including the throat, shoulders, chest, stomach/gut/abdomen, hands, and fingers. Notably, unlike the collective origin of ASMR somatosensation around the head and limbs and their vicinities, the origin of misophonic sensations around these regions were a lot more specific, while other unreported areas came up (e.g., the throat). Similar to ADCQ responses, most participants (62.26%) reported more than one area of origin, implying that misophonic sensations originated in more than one bodily area. Briefly referring back to the 70.24%, 66.66% specified the actual sensation(s) felt, with involuntary movements (in general) as the most frequent. The frequency of reports on each (categorised) specified sensation(s) is provided in Table 19. Moreover, misophonic sensations were reported to spread to other bodily areas by under half the sample (39.06%) and seemingly followed a downwards trajectory. The main areas in which the sensation spread included the head (as a collective), neck/nape, back, chest, and limbs (as a collective). The frequency of reports on each bodily area (both origin and spread) is provided in Table 20. An illustration of the areas of origin and spread reported by this misophonic sample is provided in Figure 9.

Table 19

Specified body sensations in response to participant's misophonia (n = 56)

Specified Body Sensation	Frequency (%)
Involuntary Movements (general)	23 (41.07%)
Muscle Tension	12 (21.42%)
Physical Pain (general)	11 (19.64%)
Feeling Trapped	8 (14.28%)
Other	8 (14.28%)
Feeling Sick	7 (12.5%)
Stress/Anxiety	5 (8.92%)
Changes in Body Temperature	2 (3.57%)
Voluntary Movements (general)	1 (1.78%)

Note. Stimuli in column-1 is placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each categorised specific body sensation was reported by the misophonic sample who reported experiencing misophonia and the percentages of these frequencies are reported in parentheses.

Table 20

Reported areas of origin and spread for misophonic sensations in the misophonic sample (n = 84)

Body Area – Origin (n = 53*)	Frequency (%)	Body Area – Spread (n = 24**)	Frequency (%)
Head (general)		Head (general)	
Head	15 (28.30%)	Head	2 (8.33%)
Scalp/Skull/Brain	5 (9.43%)	Scalp/Skull/Brain	4 (16.66%)
Face	2 (3.77%)	Ears	1 (4.16%)
Eyes	3 (5.66%)	Neck/Nape	6 (25%)
Ears	13 (24.52%)	Shoulders	2 (8.33%)
Mouth (general)	2 (3.77%)	Back	5 (20.83%)
Mouth (teeth)	4 (7.54%)	Chest	5 (20.83%)
Jaw	6 (11.32%)	Stomach/Gut/Abd.	1 (4.16%)
Neck/Nape	18 (33.96%)	Limbs	
Throat	3 (5.66%)	Arms	7 (29.16%)
Shoulders	3 (5.66%)	Hands	1 (4.16%)
Back	6 (11.32%)	Fingers	1 (4.16%)
Spine	1 (1.88%)	Legs	4 (16.66%)
Chest	4 (7.54%)		
Stomach/Gut/Abd.	4 (7.54%)		
Limbs			
Arms	5 (9.43%)		
Hands	1 (1.88%)		
Fingers	1 (1.88%)		

Note. Frequency refers to the number of times each body area was reported by the misophonic sample, and the percentages of these frequencies are reported in parentheses.

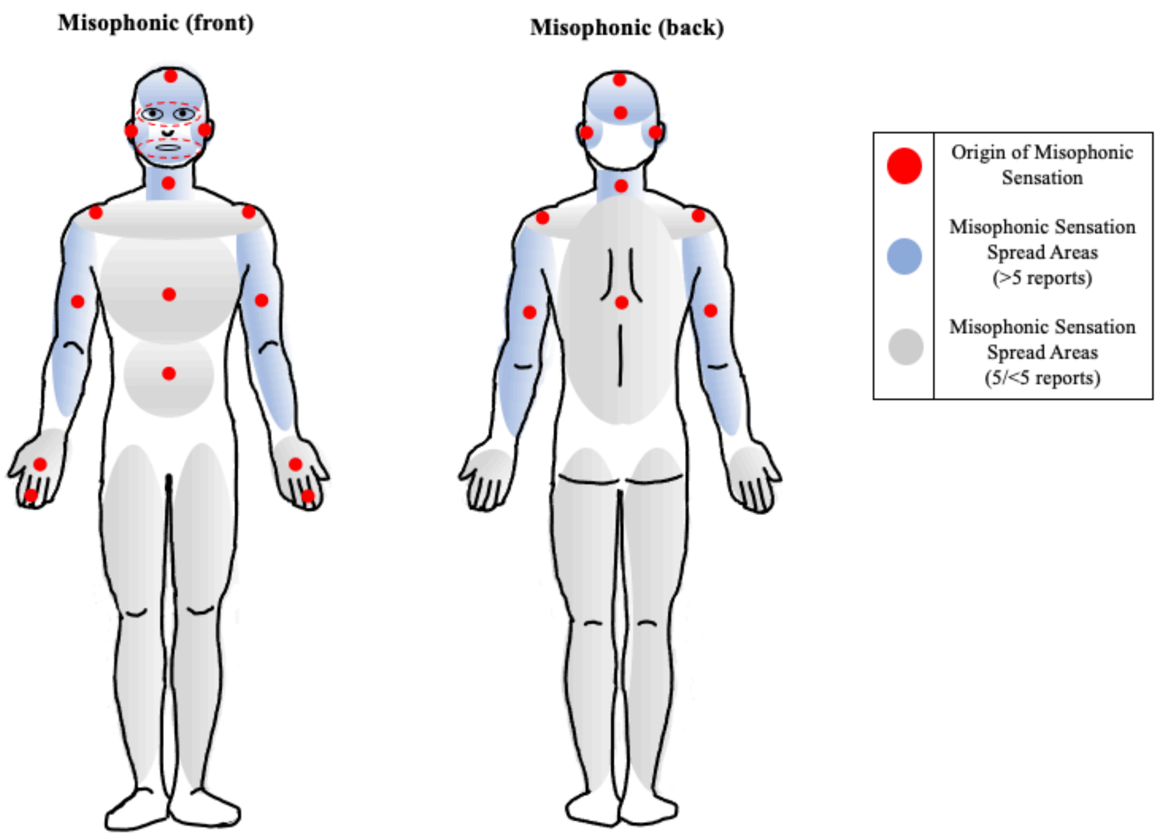
*Sample from the total misophonic sample (n = 53) who reported on originating areas.

** Sample from the total misophonic sample (n = 24) who reported on the spread.

Abd. = abdomen.

Figure 9

Mapping the somatic distribution of misophonic sensations of an misophonic sample.



Note. An illustration of misophonic sensations (from both the front and back). Red dots and the red dashed outlines represent the areas in which misophonic sensations were reported to originate, while the pale, transparent areas represent the spread of misophonic sensations to other parts of the body. Specifically, pale transparent blue areas represent those that had been reported more than 5 times by the sensitive sample, while the pale transparent grey areas represent those that had been reported 5 times or less by the sensitive sample. Misophonic sensations spread in a downwards fashion. Although this diagram illustrates several singular points of origin, similar to ASMR, due to the individualistic nature of misophonia, it was necessary to include all reported points of origin.

5.4.11. MDCQ – Thematic Analysis

Eight primary themes were identified: coping mechanism (1); association with other perceptual phenomena (2); heightened misophonia (3); feeling trapped (4); effect on life (5); effect of other factors (6); being unaware of a descriptive term and that others also experienced misophonia (7); and misophonic stimulation (8). Appendix C.2. lists the identified themes, the codes associated with these themes, a description explaining the codes and/or the themes, and example quotes taken from the many open-ended questions within the MDCQ.

5.5. Discussion

The current study sought to investigate the prevalence and somatic distribution of ASMR and misophonic sensations, the typical phenomenological characteristics of both phenomena, and the potential similarities and differences between ASMR and misophonia. A survey with a design that implemented a prevalence task as well as behavioural questionnaires on both ASMR and misophonia was employed to explore this.

5.5.1. Preliminary Prevalence Rates for ASMR and Misophonia

To date, this study was the second to investigate the prevalence rate of ASMR in the general population, and one of a more recent minority to do so for misophonia (e.g., Kılıç et al., 2021; Naylor et al., 2021; Siepsiak, Sobczak et al., 2020; Wu et al., 2014; Zhou et al., 2017). As hypothesised, the results revealed high prevalence rates for both ASMR (89.01%) and misophonia (94.51%) within the current sample. This led to the suggestion, thus, that both phenomena may be relatively prevalent in the wider population and the inference of possible response universality.

For ASMR, the high prevalence rate is consistent with a previous suggestion that the response would be high in the general population (McErlean & Banissy, 2018) and seemingly refutes del Campo and Kehle (2016) who assumed the opposite. As previously noted, the frequency of ASMR media situated online (*refer to* 2.2.) and in marketing and advertisement (Baek et al., 2018; Bode, 2019; Chae et al., 2021; Spence, 2020) may have influenced a potential rise in ASMR-sensitivity or perhaps even led to the discovery of pre-existing sensitivity within individuals and this may account for the high prevalence rate of ASMR reported in the current sample. Similarly, Koumura et al. (2019) showed preliminary evidence for ASMR-insensitive individuals being able to experience ASMR somatosensation and whose somatic distribution mostly matched that of a previous ASMR-sensitive sample (Barratt & Davis, 2015).

However, the reported prevalence is inconsistent with an existing suggestion of an ASMR prevalence rate within the general population of 20% (Poerio et al., 2022b). This approximation was based on the researchers' findings on the prevalence rate of synaesthesia in ASMR, one in which used preliminary ASMR screening protocol. Arguably, the present sample is not representative of the general population. This is in consideration of a recruitment strategy that targeted ASMR-sensitive populations to ensure the ADCQ was completed by at least, a portion of the sample. This way, the results and implications of the present prevalence rate findings should be taken very lightly.

If, via replications, the prevalence rate of ASMR is consistent with the currently reported 89.01%, or even the approximate 20% reported by Poerio et al. (2022b), ASMR researchers may need to start questioning the recruitment of control samples whereby the dichotomy of ASMR-sensitive and insensitive may be somewhat obsolete. One area of investigation where this has been more prevalent is within the neuroimaging studies of ASMR which typically report differences in structural and functional connectivity between ASMR-sensitive individuals and insensitive controls (*refer to* 3.1.1.; 3.1.2.). If, however, ASMR is more of a universal phenomenon, one may cast doubt on the reliability of such group differences which, for instance, may instead be a result of individual differences in ASMR-sensitivity and/or level of engagement in ASMR media.

This leads to the suggestion of developing some kind of spectrum of ASMR-sensitivity, perhaps not unlike Barratt and Davis' (2015) concept that

ASMR and misophonia may represent two ends of the same spectrum of *experience*. This would help future studies with recruitment of better matched ASMR samples and perchance even in the elucidation of whether ASMR can be considered universal or if there are truly individuals insensitive to the response (who may represent the lowest end of a spectrum of ASMR-sensitivity). Evidently, Poerio, Mank, and Hostler (2022a) made reference to ASMR sensitivity, referring to '*stronger ASMR*'. The authors proposed that heightened sensory sensitivity to exteroceptive and interoceptive cues may underlie the ASMR propensity (ability to experience) and intensity, speculating that 'stronger ASMR' underlies processes involved in the translation of external input to subjection feelings. Individuals with stronger ASMR reported greater interoceptive sensitivity and bodily awareness as well as being more likely to be classified as highly sensitive. A similar approach could be taken for 'weaker ASMR' (i.e., individuals who report insensitivity, who report not feeling ASMR sensations, and who have never engaged in ASMR). In fact, Swart et al.'s (2021) attempt at classifying ASMR sensitivity via their AEQ applies in this context, finding that ASMR-sensitive individuals differentiate based on ASMR propensity and intensity with a distinction between 'ASMR-Strong' and 'ASMR-Weak', not unlike Poerio et al.'s (2022a) take on stronger ASMR. Such 'weak and strong ASMR' distinctions could be applied to the proposed spectrum and investigated via the presentation of a range of ASMR stimuli and subsequent ratings scales (e.g., frequency, intensity, and somatic distribution) to gauge the strength of ASMR sensitivity, while the AEQ could also be applied in this regard. From a functional imaging perspective, one may also be able to start investigating potential differences between individuals reporting different levels of sensitivity (via the proposed spectrum). This also links to the previously discussed issue (*in* 3.1.1.; 3.1.2.) of there being no independent and standardised screening protocol in place to gauge ASMR-sensitivity, save the typical self-report (*see* McErlean & Banissy, 2017), a preliminary set of measures (Hostler et al., 2019), an assessment of ASMR intensity (ASMR-15; Roberts et al., 2019) and a recent attempt at classifying ASMR responders by experience via a subjective ASMR-Experience Questionnaire (AEQ; Swart et al., 2021).

So, ideally, the next step would be to further develop some kind of screening measure for ASMR-sensitivity building on the existing preliminary research, while also implementing within this, an ASMR-sensitivity spectrum and even physiological parameters (*as outlined in* 3.1.1.; 3.1.2.). This would aid in justifying the current as well as future ASMR prevalence rates and would benefit ASMR research as a whole (e.g., in gauging ASMR-sensitivity and recruiting well-matched ASMR-sensitive samples). In terms of screening, as discussed in 3.2., and suggested by Poerio et al. (2018), a good start may be to develop consistency tests for ASMR similar to those for synaesthesia.

For misophonia, the reported prevalence rate, while high, is in actuality inconsistent with the existing prevalence rates which collectively range from 8.5-49.1%, or 3.3-49.1% if counting the original estimation based on DST (Jastreboff & Jastreboff, 2014). Saying this, these prevalence rates are also quite inconsistent and very likely a product of two factors in particular, differing methodologies (e.g., using different testing batteries), and the use of differing terminologies of misophonia. More so, the samples these studies recruited, as noted (*in* 5.2.3.) were predominantly students or patients and as such do not represent the general population and in fact, may represent opposite ends of misophonia (the lower end for students who may merely see the response as an annoyance and the higher end for patients who find it debilitating). The current study took a more general stance in using a broader description of misophonia, developing a misophonia questionnaire based on multiple pre-exiting versions, and recruited from the general population (*refer to* 5.3.2.1.). These are factors in which future research should look to adhere to and implement and while still preliminary, it is quite possible that the high prevalence reported in this study may indeed be more precise than the prior findings. However, in light of the present recruitment method also targeting an ASMR-sensitive population, questions these implications since the sample may indeed not be representative of the general population and these prevalence findings and implications should be taken lightly.

If, via replications, prevalence rates are consistent with the current 94.51%, as discussed for ASMR, the distinction between misophonia and controls would be rather questionable, as would the research that has split participants this way (particularly so for those that have applied more objective methodologies such as neuroimaging and physiology). In a similar way to ASMR then, it would be beneficial to develop a spectrum of misophonia that could form part of a universal screening measure for misophonic sensitivity (and perhaps even a more well-rounded description of the phenomenon) such that studies can become more attuned in differentiating individuals less sensitive to misophonia (e.g., to whom the response causes general annoyance) from those who are more sensitive (e.g., to whom the response impacts social, academic, and/or work life). Likewise, with ASMR, due to the existence of physiological research on the phenomenon (e.g., Edelstein et al., 2013; Kumar et al., 2017; Schröder et al., 2019), it may be appropriate to also suggest the implementation of objective physiological parameters within possible future screening protocol. So, as discussed with ASMR, such screening protocol would aid in justifying the current as well as future misophonia prevalence rates and would benefit misophonia research as a whole (e.g., in recruiting well-matched misophonic samples).

5.5.2. Idiosyncrasy of ASMR and Misophonic Stimuli

In line with investigating the prevalence rates of both ASMR and misophonia, the study also aimed to ascertain whether there is a response that is predominantly elicited by a specific type of stimulus and to the extent to which the stimuli are idiosyncratic. Again, the results revealed that each of the 24 stimuli elicited either response in at least one participant. This implied that regardless of the type of stimulus, participants were individualistic in the response they reported to experience hence also implying a sense of idiosyncrasy to the stimuli.

While it was hypothesised that some sounds would be idiosyncratic, the results surprisingly showed that each stimulus had the capability of eliciting both responses. For example, the ASMR literature places whispered speech as the consistently reported most intense ASMR-eliciting stimulus (Barratt et al., 2017; Barratt & Davis; 2015; Fredborg et al., 2017; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018) yet 12.09% of the sample reported it triggered misophonia. Conversely, one of most typical misophonic stimuli in scraping (Cavanna & Seri, 2015; Taylor, 2017) was reported to elicit ASMR by 4.40% (metal scraping) and 6.59% (polystyrene scraping) of the sample. Although this will be covered below as part of the background questions, when the misophonic subset was asked to report whether there was an ASMR stimulus that elicited misophonia, 43.96% agreed, with mouth sounds as the most frequent response.

Collectively, this ties in with Barratt et al.'s (2017) claim that there is an idiosyncratic relationship between ASMR and misophonia which they highlighted in the example of mouth sounds. As touched on previously (2.6.4.), the literatures of both phenomena report mouth sounds as inducers. For ASMR in particular, mouth sounds are typically the least observed and rated as the least intense ASMR-eliciting stimulus (e.g., Fredborg et al., 2017; Kovacevich & Huron, 2019; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018).

True, the present background question responses revealed that mouth sounds were the ASMR stimulus most frequently reported to rarely/never elicit the response in the ASMR subset compared to being the second most frequently reported misophonia eliciting stimulus and again the ASMR stimulus that was most frequently reported to elicit misophonia (by the misophonic subset). Of course, this is not to say that every individual sensitive to ASMR experiences the response via such stimuli due to its individualistic nature. The same applies to those sensitive to misophonia, and Barratt et al. (2017) quite rightly mentioned that there does not appear to be a suitable reason for the disparity in responses to the same stimulus. From this then, the possibility that ASMR-sensitive individuals who do not experience ASMR from mouth sounds may instead experience misophonia and vice versa for misophonic individuals, was put forward. Indeed, the current findings seem to agree, with ASMR responses reported to be elicited from the three (misophonic) orofacial stimuli being less frequent than misophonic responses to the same stimuli.

What makes the current finding more intriguing however, is that each stimulus (i.e., not just mouth sounds) was idiosyncratic to some extent, though, it was found that the different types of stimuli were still able to elicit the response they were meant to elicit (as predicted) more than the alternate response (ASMR / misophonia). This implies that there may be underlying properties to the sounds that enable them to still elicit the response they are meant to elicit. One could draw on the previously discussed auditory, spatial, and interpersonal properties underlying (auditory) ASMR stimuli (*see* 2.4.) which are still relatively overlooked in the ASMR literature. It is more than possible that the same applies to misophonia. This would make for an exciting future avenue of exploration. Interestingly though, there was a single exception, pen clicking, which was reported to elicit ASMR (35.16%) more frequently than misophonia (6.59%) which was the response it was intended and expected to elicit. However, based on anecdotal accounts and more recent ASMR media trends, pen clicking has been reported and used as an ASMR stimulus. To note, when bringing in the 'neither' responses, they were relatively high for each stimulus, perhaps highlighting the naivety of the participants in ASMR and misophonic experiences thereby bolstering the fact that the sample is representative of the general population opposed to specifically ASMR-sensitive and misophonic groups as intended.

5.5.3. Auditory Elicitation of ASMR and Misophonia

Adding to the findings on prevalence and idiosyncrasy is that fact that both phenomena were elicited by solely auditory stimuli as predicted. Misophonia has been established as mostly elicited via auditory stimuli already. Thus, this is particularly more relevant for ASMR since it is often described as a response elicited via audiovisual stimulation and that the only evidence of solely auditory stimuli being able to trigger the response is either anecdotal or found in a preliminary study by Koumura and colleagues in 2019. Specifically, the latter conducted a test-retest paradigm to indicate whether ASMR-inexperienced individuals could reliably experience ASMR after a 2-week break, to which they reported high reliability. This also builds on Barratt et al. (2017) who suggested that visual aspects of ASMR-eliciting stimuli can influence ASMR but appear to be less vital than their auditory counterparts. This way, future studies would need not rely on audiovisual stimulation.

Also, from a neuroimaging perspective, investigations focused specifically on auditory brain regions, as discussed, have been relatively overlooked (*for a more in-depth overview, see* 3.1.1.) and thus, the knowledge that auditory stimuli on their own are viable and effective ASMR inducers, may also deliver more interesting activations since the stimuli presented in-scanner would be solely auditory and subsequent findings would be based on such stimulation. In line with this, Smith et al.'s (2019a) concept that this could be tested via manipulating auditory properties of several auditory ASMR-eliciting stimuli and presenting this in-scanner, would be a lot more feasible. This may then provide greater insight into the underlying auditory mechanisms involved as well as highlighting potential and lesser-known cross-modal interactions within the auditory system (*such as those discussed in* Chapter 1.).

The fact that the approximate 2min duration of stimuli implemented in this study elicited ASMR and misophonia only bolsters this further where research would not need to present stimuli with a long duration which may also aid functional imaging investigations and effectively reduce costs. Also, since the presented audio were recorded on a binaural microphone and at a proximal distance to it, leans on the outlined idea of audio-spatial interactions whereby ASMR may indeed be more likely to be elicited and perhaps even be intensified due to such an interaction between sound and spatial proximity (*see also* 2.4.4.). Back to prevalence rates though, what would be interesting, is whether implementing audiovisual stimuli would have increased prevalence rates further which could be trialled in future.

5.5.4. Response Associations

Within the task, following each of the 24 stimuli, participants were presented with a set of questions concerning their experiences to these sounds. This included pleasantness, frequency, intensity, and somatic distribution. This provided the data to base the prevalence rates and somatic distribution but also enabled the analysis of particular associations including response–pleasantness, frequency–intensity, and ASMR–misophonia. To note, this was more in the way of complimentary data and was by no means the primary focus hence potential discrepancies in the theory behind the questions as well as the associations developed from the resulting data from said questions.

5.5.4.1. Response–Pleasantness. Based on the literature, ASMR is described in a positive light while misophonia is described negatively. This way, ASMR stimuli can be deemed pleasant and misophonic unpleasant. The results revealed a significant effect of response type on pleasantness scores, and that pleasantness scores were significantly higher for ASMR but significantly lower for misophonia. Accordingly, this suggests that the data may indeed support the concept that ASMR is associated with sounds that are perceived as pleasant and vice versa for misophonia. Although this will be discussed separately in later sections, the fact that the questions from the ADCQ and MDCQ on whether emotion(s) accompanied both ASMR and misophonic sensations revealed more positive emotions for ASMR and more negative emotions for misophonia, seemingly bolster the associations on pleasantness further.

5.5.4.2. Frequency–Intensity. Neither frequency (i.e., the number of times a response is reported) nor intensity (of the sensations attributed with a response) have been the primary focus of ASMR and misophonic investigations. Considering the ASMR literature, frequency has rarely been mentioned but is nonetheless, a key aspect of the response. Conversely, intensity has propped up within the literature on several occasion and is also a key aspect. The same is true in the misophonic literature. Regarding intensity, one thing that is clear in both phenomena is that, due to their individualistic nature, those sensitive to the phenomena will vary in the intensity to which they experience ASMR and misophonia. As previously mentioned, (*in* 2.6.4.; 5.2.2.) in a prior joint investigation of ASMR and misophonia, Scofield (2019) reported weak but significant correlations between all measured variables (including frequency and intensity) which they suggested was indicative of a relationship between stronger tendencies to experience ASMR and higher levels of misophonia.

Similarly, the results of the current study revealed a significant positive correlation between frequency and intensity scores when experiencing both ASMR and misophonia. This hints at the possibility that the two factors are indeed associated, as may well be the two phenomena. The direction in which one influences the other however, is unclear but as theorised, is conceivably in the form of a positive correlation whereby the more individuals experience ASMR / misophonia (i.e., the frequency), the more intense the experiences would be. This, however, if pursued in future, could provide a reasonable explanation for the association between the two factors.

5.5.4.3. ASMR–Misophonia. To explore the relationship between ASMR and misophonia while also building on the research that has jointly investigated them, whether there is a significant correlation between the number of experiences for each response (per participant, ASMR-misophonia), and the intensity to which they are experienced (per participant, ASMR intensity-misophonia intensity) were tested. Based on the number of experiences of each response, results revealed no significant relationship between the number of times ASMR was experienced and the number of times misophonia was experienced. Based on the intensity in which responses were felt however, results revealed a weak but significant relationship between ASMR and misophonia intensity scores. This suggested that individuals who reported experiencing intense ASMR may also have reported experiencing intense misophonia (and vice versa).

What was surprising was the non-significant correlation between the number of times ASMR and misophonia were experienced, especially considering how the previous research consistently reported on their co-occurrence (Barratt et al., 2017; McErlean & Banissy, 2018; Rouw & Erfanian, 2018; Scofield, 2019). This, however, may be a product of the study design which was primarily intended to investigate prevalence and somatic distribution. The prior research all recruited specifically sensitive populations (ASMR-sensitive or misophonic), and the two studies that jointly investigated both ASMR and misophonia (McErlean & Banissy, 2018; Scofield, 2019) used the MQ (Wu et al., 2014) as an assessment of (ASMR-sensitive) participant's misophonia. This may be the way to go to take this association further.

5.5.5. Somatic Distribution of ASMR Somatosensation and Misophonic Sensations

The present study was the first to topographically map the somatic distribution of misophonia. As reported on numerous occasions, ASMR somatosensation has been attributed as one of the defining characteristics of the phenomenon, typically reported to be felt primary to the scalp and neck but may spread downwards to the secondary shoulders, back, and limbs and has been reported in both ASMR-sensitive (Barratt & Davis, 2015) and non-ASMR-sensitive (Koumura et al., 2019) individuals (*for a more in-depth discussion, refer to* 5.2.3.). Research on misophonia however, is limited to a single study that has not incorporated body maps (Dozier & Morrison, 2017). It would be entirely possible however, to topographically map misophonic sensations to bodily areas as has been done for ASMR. While discussed later, the fact that 46.63% of the present misophonic subset agreed that they experienced physical responses in response to misophonic stimulation only seems to bolster this idea.

As hypothesised, the results revealed that both ASMR somatosensation and misophonic sensations were reported as being felt in several bodily areas. This came from the prevalence task, ADCQ, and MDCQ -somatic distribution questions. This meant that the entire sample self-reported experiencing both sensations in several bodily regions in response to the presented stimuli, but also provided insight into the somatic distribution of both sensations from the smaller more specialised ASMR-sensitive and misophonic subsets within the total sample.

To start, as one of the questions presented after each stimulus, if participants reported experiencing either ASMR or misophonia, they were also asked to report the bodily location(s) in which they experienced the respective response.

For ASMR, the head (as a collective), neck/nape, shoulders, back, spine, and arms were the most frequent. Taken further, within the collectively placed 'head' area, the head (typically reported as the back of the head), scalp/skull/brain (most frequently the scalp), and the ears were the most frequent but the face, eyes, mouth (in general), teeth, and jaw were also reported but less frequently. Also, the chest, stomach/gut/abdomen, pelvis, hands, fingers, and legs were reported but again, a lot less frequently. This was this consistent with the prior literature and like Koumura et al. (2019), (potentially) non-ASMR-sensitive individuals may indeed be able to experience the response. What makes the current findings more interesting is that the previously reported areas were not completely consistent with one another which may have been a product of the recruited participants – ASMR-sensitivity versus insensitivity. For instance, the legs were an area reported by Barratt and Davis (2015) but not by Koumura et al. (2019) and conversely, the ears. The current finding, however, was consistent but more so, previously unreported areas (e.g., mouth, teeth, jaw, chest, stomach/gut/abdomen, pelvis, hands, fingers) were also reported. To note, although it must be taken lightly, question responses from ADCQ question set 2 were consistent with these findings since more than half of the ASMR-sensitive subset reported experiencing ASMR somatosensation from ASMR media (in general), that it originates in the same area(s), and that it spreads to other areas with intensity.

For misophonia, the head (as a collective), neck/nape, shoulders, back, chest, and arms were the most frequent. This was mostly consistent with Dozier and Morrison's (2017) text-based account with regions associated. Regardless, previously unreported areas were still identified including the scalp/brain, eyes, ears, mouth (in general), teeth, gums, neck, throat, spine, fingers, feet, and toes. What is interesting here however, are the complete lack of reports for the ears and orofacial regions (excluding the jaws). However, this may be a product of recruitment since Dozier and Morrison's (2017) misophonic sample had a mean misophonic severity between moderate and severe. Although the present study did not employ such measures, since the sample were initially from the general population, it is likely that they would report non/subclinical misophonic severity. This way, differences in reported bodily areas of misophonic sensations may be attributed to misophonic severity and future investigations are recommended. Alternatively, the differences may have been a result of methodological differences such as the presented stimuli (auditory versus auditory and visual stimulus presentation). With misophonia traditionally an auditory perceptual phenomenon, the present findings may be somewhat more representative of misophonic sensations.

Irrespective of this, the present study has shown that misophonic sensations can be topographically mapped. Further, the finding is made all the more interesting due to the clear similarities with the areas reported for ASMR somatosensation which point towards overlap in the somatic distribution of response sensations between these two perceptual phenomena and another with frisson. Yet, despite the similarities, there were still differences. For example, regarding the collective 'head' area, where the back of the head, scalp/skull/brain, and ears were the most frequently reported areas for ASMR somatosensation, only the head and ears were the most frequently reported areas for misophonic sensations. Also, despite being less frequently reported, the other 'head' areas (especially when grouping the orofacial areas) were still a lot more frequently reported for misophonia with the addition of an area unreported for ASMR, the gums. Indeed, the results of the paired-samples t-tests reveal these distinctions with orofacial regions, with there being a significant (mean) difference for misophonia versus ASMR.

One possible explanation could be that the misophonic subset who reported on these orofacial areas are consciously experiencing overt tactile sensations in and around these orofacial regions via mentalisation. This way, an effect resembling mirror-touch but without a visual component could be occurring whereby those sensitive to misophonia are reporting experiencing misophonic sensations in body areas that are the source of their misophonia by visually picturing it in their mind. Surprisingly, a recent functional MRI investigation of misophonia seemingly lends support. Kumar et al. (2021) introduced an explanatory model of misophonia based on supposed 'hyper-mirroring' of orofacial actions of others whereby sounds act as the medium to which such actions are mirrored. Arriving at this theory, the authors referred to aspects of misophonic phenomenology, particularly, how most misophonic stimuli are human-generated (like ASMR), involving orofacial actions (i.e., mouth-based sounds) and ultimately result in an aversive emotional response, while the mirror neuron system has been shown to respond to actions generated by others and underlie emotional responses.

To this end, mirror neurons are a class of neuron originally reported in non-human primates (di Pellegrino, Fadiga, Fogassi, Gallese & Rizzolatti, 1992; Gallese, Fadiga, Fogassi & Rizzolatti, 1996) and are described as having the ability to modulate their activity when not only performing an action but also when observing another performing the same/similar action (Kilner & Lemon, 2013). Indeed, studies on non-human primates have reported on mirror neurons that 'motorically code' ingestive and communicative mouth actions such as lip smacking (Ferrari, Gallese, Rizzolatti & Fogassi, 2003) while there is also evidence of their activation by solely the sound of an action (Kohler et al., 2002). This has somewhat been extended to humans with mouth actions of others being mirrored in relevant areas (e.g., the motor cortex) in the individual who is presented with the stimulus of said action (Buccino et al., 2001; 2004; *for a* *review, see also* Buccino, Binkofski & Riggio, 2004). Interestingly then, Kumar et al. (2021) showed stronger resting-state connectivity between the auditory cortex and the ventral premotor cortex that is responsible for orofacial movements; stronger functional connectivity between the auditory cortex and orofacial motor area; and stronger activation of the orofacial motor area – in a misophonic sample (versus controls). Taken together, this may explain the present differences in frequency for mouth-related areas being higher in the misophonic sample. A future study jointly investigating misophonia and MTS, especially with misophonia having been shown to be influenced by visual stimuli, may shed more light on this matter. More so, unreported areas in the throat, feet, and toes were also reported, while the back was not reported. This way, while perceptual phenomena may overlap in particular areas, the differences may imply response specificity.

Similar findings were reported from the ADCQ and MDCQ equivalents of the prevalence task somatic distribution question. Starting with the ADCQ, again, ASMR somatosensation originated mainly around the head (as a collective), neck/nape, and the back/spine but also in other areas including the shoulders, chest, and arms. Already, this is mostly consistent with the presently reported prevalence task somatic distribution as well as the previous research. Moreover, 69.23% of this ASMR-sensitive subset reported more than one area of origin, while 88.46% reported ASMR somatosensation to consistently originate in the specified area(s), implying that ASMR somatosensation can originate in more than one area but will most likely be consistently felt in the reported area(s).

Further, like the previous research, ASMR somatosensation was reported to spread to other bodily areas and seemingly followed a downwards trajectory as typically described in the literature. The majority of this subset (96.15%) reported on the spread, with the head (as a collective), neck/nape, back, spine, arms, and legs being the most frequent and less frequently, the shoulders, chest, stomach/gut/abdomen, hands, and fingers. Like Barratt and Davis (2015), most the subset agreed that their ASMR somatosensation spread with intensity (84.62%). This implied that ASMR somatosensation can spread to multiple areas depending on the perceived level of intensity where due to the individualistic nature of the response, only certain stimuli can achieve this ability to spread and will be dependent on the individual. This may also explain why some of the previously unreported areas in the previous research that were reported in the prevalence task somatic distribution (e.g., mouth, teeth, jaw, pelvis) were not reported in this subset while others (e.g., chest, stomach/gut/abdomen, hands, fingers) were but less frequently. One cannot discount however, that this may have also been due to how this ADCQ subset may not have been comprised of the individuals who reported on these areas in the prevalence task. Regardless, as a collective, the reported areas of origin and spread are consistent with the somatic distribution reported in the present prevalence task as well as the previous literature though future revisions are necessary.

For the MDCQ, again, 70.24% of the subset agreed that they experienced bodily sensations in response to misophonic stimulation and of these, 63.09% reported the bodily region(s) in which they had previously experienced misophonic sensations. Misophonic sensations originated mainly around the head (as a collective), neck/nape, back/spine, and arms though the throat, shoulders, chest, stomach/gut/abdomen, hands, and fingers were also reported but less frequently. Also, similar to the ADCQ findings, 62.26% of this misophonic subset reported more than one area of origin, implying that misophonic sensations can originate in more than one area. Already, this is mostly consistent with the presently reported prevalence task somatic distribution of both responses, the ADCQ findings, as well as the previous ASMR findings.

What was interesting though was that compared to the ADCQ, areas in and around the mouth (in general, teeth, jaw) were reported once again, as was the previously unreported throat. This may support the proposed link between misophonia and MTS, while it may be possible that these regions infer the outlined response specificity and may be exclusive to misophonia. Further, like the ADCQ findings and previous ASMR research, misophonic sensations were reported to spread to other bodily areas and seemingly followed a downwards trajectory. However, this was only the case in 39.06% of this subset, with the head (as a collective), neck/nape, back, chest, and arms as the most frequently reported areas though the shoulders, stomach/gut/abdomen, hands, fingers, and legs were also reported but a lot less frequently. So, again, on top of being the first topographical mapping of misophonic sensations, as a collective, the reported areas of origin and spread are consistent with the somatic distribution reported in the present prevalence task for both ASMR and misophonia as well as the previous ASMR literature, but again future revisions are necessary.

Collectively, the current findings have enabled the topographical mapping of ASMR somatosensation and misophonic sensations which were relatively consistent with one another (in the prevalence task, ADCQ, and MDCQ -somatic distribution questions), with the previous research, and with frisson. From this, the possibility that perceptual phenomena share a path was suggested where any reported differences (i.e., body areas) may highlight response specificity. As Barratt and Davis (2015) mentioned however, that individuals do not experience the same ‘route’ (of somatic distribution) where they could only report on what they referred to as the ’common path’ of ASMR somatosensation, the current heatmaps can only be taken as such. This may similarly apply to misophonia and while a workaround only seems possible via a case-by-case basis, it is still a point worth considering for the current findings and in future revisions.

The key takeaway point from the overall findings though, is the link to Barratt and Davis (2015). As outlined (in 2.6.4.; 5.2.2.-3.), the researchers were the first to link ASMR and misophonia wherein the two phenomena were suggested to be polar opposites (in terms of emotionality) and represent opposing ends of a spectrum of sound-emotion synaesthesia (with ASMR being the positive end and misophonia the negative). The flaw in this was the tangibility of concurrents, that ASMR also consists of somatosensation, while there was no mention of a negative equivalent to ASMR somatosensation in the misophonia literature (which, at the time of publication, at least considering Edelstein et al.'s 2013 finding of physical manifestations from misophonic stimulation, was not entirely true).

First off, the present study has shown consistency with Dozier and Morrison (2017), evidencing the somatic distribution of misophonic sensations (above), while also reporting on physical responses to misophonic stimulation (*below, in* 5.5.7.) not unlike the previous research. Although this 'resolves' the issue around there being no misophonic equivalent to ASMR somatosensation, the primary flaw in the tangibility of concurrents still exists. This is because Barratt and Davis (2015) suggested ASMR and misophonia to be polar opposites in terms of emotionality. So, despite reporting on the somatic distribution of both ASMR somatosensation and misophonic sensations, per their suggestion, accepting this would neglect the presence of emotionality in both responses which is central to their concept of these two phenomena representing opposing ends of the same spectrum. This way, the researchers saw somatosensation as secondary to emotion but arguably, as discussed in 2.6.4., the inverse may also be true and ASMR research has previously pointed to this (Valtakari et al., 2019). In fact, misophonia research has drawn on this exemplified in the concept that misophonic physical responses may be masked by misophonic emotional responses, wherein the physical response may be the initial sensation that influences the emotional response (Dozier & Morrison, 2017).

Further tying these sensations together has seemingly presented itself in emotion research where different emotions were expressed in specific bodily locations (Nummenmaa, Glerean, Hari & Hietanen, 2014; Nummenmaa, Hari, Hietanen & Glerean, 2018). For instance, happiness and relaxation were expressed intensely around the head and chest, while disgust, distress and anger were expressed in the mouth, chest, and upper body. Respectively, this resembles not only the presently reported somatic distribution but also the attributed emotions (*albeit discussed below in* 5.5.7.) of both phenomena. In fact, this may even support the current findings, not solely in terms of consistency but may help with some explanations (e.g., how mouth-related areas were more frequently reported for misophonia versus ASMR). Also, the results of the paired-samples t-tests highlight these distinctions with orofacial and chest regions being a significant (mean) difference for misophonia versus ASMR (and vice versa for the head and scalp). This way, one may rather strongly make the inference that ASMR and misophonia are polar opposites in regard to somatic sensations as well as emotion where they may indeed represent opposing ends of a spectrum of *experience* but is still in need of future investigation. As a final point on topographical mapping, particularly in the case of ASMR, this too could be trialled in any future screening protocol for the phenomena.

5.5.6. Background Questions

The ‘background questions’ provided insight into the response sensitivity, stimulus preferences and preliminary prevalence of synaesthesia and trait openness within the current sample. First, regarding response sensitivity, 83.52% self-reported as ASMR-sensitive (though only 28.57% reported regularly engaging in ASMR media) and 92.31% as misophonic. While subjective and hard to determine, this does seemingly tie in with the findings from the prevalence task.

Second, regarding the eliciting stimuli, responses were consistent with the previous literature. For ASMR stimuli, whispered speech was the most frequently reported ASMR-eliciting stimulus, followed by tapping, brushing, personal attention, mouth sounds, crinkling/crisp sounds, (light) scratching, and other. First off, what is clear is the consistency with the prior research (Barratt et al., 2017; Fredborg et al., 2017; Kovacevich & Huron, 2019; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018). To note, as has been the case for each of these studies, only whispered speech has consistently been placed (always the most frequently reported stimulus), while other stimuli (e.g., tapping, brushing, crinkling, mouth sounds) are typically reported but place differently in each study.

What this seemingly implies is that there must be a reason underlying the continued reporting and placement of whispered speech. For instance, it is possible that the previously discussed interpersonal properties (*see* 2.4.4.; 4.5.3.) are key and in need of focused investigation; that it may highlight cross-modal interactions of multiple sensory properties (and even different auditory properties, *see* 2.4.2.) underlying the sound; or even that whispered speech has been so highly imbedded within ASMR media that has ultimately led to a consistently high frequency of reports among the research. As for the other stimuli, it could quite possibly be a case of individualism and therefore, participant preference. The finding is also mirrored in a following question that asked participants to select the stimulus that rarely/never elicits ASMR with mouth sounds as the most frequent, followed by crinkling, scratching, tapping, brushing, personal attention, whispered speech, and other. Notably, though less frequently reported opposed to mouth sounds, whispered speech (in particular) was still reported to rarely/never elicit ASMR which seemingly highlights the individualistic nature of the response.

For misophonic stimuli, scratching/scraping was the most frequently reported misophonia eliciting stimulus, followed closely by mouth sounds, then polystyrene/Styrofoam (scraping), and screeching/screaming/squeaking sounds. Also, in the following question that asked participants whether there was an ASMR stimulus that elicits misophonia to which 43.96% agreed, mouth sounds were the most frequent, followed by scratching/scraping. This is consistent with the misophonic literature (Cavanna & Seri, 2015; Edelstein et al., 2013; Rouw & Erfanian, 2018; Taylor, 2017; Wu et al., 2014) but also with the above findings that mouth sounds were one of the less frequently reported ASMR eliciting stimuli and the most frequently reported ASMR stimulus to rarely/never elicit ASMR (followed by scratching/scraping). Like the ASMR stimuli, other misophonic triggers (including whispered speech) were reported but a lot less frequently than stimuli in their category and compared to those reported for the ASMR questions and thus, are likely a product of individualism.

As a collective, the findings for both ASMR and misophonic stimuli have been consistent with the previous research. Again, Barratt and Davis (2015) made note of phenomenological similarities between the two phenomena where the current findings highlight two of their proposed similarities in both responses originating from human-centric movement and behaviour (based on the stimuli presented) and how the two responses have some consistency (*see* 5.2.2.). Moreover, the findings are mostly consistent with Scofield (2019) who, when reporting on types of auditory stimuli to trigger both perceptual responses, found whispering to be the strongest ASMR inducer and eating sounds as the strongest misophonic inducer (*refer to* 2.3.). It goes without saying that going forward, more research should implement questions on the stimuli that elicit each phenomena every so often to account for potential shifts in the eliciting stimuli, (for ASMR) to account for stimulus preferences, as well as helping develop understanding on the underlying properties of such stimuli and phenomena.

The remaining background questions were on synaesthesia and openness. For the former, 25.27% of the sample self-reported as experiencing synaesthesia. This was primarily based on Barratt and Davis (2015) previously reporting 5.9% prevalence of synaesthesia in their ASMR-sensitive sample (*for more information, see* 2.6.2.) and their concept that ASMR and misophonia may represent two ends of a spectrum of (originally) sound-emotion synaesthesia. However, since the specific synaesthetic variant(s) were not reported and with no screening measure in place, not much can be made of this. For the latter, 94.51% self-reported as being open to new experiences. This was based on prior ASMR, synaesthesia and frisson research consistently reporting elevated levels of trait openness in sensitive participants. Similar to the research outlined in Chapter 4, the high level of openness in the current sample is consistent with the previous research thereby also supporting the idea that perceptual phenomena (ASMR, synaesthesia, frisson – *see* 2.6.) may share a similar personality profile in heightened openness to experience. Also, as was the case with the question on synaesthesia, no actual measure was used to assess participants (in this case, for example, the BFI) hence not much can be made of the finding.

5.5.7. Aspects of the ADCQ and MDCQ

Similar to prior research, the results from both questionnaires have built on and broadened current understandings of both phenomena and have also provided useful insights for those intending to develop appropriate and effective ASMR and misophonic stimuli for research and/or media purposes. Also, the findings have bolstered current understandings of the underlying phenomenological characteristics of both phenomena.

ADCQ Responses

As mentioned, as a response, ASMR is often described as pleasant and attributed with somatosensation (a tingling sensation) and a feeling of relaxation typically reported to be emotionally positive. True, the questions investigating the sensations that essentially make up and distinguish the response highlighted that the phenomenon is pleasurable, elicits positive emotion (specifically relaxation/calmness and happiness), as well as somatosensation, and a feeling of relaxation. In line with this are the factors underlying ASMR somatosensation. In a previous study, Smith et al. (2017) reported a 59.54sec onset time for ASMR somatosensation (0-90sec range). In the present study, questions investigating ASMR somatosensation indicated that the onset time is short in the current ASMR-sensitive subset (with 1-5min and 0-1min being the first and second most frequently reported); that the frequency varies but occurs no less than twice per media engaged in; and that the duration also varies but can last from 0sec-3min (with <10sec and 30sec-1min being the equally most frequently reported). From this, the reported onset time agrees with Smith et al. (2017) but perhaps more surprising is the fact that this is the first study to report on the (general) frequency and duration of ASMR somatosensation. Briefly, the fact that the present approximate 2min long stimuli were able to elicit ASMR bolsters this. While this is true and provides much needed insight into one of the key aspects of the response, it is still highly preliminary and thus needs further exploration.

Following, research has also reported on the average age of onset to be between 5-15 years (Barratt & Davis, 2015; Poerio et al., 2018). An average age of onset of 19 years was reported as the age that the current ASMR-sensitive sample reported discovering ASMR. While the prior research identified an age of onset younger than the currently reported 19 years, it is possible the participants in the present study read the question in terms of when they first discovered ASMR media, not when they first discovered ASMR themselves (i.e., outside of media and prior to knowing the term). Saying this, Barratt and Davis (2015) did report 41 of their ASMR-sensitive sample as first experiencing the response further into adulthood (post 18 years), suggesting the present finding may be true for this group of ASMR-sensitive individuals. Grouped, the above findings have shown consistency with the usual descriptions of the sensations associated with ASMR, the factors underlying ASMR somatosensation, and the age of onset.

Unlike the prior research that sought to list ASMR-eliciting stimuli, not much attention had been placed on experiencing ASMR outside of ASMR media (i.e., stimuli in the real world). A single participant in Kovacevich and Huron’s (2019) study commented on how Bob Ross triggered their ASMR long before the initialism existed (*refer to* 2.3.), while the fact that ASMR was termed to describe the phenomenon suggests it long existed prior to the development of stimuli specialised in eliciting the response. In line with this, the question investigating whether participants had previously experienced ASMR outside (i.e., ASMR in the real world opposed to ASMR media) revealed 88.46% of the present ASMR-sensitive subset agreed and reported on such instances. Of the sounds reported, whispered speech was equally the most frequent alongside watching/listening to others, again underlining the likely importance of interpersonal properties in eliciting ASMR. Perhaps more interesting though, is that this is the first look at the stimuli that elicit the response outside of typical ASMR media that is not anecdotal and in essence, provides a glimpse into the origins of ASMR prior to its coining.

Following on, research has reported on the viewing habits of those sensitive to the response (Barratt et al., 2017; Barratt & Davis, 2015; McErlean & Osborne-Ford, 2020; Poerio et al., 2018). Presently, the questions investigating the viewing habits of ASMR-sensitive individuals highlighted similarity with the previous research. First, there was variation in the frequency of engaging in ASMR media per week though daily consumption and engagement 3 days per week were equally the most frequent which is consistent with McErlean and Osborne-Ford (2020) (daily and 2-3 times a week) and Poerio et al. (2018) (daily and a few times a week). Second, the optimal duration of a single ASMR media was reported to be longer than 10min which is in stark contrast to Barratt et al. (2017). This, however, may highlight either individualism or a possible shift in the preferences of ASMR-sensitive individuals (which may draw on possible habituation). Third, two ASMR-eliciting stimuli was the most frequently reported trigger load per ASMR media which was consistent with Barratt et al. (2017). What was surprising though was the frequency placement of trigger load since the current study reported two as the most frequently reported followed by three, four+, then one, while Barratt and colleagues reported two, one, three, four+.

Perhaps similar to the optimal duration of ASMR media, the current finding may be representative of the shifting preferences of ASMR-sensitive individuals where having more than one stimulus in a single ASMR media is the new trend and may draw on the need for more stimulation to avoid potential habituation (which could be the case with a single stimulus). Fourth, the most frequent time of day for engaging in ASMR media was at night (prior to sleep) which was consistent with Barratt and Davis (2015). Fifth, more than half the current ASMR-sensitive sample reported engaging in ASMR media while working, studying, or similar. While this had not previously been assessed, it builds on the reasons for ASMR engagement.

Taken together, this builds on our understanding of the viewing habits of ASMR-sensitive individuals, while the second and third questions may indeed provide insight into the development of effective ASMR-eliciting stimuli. Specifically, that a longer duration of ASMR content per media, and greater trigger load (at least two stimuli per media) should be considered by those looking to develop their own stimuli.

Similar to viewing habits, previous research has also reported on the sensory properties of ASMR stimuli and relevant equipment to develop and engage in ASMR media (*see* 2.4.). Both of these, again, similar to viewing habits, provide valuable insight into the response and highlights considerations for factors to control when developing effective ASMR-eliciting stimuli. As touched on throughout 2.4., the underlying sensory properties of ASMR-eliciting stimuli should be considered, with the present sample reporting on several influencing factors. This included audiovisual stimuli (over solely auditory or visual stimuli), seeing where an ASMR sound originates, stimuli that have been recorded proximally to the microphone, pitch of ASMR stimuli (low versus high), directed focus of the host, and feelings of connectedness to the host. This is consistent with the previous literature (e.g., Barratt et al., 2017; Koumura et al., 2019) and highlights the interplay of properties from several sensory domains (auditory, visual, spatial, and interpersonal).

As for equipment, more than half the ASMR-sensitive subset agreed that they engaged in binaurally recorded ASMR media, that it is more effective in eliciting ASMR (versus regularly recorded ASMR media), and that it results in more intense ASMR. This builds on and is consistent with past findings (Barratt et al., 2017; Barratt & Davis, 2015; *see* 2.4.1.). Also, in terms of ear/headphone usage, more than half the ASMR-sensitive subset agreed that they wear them during engagement in ASMR media, that wearing them is more effective in triggering ASMR (than not wearing them), and that they result in more intense ASMR. Together, binaural ASMR and ear/headphone usage may link to the previously outlined (audio)spatial-interpersonal association and may indeed be more effective in eliciting ASMR, and a more intense response at that (*see* 2.4.4.).

Overall, the above findings regarding the sensory properties of ASMR stimuli and equipment may all serve as points of interest for those looking to develop effective ASMR stimuli. Specifically, that it may be beneficial to include a visual accompaniment to any presented sound (i.e., record audiovisual ASMR), refer to the viewer-listener and/or direct attention to them, ensure the audio is low pitched, and that stimuli would benefit from being recorded proximally to and via a binaural microphone, and that participants/viewer-listeners should be encouraged to wear ear/headphones.

MDCQ Responses

As mentioned, as a response, misophonia is often described as an abnormally strong sensitivity to certain sounds accompanied by unpleasant emotional reactions and autonomic arousal. Again, this can come across as in stark contrast to ASMR. As was the case with the ADCQ, MDCQ questions investigating such sensations have acknowledged their attribution in typical descriptions of the phenomenon. First and foremost, emotion is central to misophonia and the present question investigating whether participants generally experience emotion(s) from misophonic stimulation revealed the vast majority of the misophonic subset did. Consistent with the prior research (e.g., Rouw & Erfanian, 2018), only negative emotions were identified, with anger/rage and annoyance/irritation as the two most frequently reported. In line with this, another question on the consequences of being unable to avoid misophonic sounds revealed the same two negative emotions as the most frequent ‘consequences’. Overall, this builds on the idea that misophonia and ASMR are polar opposites since the emotions reported to be experienced in conjunction with ASMR sensations within the ASMR subset were all positive.

On top of the psychological/emotional effects, there exist physical effects hence the typically described accompaniment of autonomic arousal. A distinguishing factor between ASMR and misophonia that the prior research identified was the supposed non-existence of a negative equivalent to ASMR somatosensation in the misophonia literature which linked to the issue of the tangibility of concurrents preventing the association of the two phenomena (*refer to* 5.5.5.). Above, the presently reported somatic distribution of misophonic sensations was reasoned to counter this. The same can be said for the MDCQ questions that investigated the physical responses to misophonic stimulation whereby 46.63% of the misophonic subset agreed that they (generally) experience a physical response(s) from misophonic stimulation. The following were reported: increased heart rate, involuntary and voluntary movements, muscle tension, changes in breathing and body temperature, anxiety, feeling sick, and physical pain.

In the same way that misophonia is associated with autonomic arousal, the above aversive physical responses, for the most part, are characteristic of typical autonomic nervous system responses. As previously noted, the theory driving this investigation into the somatic distribution of misophonic sensations was based on anecdotal accounts, accompanying physical responses (Edelstein et al., 2013; Rouw & Erfanian, 2018; Schwartz et al., 2011), heightened physiological responses (Edelstein et al., 2013; Kumar et al., 2017), pharmacological influence (Edelstein et al., 2013), the general autonomic nature of the response, and an early attempt at mapping areas of misophonic sensation (Dozier & Morrison, 2017). While not every one of the misophonic subset reported on experiencing physical responses, the findings are still consistent with the existing research (Edelstein et al., 2013; Rouw & Erfanian, 2018; Schwartz et al., 2011) and as briefly declared in 5.5.5., only bolster the current somatic distribution findings, as well as the association between ASMR and misophonia as polar opposites. The misophonia literature would however, benefit from further physiological investigations to support what is essentially subjective accounts of accompanying physical responses. Based on the present findings, skin conductance, heart rate, and respiratory measures may be the best suited parameters to measure the physiological profile of misophonia perhaps by measuring such parameters during misophonic stimulus presentation though screening participants for specific physical responses would be vital.

In line with this and the outlined attributed negative emotion, the majority of the misophonic subset also agreed that they generally feel aversion to the source(s) of misophonia. Similarly, when reporting on the ‘consequences’ of being unable to avoid misophonic sounds, several responses were reported including negative emotions, psychological and physical effects, and more interestingly, coping and habituation. The latter two in particular fit in line with the questions investigating coping mechanisms. Since misophonia is aversive, it is no surprise to find more of the misophonic subset agreeing (versus disagreeing) that misophonic sounds can interfere with their social and/or work functioning. Theme 5 of the thematic analysis of participant responses around misophonia (‘Effect on Life’) also highlighted this. Yet, more of the subset also agreed (opposed to disagreed) that they feel they have control over misophonic sounds (i.e., in the sense that they are successful at stopping them), with the majority of the misophonic subset also agreeing to employ methods such as leaving an area where a misophonic sound is present and using other sounds or mechanisms to drown out / mask the misophonic sound (e.g., turning the TV on, covering ears, wearing noise cancelling headphones). Interestingly, theme 1 of the MDCQ thematic analysis (‘Coping Mechanisms’) also highlighted this, while it is also consistent with previous research (Cavanna & Seri, 2015).

Building on the above (5.5.6.) and prior research that listed misophonic stimuli, were the questions investigating the source of misophonia. Of the stimuli reported, people other than themselves was the most frequent, followed by inanimate objects. Also, when probed on specific stimuli, scraping and mouth sounds were the two most frequently reported. Again, this builds on the above findings as well as the previous research that listed misophonia eliciting stimuli.

Last, previous research has also reported on the sensory properties of misophonic stimuli. Similar to the ADCQ questions on the same topic, the MDCQ counterparts also provide insight into the response while bringing to attention, considerations for factors to control when developing effective misophonic stimuli. Presently, the misophonic subset reported on two influencing factors in particular: stimuli that are proximal to the misophonia-sensitive individual, and the pitch of misophonic stimuli (high versus low). While the finding on pitch is understandable when considering that the literature has referred to pitch (especially high-pitched sounds) as a property of sound that influences the aversive misophonic sensations (Brout et al., 2018; Taylor, 2017), spatial properties of misophonic stimuli have not been previously discussed and together, highlight a potential audio-spatial association (perhaps similar to that outlined for ASMR). What is interesting here however, is another potential phenomenological similarity in terms of proximity (spatial distance) where the closer a sound is heard, the more intense the response of either misophonia or ASMR, will be which builds on the phenomenological similarities between the two phenomena identified by Barratt and Davis (2015). Pitch, however, may indeed be classed as a difference between the two phenomena. As was the case with the ADCQ counterpart, the current findings regarding the sensory properties of misophonic stimuli may all serve as points of interest for those looking to develop effective misophonic stimuli. Specifically, that it may be beneficial to ensure the audio is high pitched, and that stimuli would benefit from being recorded/presented proximally.

Collectively, the ADCQ and MDCQ responses have built on and bolstered current understandings of both phenomena, while also providing insight into considerations for factors to control for those looking to develop ASMR and/or misophonic stimuli in the lab or for media in general. It is important to stress, however, that the question responses that came under the categories for ‘question set 2’ (*see* 4.3.8.; 4.3.9.) for both questionnaires need to be approached with caution since the MDCQ was found to not have internal consistency, while the ADCQ had neither construct validity nor internal consistency. While their failing was more likely due to lacking the sufficient number of participants required to achieve significance, and despite knowing that responses showed consistency with previous research, it still needs to be taken incredulously. Thus, future studies may benefit from using or adapting pre-existing and essentially more well-established questionnaires such as the MQ (Wu et al., 2014) and ASMR Checklist (Fredborg et al., 2017) to avoid such issues with novel questionnaires. With this, one would also be able to better gauge how/why ASMR and misophonia potentially co-occur due to their ability to essentially measure response sensitivity and symptomology and would thus build on previous suggestions that applied similar paradigms: that ASMR-sensitive individuals may display increased levels of misophonia symptomology (McErlean & Banissy, 2018), and the indication of a relationship between stronger tendencies to experience ASMR and higher levels of misophonia (Scofield, 2019).

5.5.8. Study Limitations

Although the current study was successful in reporting preliminary prevalence rates for both ASMR and misophonia, somatic distribution of ASMR somatosensation and misophonic sensations, and on several phenomenological characteristics, it was not without issues.

To start, there are classic methodological limitations. Although the recruited sample was relatively large (N = 91), in comparison to the previous studies that explored misophonic prevalence rates, the current sample size is much smaller. Moreover, it is likely that the sample is not actually representative of the general population. In light of the present recruitment method also targeting an ASMR-sensitive population. As there was no way to extract or verify the exact number of participants who were recruited this way to run this preliminary prevalence rate analysis with these targeted participants excluded, the current prevalence data is not representative of the general population and the resultant prevalence findings and implications should be taken lightly. Also, for misophonia prevalence specifically, despite the high prevalence rate, it is unclear whether this ‘subset’ was representative of the entirety of the proposed spectrum of misophonia where it is likely that most represent the lower end of the misophonic spectrum. However, due to the scope of the ethics, recruiting clinical misophonic samples was not an option, neither was recruiting misophonic samples from misophonic platforms due to restrictions on posting studies on such platforms. Nevertheless, the thematic analysis of participant responses around misophonia did reveal that at least some of the current sample fell under the higher end of the spectrum (e.g., themes 4, 5, and 6) as did participant responses to the ‘consequences of not being able to avoid misophonic sounds’ question (e.g., stress/anxiety, physical pain, crying). Future replications would still be wise to recruit a more diverse misophonic sample.

Along these lines, one must also factor in selection bias. It has been shown that participants are 40% more likely to participate in a study if they show interest in or are affected by the study topic/s (Groves, Presser & Dipko, 2004). In terms of the present study, one may question whether the reported prevalence rates are actually higher in this study than they are for the general population since the topics in question were ASMR and misophonia which are what can be described as ‘current’ and ‘trending’. One should also take note of a similar study which reported on the potential link between ASMR and synaesthesia based on 5.9% of their sample self-reporting as synaesthetic which was higher than a previous report of synaesthesia within the general population. However, the prevalence of synaesthesia has been deemed to always be higher in instances where the measure is self-report (McErlean & Banissy, 2017). Taking all of this into account, the concept that the current sample may be less representative of the general population (in terms of ASMR and misophonic sensitivity) cannot be discounted.

Last, and perhaps the key issue is the subjectiveness of the current findings. Notably, most of the ASMR and misophonia literature has relied on and still mostly relies on self-report measures. Even the more objective research utilises self-report screening protocol hence the outlined necessity to develop a more objective gauge of ASMR and misophonic sensitivity (*see* 5.5.1.). The current study was no different with the prevalence, somatic distribution and questionnaire data all being subjective, meaning the findings have to considered as such. Thus, despite the findings on the prevalence rates of both ASMR and misophonia in the general population and the somatic distribution of ASMR somatosensation and misophonic sensations being promising, they are preliminary. They, like most of the research base for both phenomena, is in need of future replication, the development of more viable screening protocol and more objective research (i.e., physiology and neuroimaging).

Also, in line with this, the novel ADCQ and MDCQ had 20-item and 13-item Likert-based questions to which, following CFA and Cronbach’s alpha, the MDCQ was deemed to have construct validity but not internal consistency while the ADCQ had neither (though the insignificant CFA was likely a result of the small size of the ASMR-sensitive subset). This meant that the question responses (at least) from these Likert questions should be considered with caution but again, this was secondary to investigating the prevalence and somatic distribution of both phenomena. As pointed out, it may be more appropriate (in future) to use and build on the pre-existing MQ (Wu et al., 2014) and ASMR Checklist (Fredborg et al., 2017) as previously done (e.g., Scofield, 2019) as opposed to developing more novel measures. Saying this, the ADCQ and MDCQ could be used to build on these existing questionnaires. Similarly, not much can be made of the findings for the two background questions on synaesthesia and openness since appropriate measures were not implemented to assess the two (*refer to* 5.5.6.).

Future studies investigating the link between the two phenomena and synaesthesia either separately or together would be beneficial, especially considering the way Barratt and Davis (2015) linked the three perceptual phenomena. Also, personality research on misophonia would be novel and finding elevated trait openness in misophonic samples would add to the idea that perceptual phenomena (at least ASMR, synaesthesia, and frisson – *see* 2.6.) may share a similar personality profile, while further personality research on ASMR would work to support or refute the existing research (e.g., Fredborg et al., 2017; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020).

5.5.9. Future Research on the Somatic Distribution of ASMR and Misophonia

The following represents the design of a future study based on the current and prior somatic distribution findings. To note, this was originally intended to comprise the heatmap design of this study but could not be implemented due to time constraints and issues with programming, mainly in adapting the code to work with the study design described below.

As outlined above (2.6.4.; 5.2.3.), the previous studies that investigated the somatic distribution of ASMR did successfully report on the bodily areas in which ASMR somatosensation is typically felt and was mostly consistent in both ASMR-sensitive (Barratt & Davis, 2015) and non-ASMR-sensitive (Koumura et al., 2019) individuals and with those reported in frisson (Konečni et al., 2007; Nusbaum, & Silvia, 2011). It is worth noting however, that these findings are heavily reliant on self-report and the figures produced have rather simply been an illustration of the reported areas that the touch sensations of ASMR are felt on body maps. So, to take this further (albeit still somewhat subjectively), the suggestion was to allow participants to illustrate where on the body that touch sensations are occurring and at the exact moments that they are felt. Essentially, this would allow real-time measuring of the onset and somatic distribution of ASMR somatosensation. Indeed, relatively recently, Nummenmaa et al. (2018) mapped the topographical organisation of particular feeling states. This was carried out via open-access software developed by their lab termed emBODY. Essentially, from this, the researchers created several maps of subjective emotion where different bodily sensations were each associated with different feeling states.

It is entirely possible for this design to be adapted for ASMR where ASMR-eliciting sounds would be presented alongside heatmaps (two blank body map outlines reflecting the front and back side) to 'record' the somatic distribution of ASMR somatosensation during ASMR stimulus presentation. While listening to each sound, subjects would be asked to colour the body maps to approximately match where they felt somatosensation (if at all). Onset times could also be measured via this paradigm where the first press (of the cursor) on a body map during stimulus presentation may illustrate (albeit likely a slightly delayed) ASMR onset for that stimulus. Since the current study reported on the somatic distribution of not only ASMR somatosensation but also misophonic sensations, gives all the more reason to implement both ASMR-eliciting and misophonic stimuli (sounds) in this design. On top of this, the post-audio questions and questionnaires could also be re-implemented. This way, such a study may lead to more objective, real-time assessment of ASMR somatosensation and misophonic sensations, and onset times. If successful, the same design could also be applied to other similar perceptual phenomena that are auditory, visual and/or audiovisual in nature including frisson and synaesthetic variants such as MTS. Currently, a similar design was implemented for Study-2 and will be discussed accordingly below.

5.5.10. Conclusion

To conclude, this study sought to jointly investigate two perceptual phenomena in ASMR and misophonia. The primary interest was investigating and bringing to light, the prevalence rates of both phenomena within the general population, and the somatic distribution of ASMR somatosensation and misophonic sensations, while secondarily assessing the phenomenological characteristics of both phenomena. Analyses revealed findings in the form of both ASMR and misophonia as highly prevalent within the current sample which was suggested to potentially mirror the wider general population and implying possible universality of the two responses but was hampered by a recruitment issue that meant the sample was not representative of the general population. Also, the stimuli developed and presented in this study were found to elicit both responses and despite initial idiosyncrasy, were all (bar one sound) able to elicit the response they were meant to elicit. Interestingly, the study showed that solely auditory stimuli were able to do this.

Moreover, the somatic distribution findings showed that ASMR somatosensation was consistent with the prior literature and that of frisson but also that misophonic sensations were able to be topographically mapped and shared a likeness to the 'path' of ASMR somatosensation currently and previously reported and again to that of frisson. Furthermore, the question responses highlighted consistency with the literature on the phenomenological characteristics for both ASMR and misophonia, while also highlighting considerations for factors to control for those looking to develop effective ASMR and misophonic stimuli. It is possible, that based on the collective findings, like previous joint investigations, to conclude co-occurrence of ASMR and misophonia. As Barratt and Davis (2015) initially suggested, the two may indeed represent opposing ends of a spectrum of experience. Although possible, one should consider that co-occurrence does not mean they are the same. Instead, with ASMR being conflated with misophonia and other similar phenomena, it seems appropriate to start referring to ASMR as a distinct response. Also, the development of sensitivity spectrums for both ASMR and misophonia were discussed, as was the need for independent and standardised screening protocol for both phenomena. The current study thus has both built on and provided insights into both phenomena that can be taken further with future ASMR and misophonia research, both individually and together.

STUDY-2

5.6. Methodology

5.6.1. Contributions

I designed the present study. Similar to ‘Study-1’, a master’s student collected the data and assisted in data analysis (*particularly* 5.7.1-2., 5.7.6., 5.7.8.). Also, regarding the analysis of the somatic distribution data, I designed the heatmap figures utilised to present this data.

5.6.2. Participants

5.6.2.1. Developing an ASMR-Sensitive Sample Pool. Briefly, to account for a Prolific policy regarding screening protocol (with reject nodes) implemented in the main body of an online survey, while also helping to recruit a solely ASMR-sensitive sample, a pre-study screening survey was conducted. Its purpose was to develop a pool of ASMR-sensitive individuals who could then be asked to take part in the main study via invitation. This survey consisted of asking the ASMR sensitivity question from the background questions (*see* Appendix B.7.) whereby responding ‘yes’ meant the participant identified as ASMR-sensitive. Participants were also asked for their Prolific ID so they could be invited to partake in the main study if ASMR-sensitive. This survey also pre-screened English language fluency (via a Prolific pre-screen function), circulating to such individuals in the Prolific sample pool. Of a sample of 150 who took part, 95 self-reported as ASMR-sensitive. Of these, 75 completed the study (12 failed attempts, 8 non-attempts), however, only 47 of these passed the headphone screen. This left a total of 47 ASMR-sensitive participants.

5.6.2.2. Recruitment. A volunteer sample of 47 self-reported ASMR-sensitive participants (25 male, 22 female; *M* = 24.72; *SD* = 7.31; range = 18-60) completed the survey. As was the case with Study-1, this was a subset of a larger sample of 200 participants, 150 from Prolific and 50 from social media (Twitter, https://twitter.com) and online forums (Reddit, https://www.reddit.com/). As mentioned above (*in* 5.6.2.1.), the Prolific sample was filtered down to 47 due to screening measures (ASMR-sensitivity and ear/headphone usage), and within this, non-completions, and non-attempts. The sample from social media were all non-completions. In the resulting sample thus, all participants were recruited to partake in the survey via the survey platform Prolific (prolific.co). Volunteers were eligible to take part in the main online study if they met the following criteria: were over 18 years old, fluent in English, self-reported as ASMR-sensitive (assessed via the pre-screen survey and study background questions – *see* 5.6.4.; Appendix B.7.), and had access to ear/headphones (assessed via an online screening test – *see* 5.6.3.2.). Informed consent was obtained from all participants. Ethical approval was granted from the UCL Research Ethics Committee, in accordance with the declaration of Helsinki (Project ID Number: 1584/003).

5.6.3. Materials

5.6.3.1. Stimulus Development. As was the case with Study-1, the survey for Study-2 incorporated the same sound stimulation task and therefore utilised the same set of stimuli – of which, the stimuli presented were solely auditory. Briefly, based on the prior literature (Barratt et al., 2017; Koumura et al., 2019; Smith et al., 2017), the sounds presented in this study were recorded by the same individual on a binaural microphone (Sennheiser AMBEO Smart Binaural microphones) to preserve the spatial properties of the sounds recorded and were recorded in a natural, echoic environment to maintain stimulus realism. The audio software Audacity (version 3.0.2) was used to edit the sounds accordingly. The end product consisted of 24 audio files: 8 ASMR-eliciting, 8 misophonic, and 8 controls – each approximately 2min in duration (*M* = 1.96) (*for a detailed explanation and table briefly describing each stimulus, refer back to* 5.3.3.3.). This time however, the control stimuli were excluded, bringing the stimulus total to 16. Since the goal was to recruit ASMR-sensitive participants, control audio was not essential, while the misophonic sounds were instead both comparator and control (to ASMR sounds).

5.6.3.2. Headphone Screening. Again, as was the case with Study-1, the survey for Study-2 also incorporated a headphone screening measure due to the auditory and online nature of the design. Briefly, the readily available efficacious 'Efficient Headphone Screen' (Milne et al., 2020; https://gorilla.sc/openmaterials/100917) was incorporated into the study design once more (*for a detailed explanation, refer back to* 5.3.3.4.). This time, the accompanying binaural beat test (gorilla.sc) was removed to again account for a Prolific policy regarding screening protocol (with reject nodes) implemented in the main body of an online survey, and to minimise study costs.

5.6.3.3. Heatmap Task. In order to implement the 'real-time' heatmap design suggested in 5.5.9., one of the open-beta zones on Gorilla was used, 'canvas paint' (https://support.gorilla.sc/support/reference/task-builder-zones#canvaspainting). Briefly, this function enables participants to 'draw' over a specific image that has been input within the survey (by right-clicking and dragging the mouse cursor), with body maps, one of the provided examples of use. Thus, a freely sourced png of blank outlined body maps was uploaded. Colour options and 'brush' sizes are also provided. The colour used was blue (RGB coordinate: 33,166,157) and the size (in pixels) of the 'paint brush' was 8.

5.6.4. Task and Procedure

Participants completed an online questionnaire, developed on the survey software Gorilla (gorilla.sc) and hosted via the survey platform Prolific (prolific.co). The survey was accessed solely by users of Prolific. Similar to Study-1, prior to beginning the task, participants were presented with the study information sheet and informed consent form (*see* Appendix B.3.; B.4.). All participants were at least 18 years of age, provided informed consent (via checkbox), and self-reported as ASMR-sensitive. The survey duration was approximately 1hr 10min (*M* = 67min).

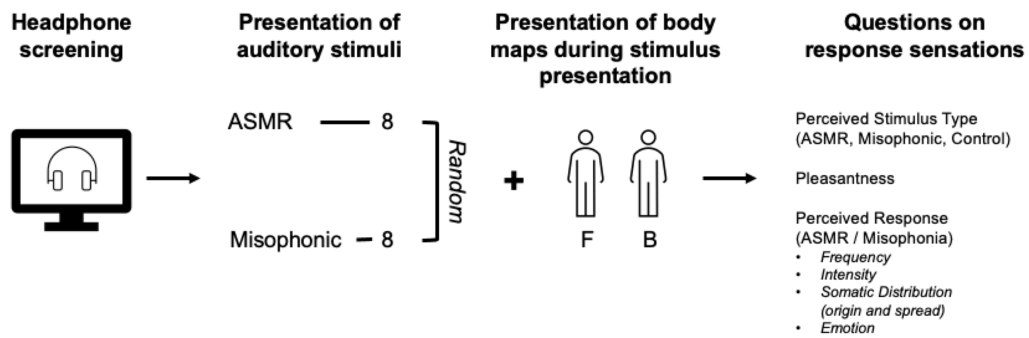
Next, participants were presented with an adapted version of the set of background questions from Study-1 (*see* Appendix B.7.). Briefly, this consisted of demographic information (age and sex), basic ASMR phenomenology (response sensitivity, the stimulus/stimuli that most frequently elicits the response and that rarely/never elicits the response, and whether they regularly engage in ASMR media), and basic misophonia phenomenology (response sensitivity, the eliciting stimulus/stimuli, and whether an ASMR stimulus or stimuli elicit misophonia). Unlike Study-1, the question asking whether participants believe themselves to be ASMR-sensitive was removed since this was used as the pre-screen prior to this study. Also, the background questions on synaesthesia and openness were removed since it would prove difficult to confirm the authenticity of the resulting answers without the implementation of appropriate measures (e.g., consistency tests for synaesthesia and personality questionnaires). Again, refer to Appendix B.7. for the pre-screen survey and background questions. Due to the online and auditory nature of the task, participants then underwent headphone screening (the ‘Efficient Headphone Screen’; Milne et al., 2020).

This was proceeded with a description and example of the auditory task to follow to provide participants with a degree of familiarity on what was expected of them. Following this came the auditory task which consisted of randomly presenting a total of 16 auditory stimuli consisting of 8 ASMR-eliciting and 8 misophonic sounds. While listening to the presented audio, body maps (outlines of the front and back sides of the human body – both labelled as such) would be presented wherein participants were instructed to colour the area or areas in which they felt somatosensation in response to the audio during its presentation (i.e., right click and drag their cursor on the body maps to map any potentially experienced somatosensation in ‘real-time’).

Once a participant had listened to the audio and mapped the body area or areas in which they felt somatosensation, if they experienced any, a participant would be prompted to answer a set of questions based on the audio they heard. Similar to Study-1, first came reporting the perceived response, whether they experienced ASMR, misophonia or neither. To note, the descriptions of both phenomena were present at all times (at the top of each screen). Second was rating the pleasantness of the sound (5-point Likert ranging from very unpleasant to very pleasant with a neither un/pleasant midpoint). Third, if they experienced either ASMR or misophonia, came the intensity of the response (5-point Likert ranging from 1-5 where 1 = very mild, 5 = very intense), the frequency of ASMR/misophonic sensations (5-point Likert ranging from 1-5 where 1 = none of the time, 5 = all of the time), and the somatic distribution (the originating area/s and the spread area/s and was purposefully open-ended for both). The latter question on somatic distribution was kept as a failsafe (in the event that the heat map task failed) and to be used as a comparator with the somatic distribution data from Study-1. To note, since the original only asked for the originating area, the spread was an addition for Study-2. Also, one final question on emotion was asked (whether the audio they listened to was negative, neutral, positive, represented as 2, 0, 1, respectively). These questions were based on Hostler et al.'s (2019) criteria. This would continue until all the audio clips had been listened to and the questions on each had been completed. This time, a progress bar was input following the final question on emotion to help participant gauge how close they were to finishing the survey. Upon completion, participants were debriefed (to note, no deception was involved in the study, but debriefing was added nevertheless, *see* Appendix B.5.) and thanked for their time. An illustration of the task is provided in Figure 10.

Figure 10.

Illustration of the Study-2 task paradigm



5.6.5. Data Analyses

The current study is a mixed-methods design. All quantitative data analyses were carried out in Microsoft Excel and SPSS (version 27). All heatmap analyses were exploratory and included the Study-1 version with heatmaps developed on Microsoft PowerPoint, and the newer version utilising software on Gorilla (*refer to* 5.6.3.3.) and developed on png opacity changer software (https://onlinepngtools.com/change-png-opacity) and Paint 3D.

5.6.5.1. Demographics. Similar to Study-1, descriptive statistics were run, followed by a Pearson's correlation coefficient to assess whether the demographic variable age influenced the dependent variables, (self-reported) ASMR / misophonic -sensitivity (and within this, frequency, intensity, pleasantness). This way, if found to be significant, it would be used as control variables. Also, an independent samples t-test was run to similarly assess the demographic variable sex.

5.6.5.2. Background Questions. Similar to Study-1 (5.3.5.7.) and previous research (e.g., Barratt et al., 2017; Barratt & Davis, 2015), descriptive statistics of frequency were conducted on the background questions data (on the yes/no/DK / unsure, multiple choice, and open question responses). Specifically, these frequency statistics were transformed into percentages as a means to enable comparisons with prior findings.

5.6.5.3. Developing preliminary prevalence rates for ASMR and misophonia. Like Study-1 (*in* 5.3.5.3.), participant responses on whether they experienced ASMR, misophonia or neither following the presentation of the 16 stimuli were filtered and descriptive statistics of frequency were conducted. Preliminary prevalence rates were then developed based on this. Specifically, this was the percentage of participants who experienced each response on at least one occasion. This was then repeated for those who experienced each response: >5, >10, and >15 times. Again, this provided the preliminary prevalence rates for these responses and gave insight into how it relates to the number of times the phenomena are experienced.

5.6.5.4. Frequency statistics for ASMR and misophonia responses based on stimulus type. As with Study-1 (*in* 5.3.5.4.), and similar to 5.6.5.3., participant responses on whether they experienced ASMR, misophonia or neither were filtered, this time by stimuli, and descriptive statistics of frequency were performed. Percentages of each response following each stimulus were developed based on this. Again, this was to determine whether there is a response (ASMR, misophonia, neither) that is predominantly elicited by a specific type of stimulus (ASMR/misophonic sounds) and to the extent to which the stimuli are idiosyncratic (i.e., a stimulus that is able to elicit both phenomena, in this case, ASMR and misophonia) expressly since idiosyncratic relations between ASMR and misophonia have been reported for a specific stimulus in mouth sounds (in general) but could be possible for other stimuli. Again, upon developing the percentages, a chi square analysis was conducted to test whether the types of stimuli (ASMR/misophonic sounds) were significantly different in their ability to elicit the response they were meant to elicit (i.e., whether each type of stimulus produced significantly different patterns of responses).

5.6.5.5. Emotion responses for ASMR and misophonia. Similar to 5.6.5.3. and Study-1 (5.3.5.3.), participant responses on whether they experienced positive emotion, negative emotion or neither (neutral emotion) following the presentation of the 16 stimuli were filtered and descriptive statistics of frequency were conducted. Emotion responses were based on this. Specifically, this was the percentage of participants who experienced each emotion on at least one occasion. This was then repeated for those who experienced each response: >5, >10, and >15 times. Again, this provided the emotion responses and gave insight into how it relates to the number of times the phenomena are experienced.

5.6.5.6. Frequency statistics for emotion responses based on stimulus type. Similar to 5.6.5.4., 5.6.5.5., and Study-1 (5.3.5.4.), participant responses on whether they experienced positive emotion, negative emotion or neither (neutral emotion) were filtered, this time by stimuli, and descriptive statistics of frequency were performed. Percentages of each emotion following each stimulus were developed based on this. Again, this was to determine whether there is an emotion (positive, negative) that is predominantly elicited by a specific type of stimulus (ASMR/misophonic sounds). Again, similar to 5.6.5.4., 5.6.5.5., and Study-1 (5.3.5.4.), upon developing the percentages, a chi square analysis was conducted to test whether the types of stimuli (ASMR/misophonic sounds) were significantly different in their ability to elicit the emotion typically linked to the response with positive emotion linked with ASMR and negative emotion with misophonia (i.e., whether each type of stimulus produced significantly different patterns of responses).

5.6.5.7. Analysing response associations based on post-task Likert data. As mentioned in Study-1 (*in* 5.3.5.5.), the ASMR and misophonia literatures typically attribute the responses with a degree of pleasantness, with ASMR and ASMR-eliciting sounds commonly regarded as pleasant and misophonia and misophonic sounds the opposite. Not including the findings from Study-1, the relationship between response type and perceived pleasantness has not been experimentally tested and so, analysing this relationship between response type (ASMR or misophonia) and pleasantness score (from the pleasantness Likert scale scores) may either support or reject this theory. Collectively, a Kolmogorov-Smirnov test of normality (Neither: $D(235)=.414$, $p<.001$; ASMR: $D(297)=.347$, $p<.001$; Misophonia: $D(220)=.292$, $p<.001$) and Levene's test of homogeneity of variance ($F(2,749)=14.214$, $p<.001$) showed that the data did not meet the assumptions of normal distribution and homogeneity of variance. Thus, non-parametric tests were employed with a Kruskal-Wallis test applied to analyse the outlined relationship. Moreover, to further examine the association between response type and pleasantness (scores) for specifically both phenomena, Mann-Whitney U tests were also carried out.

Second, neither frequency nor intensity have been the focus of investigation in the literatures of both ASMR or misophonia, meaning that current understandings of these factors separately and if/how they are associated is limited (not including the Study-1 findings). Again, if frequency and intensity are associated, it would likely be in the form of a positive correlation whereby the more ASMR or misophonia is experienced (frequency), the more intense the experiences would be (intensity). Similar to pleasantness, two Kolmogorov-Smirnov tests of normality were run, one on frequency and intensity scores for ASMR (Frequency: $D(290)=.213$, $p<.001$; Intensity: $D(290)=.176$, $p<.001$) and misophonia (Frequency: $D(213)=.208$, $p<.001$; Intensity: $D(213)=.213$, $p<.001$). Neither frequency nor intensity followed a normal distribution for either response hence the need to employ non-parametric tests. Thus, a Spearman's correlation was used to compare frequency and intensity scores (from the frequency and intensity Likert scale scores, respectively) for both ASMR and misophonia responses.

Third, to explore the relationship between ASMR and misophonia, whether there is a significant correlation between: the number of experiences for each response (per participant, ASMR-misophonia), and the intensity to which they are experienced (per participant, ASMR intensity-misophonia intensity), were tested. For ASMR experiences alone, a Kolmogorov-Smirnov test of normality revealed again that the data was not normally distributed (ASMR: $D(47)=0.138$, $p=0.025$; Misophonia: $D(47)=0.119$, $p=0.092$) hence a non-parametric test in the form of a Spearman's correlation was run to test the outlined relationship. Also, as a confirmatory measure of said relation between ASMR and misophonia, whether the intensity to which each response is felt (using medians) is correlated was explored. Once again, a Kolmogorov-Smirnov test of normality revealed that the intensity data was not normally distributed (ASMR Intensity: $D(45)=.141$, $p<.022$; Misophonia Intensity: $D(45)=.187$, $p<.003$) thus another Spearman's correlation was run (whereby medians versus means were used to test such relationships).

Fourth, and novel to Study-2, is the association between response type and emotion. Similar to response-pleasantness, the ASMR and misophonia literatures typically attribute the responses with emotional valence with ASMR commonly associated with positive emotion and misophonia the opposite. As was the case with response-pleasantness, the relationship between response type and perceived emotion has not been experimentally tested and so, analysing this relationship between response type (ASMR or misophonia) and emotion score (from the emotion question scores) may either support or reject this theory. Collectively, a Kolmogorov-Smirnov test of normality (Neither: $D(235)=.447$, $p<.001$; ASMR: $D(297)=.441$, $p<.001$; Misophonia: $D(220)=.528$, $p<.001$) and Levene's test of homogeneity of variance ($F(2,749)=19.466$, $p<.001$) showed that the data did not meet the assumptions of normal distribution and homogeneity of variance. This meant there was a need to employ non-parametric tests therefore, a Kruskal-Wallis test was applied to analyse the outlined relationship. Moreover, to further examine the association between response type and emotion (scores) for specifically both phenomena, Mann-Whitney U tests were also carried out.

5.6.5.8. Mapping the somatic distribution of ASMR somatosensation and misophonic sensations based on the heatmap task stimuli. As mentioned in the beginning of 5.6.5., the survey software used, Gorilla (via its 'canvas paint' function) enabled participants to topographically map their somatosensation while listening to the auditory stimuli presented in the study by colouring body maps (again, outlines of the front and back sides of the human body, labelled) presented alongside each stimulus. This wrote out hyperlinks to png files (i.e., heatmap figures) per stimulus per participant (16 per person).

In total, participants produced 473 usable heatmaps. This excluded 44 unusable heatmaps for the 'neither' response, blank heatmaps, and a single corrupted heatmap. These were then compiled into composite heatmaps by altering their opacity via a freely available online png opacity changer software (https://onlinepngtools.com/change-png-opacity). Opacity levels per individual heatmap were lowered to ensure they matched the proportion of the total number of heatmaps for the response to the stimulus. For instance, a heatmap in a category with four total usable responses (individual heatmaps) would be lowered to 25% opacity. These heatmaps were then layered via the freely available image editing software, Paint 3D. The degree of opacity highlights the frequency of sensation felt, whereby areas with a higher frequency of reports appearing opaquer, and vice versa for areas with a lower frequency. Mapped areas are referred to as clusters. To note, since Gorilla paint function was set to blue-green, this meant the resultant heatmaps were also this colour. Also, all colouring outside the body maps was removed from the subsequent heatmaps.

This resulted in a total of 32 composite heatmaps. This meant there would be 32 individual composite heatmaps made up of each participant's topographical data per individual stimulus. The 32 heatmaps were split into two sets of 16. Regarding the first, since there were 8 ASMR-eliciting and 8 misophonic stimuli, 16 individual heatmaps were developed and grouped to represent ASMR somatosensation for the ASMR-eliciting stimuli and misophonic sensations for the misophonic stimuli. The second set of 16 individual heatmaps consisted of the opposite. They were developed and grouped to represent ASMR somatosensation for the misophonic stimuli and misophonic sensations for the ASMR-eliciting stimuli.

Also, as a failsafe in the event that the heatmap task failed due to technical issues, and as a comparator with the somatic distribution data from Study-1, the text-based method of mapping the somatic distribution of ASMR somatosensation and misophonic sensations developed for the Study-1 somatic distribution data will also be used. Again, one of the questions following the presentation of each auditory stimulus asked participants to report the bodily location(s) in which they experienced either sensation, if at all, and was open-ended. For Study-2 however, this was split into two open-ended questions including the bodily area(s) of origin and spread. Thus, this provided data on the somatic distribution of both sensations (origin and spread) for each of the 16 presented stimuli. Like Study-1 and the previous literature (Barratt & Davis, 2015; Koumura et al., 2019; Swart et al., 2021), the reported areas were collectively mapped onto body map figures (termed 'heatmaps') for both ASMR somatosensation and misophonic sensations. The reported areas of origin were each colour pinpointed per the frequency to which they were reported (>50, 20-50, 10-19, <10) while the reported areas of spread were similarly coloured per the frequency to which they were reported (>50, 20-50, 10-19, <10). Also, like Study-1, paired-samples t-tests were run for key body areas (i.e., those with a frequency of >10) for both ASMR somatosensation and misophonic sensations as a means to compare the somatic distribution data for the two responses. To note, since this data consisted of totals (for each body area for each response type), the sample sizes vary per analysis.

5.7. Results

5.7.1. Demographics

The Pearson's correlation coefficient revealed that the demographic variable age did not significantly correlate with ASMR (r (47) = -.141, p = .346, n.s.), but it did with misophonia (r (47) = .390, p = .007). However, this became non-significant with the removal of a 60yr-old outlier (r (46) = .196, p = .192, n.s.). The independent samples t-test revealed no difference between sex and response (ASMR: t (45) = -1.472, p = .148; Misophonia: t (45) = .354, p = .725) (Table 21). Specifically, males report experiencing ASMR less frequently (males: M = 6.20, SD = 4; females: M = 7.91, SD = 3.939), but report experiencing misophonia more frequently -than females (males: M = 5.16, SD = 3.051; females: 4.86, SD = 2.642).

Table 21

Demographic characteristics and correlations with ASMR and misophonic sensitivity (N = 47)

Demographic Characteristic	Participants (N = 47)	Correlation with ASMR (*p*)	Correlation with Misophonia (*p*)
Age (years)		.346	.007
M (*SD*)	24.72 (7.31)		
Range	18-60		
Sex			
Male	25 (53.19%)		
Female	22 (46.81%)		

Note. For Sex, counts are presented with percentages in parentheses.

Results – Background Questions

5.7.2. Background Questions

Based on the pre-screen survey, all participants (N = 47) self-reported as ASMR-sensitive. Whispered speech (76.60%) and crinkling/crisp sounds (46.81%) were the most frequently reported ASMR-eliciting stimuli, while ‘other’ (a participant’s own response) was the lowest. To note, the ‘other’ category consisted of keyboard typing, scissor snipping, and hairdryer noise. Moreover, mouth sounds (48.94%) and personal attention (34.04%) were the most frequently reported ASMR-eliciting stimuli to rarely/never elicit ASMR, while ‘other’ (a participant’s own response) was the lowest. Further, despite the entire sample self-reporting as ASMR-sensitive, less than half 44.68% (n = 21) reported regular engagement in ASMR media (compared to 51.06% who disagreed, and 4.26% who were unsure). The frequency of reports on each stimulus is provided in Table 22.

Similarly, analysis of responses found that, of the entire sample (N = 47), 78.72% of participants (n = 37) self-reported as misophonic (compared to 21.28% who reported as non-sensitive). Of this subset, scratching/scraping (in general) (72.97%) and mouth sounds (in general) (24.32%) were the most frequently reported misophonia-eliciting stimuli. Also, 38.30% of this misophonic subset (n = 18) agreed that there were ASMR stimuli that triggered their misophonia (compared to 51.06% who disagreed, and 10.64% who were unsure). Mouth sounds (in general) and scratching/scraping (in general) were the most prominent, 55.56% and 33.33% respectively. The frequency of reports on each stimulus is provided in Table 23.

Table 22

ASMR stimuli reported to be most eliciting and rarely or never eliciting in the entire sample (N = 47)

ASMR Stimulus (most eliciting)	Frequency (%)	ASMR Stimulus (rarely/never elicits)	Frequency (%)
Whispered Speech	36 (76.60%)	Mouth Sounds	23 (48.94%)
Crinkling/Crisp Sounds	22 (46.81%)	Personal Attention	16 (34.04 %)
Scratching	21 (44.68%)	Tapping	12 (25.53%)
Tapping	20 (42.55%)	Scratching	12 (25.53%)
Mouth Sounds	18 (38.30%)	Crinkling/Crisp Sounds	11 (23.40%)
Brushing	16 (34.04%)	Brushing	7 (14.89%)
Personal Attention	11 (23.40%)	Whispered Speech	6 (12.77%)
Other	3 (6.38%)	Other	0 (0%)

Note. Stimuli in columns 1 and 3 are placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each ASMR stimulus was reported by the entire sample and the percentages of these frequencies are reported in parentheses.

Table 23

Misophonia stimuli reported to be most eliciting and ASMR stimuli reported to elicit in the misophonic sample (n = 37)

Misophonic Stimulus – most eliciting (n = 37*)	Frequency (%)	ASMR Stimulus – elicits misophonia (n = 18**)	Frequency (%)
Scraping/Scratching	27 (72.97%)	Mouth Sounds	10 (55.56%)
Mouth Sounds	9 (24.32%)	Scraping/Scratching	6 (33.33%)
Teeth Grinding	2 (5.41%)	Nail Filing	1 (5.56%)
Ambient Noises	2 (5.41%)	Brushing	1 (5.56%)
Rubbing Sounds	2 (5.41%)	Tapping	1 (5.56%)
Nail Filing	1 (2.70%)	Whispered Speech	1 (5.56%)
Pen Clicking	1 (2.70%)		
Appliance Sounds	1 (2.70%)		
Animal Noises	1 (2.70%)		
Squeaking Sounds	1 (2.70%)		
Heavy Breathing	1 (2.70%)		
Loud Laughter	1 (2.70%)		
Loud Clattering	1 (2.70%)		
Crinkling/Crisp Sounds	1 (2.70%)		

Note. Stimuli in columns 1 and 3 are placed in order of frequency (from highest at the top to the lowest). Frequency refers to the number of times each misophonic stimulus (column-1) and ASMR stimulus (column-3) was reported by the misophonic sample, and the percentages of these frequencies are reported in parentheses.

*Sample from the total misophonic sample who reported on misophonic stimuli (n = 37).

** Sample from the total misophonic sample who reported on ASMR stimuli that triggers their misophonia (n = 18).

Results – Prevalence

5.7.3. Prevalence – Developing Preliminary Prevalence Rates for ASMR and Misophonia

The descriptive statistics of frequency revealed that 97.87% of the entire sample (N = 47) reported experiencing ASMR at least once, while 97.87% reported experiencing misophonia at least once. When taken further by specifically using those who reported experiencing each phenomenon more often, reductions were prevalent for both responses, reductions in which were greater the more often participants reported experiencing each phenomenon. For ASMR, 68.09% experienced the phenomenon >5 times and 14.89% >10 times. A similar downward trend was present for misophonia with 40.43% experiencing the phenomenon >5 times and 4.26% >10 times. Not a single participant experienced either response >15 times.

5.7.4. Prevalence – Frequencies for ASMR and Misophonia Responses based on Stimulus Type

The descriptive statistics of frequency revealed that each of the 16 stimuli were idiosyncratic in that they were found to elicit either response in at least one participant. The frequency of reports on each stimulus is provided in Table 24 (*and illustrated in* Appendix C.4.). More so, a chi square analysis revealed that the observed frequencies of each response differed significantly from the expected frequencies, depending on the type of stimulus (χ^2 (2, 47) = 94.994, p < .001). ASMR responses were more frequent than expected for ASMR-eliciting stimuli while misophonic responses were less frequent for ASMR-eliciting stimuli. The same was true for misophonic responses for misophonic stimuli.

Table 24

Preliminary prevalence rates of each response for each of the 16 stimuli (N = 47)

Stimuli	Prevalence (%)		
	ASMR	Misophonia	Neither
ASMR Stimuli			
Whispered Speech	76.60%	19.15%	4.26%
Crinkling	51.06%	12.77%	36.17%
Hair Brushing	57.45%	8.51%	34.04%
Keyboard Typing	53.19%	2.13%	44.68%
Page Turning	38.30%	21.28%	40.43%
Scissor Snipping	53.19%	10.64%	36.17%
Tapping	34.04%	14.89%	51.06%
Light Scraping/Scratching	42.55%	17.02%	40.43%
Misophonic Stimuli			
Metal Scraping	6.38%	78.72%	14.89%
Nail Filing	44.68%	27.66%	27.66%
Pen Clicking	40.43%	8.51%	51.06%
Velcro	38.30%	27.66%	34.04%
Polystyrene Scraping	4.26%	89.36%	6.38%
Chewing (gum)	19.15%	42.55%	38.30%
Eating/Crunching (crisps)	40.43%	44.68%	14.89%
Eating/Crunching (apple)	31.91%	42.55%	25.53%

5.7.5. Prevalence – Emotion Responses for ASMR and Misophonia Stimuli

The descriptive statistics of frequency revealed that the entire sample (N = 47) reported experiencing negative emotion at least once, while 97.87% (n = 46) reported experiencing positive emotion at least once. When taken further by specifically using those who reported experiencing each emotion more often, reductions were prevalent for both responses, reductions in which were greater the more often participants reported experiencing each emotion. For negative emotion, 48.94% experienced it >5 times, while not a single participant experienced it >10 times. A similar downward trend was present for positive emotion with 65.96% experiencing it >5 times and 8.51% >10 times, while not a single participant experienced it >15 times.

5.7.6. Prevalence – Frequencies for Emotion Responses based on Stimulus Type

The descriptive statistics of frequency revealed that each of the 16 stimuli were idiosyncratic in that they were found to elicit either emotion in at least one participant. The frequency of reports on each stimulus is provided in Table 25. More so, a chi square analysis revealed that the observed frequencies of each emotion differed significantly from the expected frequencies, depending on the type of stimulus (χ^2 (2, 47) = 109.457, $p < .001$). On closer inspection (of the residuals), emotion responses were more frequent than expected for sounds belonging to each type of stimulus. For instance, positive emotion was more frequent than expected for ASMR-eliciting stimuli while negative emotion was less frequent for ASMR-eliciting stimuli (neutral emotion was higher than both). Similarly, negative emotion was more frequent than expected for misophonic stimuli while positive emotion was less frequent for misophonic stimuli.

Table 25

Emotion responses for each of the 16 stimuli (N = 47)

Stimuli	Prevalence (%)		
	Positive Emotion	Negative Emotion	Neutral Emotion
ASMR Stimuli			
Whispered Speech	63.83%	19.15%	17.02%
Crinkling	44.68%	14.89%	40.43%
Hair Brushing	51.06%	6.38%	42.55%
Keyboard Typing	42.55%	4.26%	53.19%
Page Turning	23.40%	19.15%	57.45%
Scissor Snipping	38.30%	17.02%	44.68%
Tapping	29.79%	10.64%	59.57%
Light Scraping/Scratching	38.30%	19.15%	42.55%
Misophonic Stimuli			
Metal Scraping	4.26%	74.47%	21.28%
Nail Filing	27.66%	27.66%	44.68%
Pen Clicking	36.17%	8.51%	55.32%
Velcro	23.40%	31.91%	44.68%
Polystyrene (scraping)	2.13%	91.49%	6.38%
Chewing (gum)	12.77%	53.19%	34.04%
Eating/Crunching (crisps)	29.79%	48.94%	21.28%
Eating/Crunching (apple)	21.28%	51.06%	27.66%

5.7.7. Prevalence – Associations

5.7.7.1. Response–Pleasantness. The Kruskal-Wallis test revealed a significant effect of response type on pleasantness scores ($H(2) = 426.247$, $p < .001$). Taken further, for ASMR, the Mann-Whitney U test revealed that pleasantness scores were significantly higher (even post Bonferroni correction) for ASMR responses (Mdn = 4) than for no response (Mdn = 3) ($U = 12520$, $z = -13.694$, $p < .001$). In stark contrast, for misophonia, the Mann-Whitney U test revealed that pleasantness scores were significantly lower (again, even post Bonferroni correction) for misophonia responses (Mdn = 2), compared to no response (Mdn = 3) ($U = 5641.5$, $z = -15.266$, $p < .001$).

5.7.7.2. Frequency–Intensity. For ASMR, the Spearman's correlation revealed a significant positive correlation between frequency and intensity scores when experiencing ASMR (r_s (290) = .573, $p < .001$). A similar trend was found for misophonia whereby the Spearman's correlation revealed a significant positive correlation between frequency and intensity scores when experiencing misophonia (r_s (213) = 0.654, $p < .001$) (*see* Figures 11-12.).

5.7.7.3. ASMR–Misophonia. Regarding the number of experiences of each response (ASMR and misophonia), the Spearman's correlation revealed a significant negative correlation between the number of times ASMR was experienced and the number of times misophonia was experienced (r_s (47) = -.438, $p = .002$). In contrast, regarding the intensity in which the responses were reportedly felt, the Spearman's correlation revealed a non-significant correlation between ASMR and misophonia median intensity scores (r_s (45) = .272, $p = .071$, n.s.). Checking to determine whether this was due to the exclusion of the data of two participants (since two individuals only ever reported on the intensity of one response for every stimulus versus both responses), the same analysis was re-run including this data. Again, however, the Spearman's correlation revealed a non-significant relationship between ASMR and misophonia median intensity scores by a margin (r_s (47) = .281, p = .056, n.s.) (*see* Figures 13-14.).

5.7.7.4. Response–Emotion. The Kruskal-Wallis test revealed a significant effect of response type on emotion score (*H*(2) = 509.260, p < .001). Taken further, for ASMR, the Mann-Whitney U test revealed that emotion scores were significantly higher (even post Bonferroni correction) for ASMR responses (Mdn = 3) than for no response (Mdn = 2) (U = 12296, z = -14.457, p < .001). In stark contrast, for misophonia, the Mann-Whitney U test revealed that emotion scores were significantly lower (again, even post Bonferroni correction) for misophonia responses (Mdn = 1), compared to no response (Mdn = 2) (U = 4631.5, z = -17.192, p < .001).

Figure 11

Relationship between the ASMR frequency scores and ASMR intensity scores

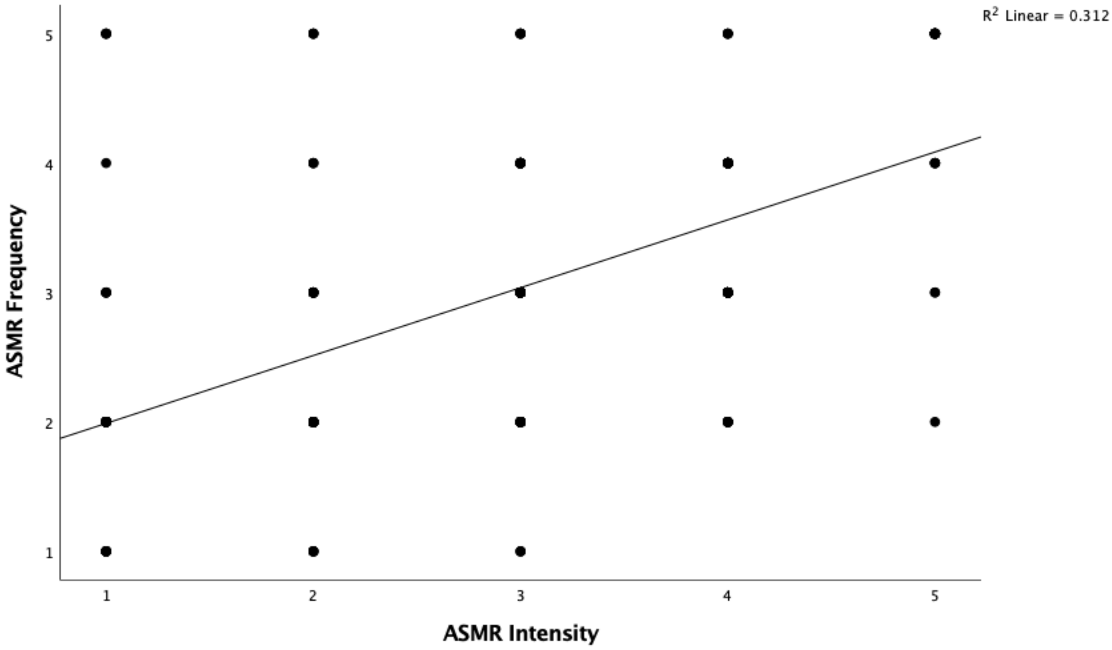


Figure 12

Relationship between the misophonia frequency scores and misophonia intensity scores

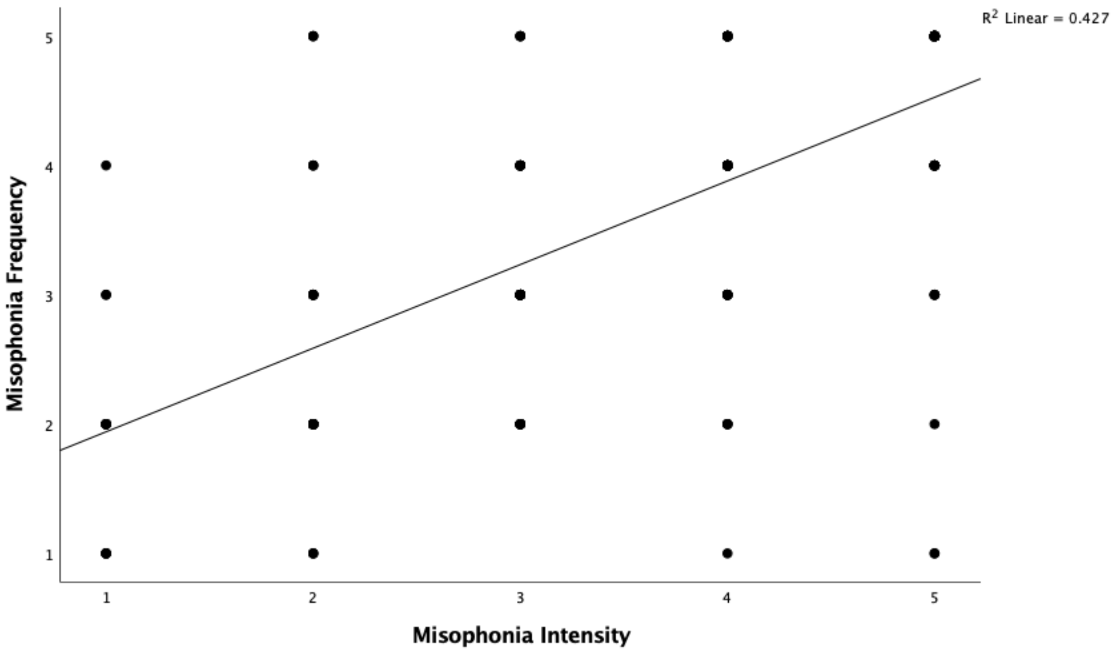


Figure 13

Relationship between the number of times ASMR was experienced (ASMR count) and the number of times misophonia was experienced (misophonia count)

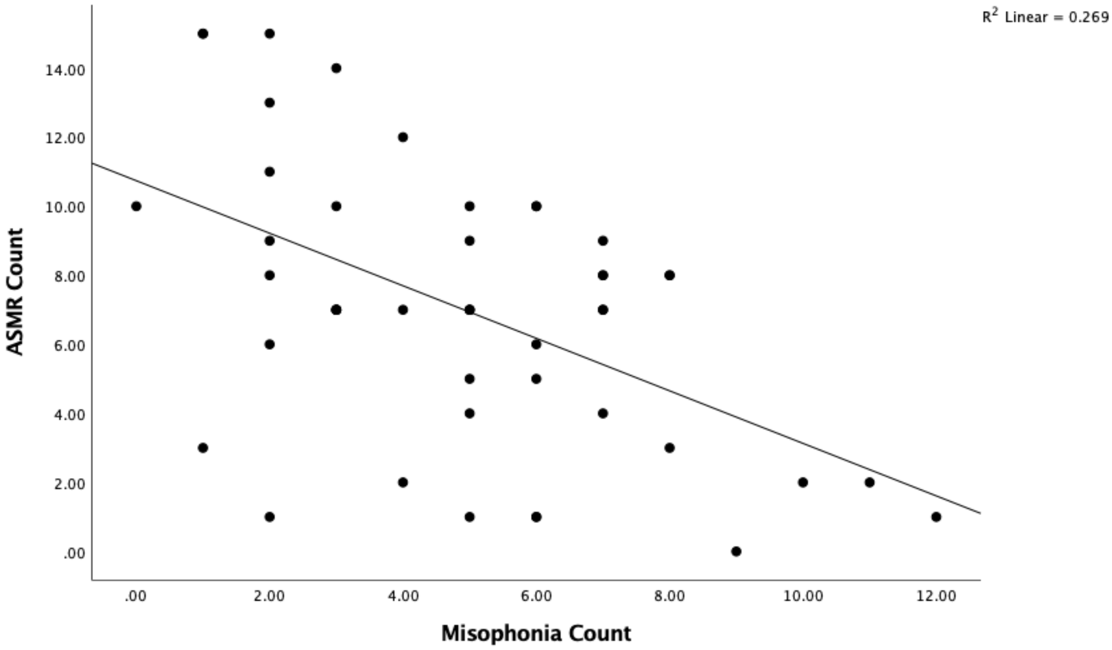
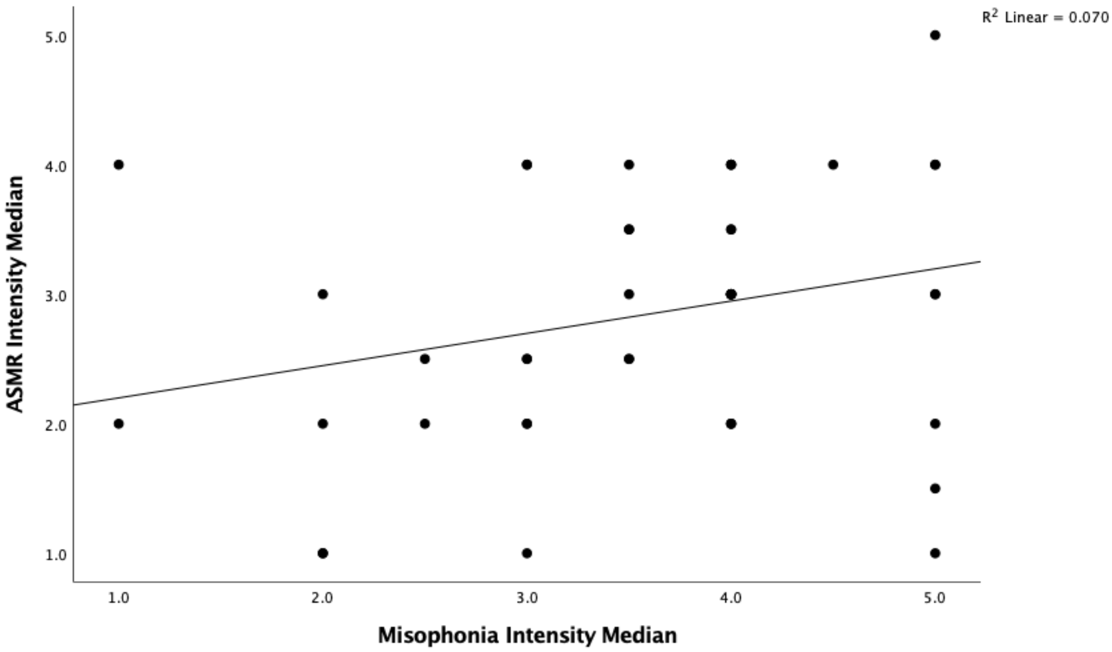


Figure 14

Relationship between the ASMR intensity scores (medians) and the misophonia intensity scores (medians)



Results – Heatmaps

5.7.8. Heatmap Task – Mapping the Somatic Distribution of ASMR Somatosensation on Heatmaps 1

With the present sample screened as ASMR-sensitive, they have all, at some point, experienced ASMR somatosensation. Each stimulus elicited ASMR somatosensation in at least one participant. Since participants responded differently to each stimulus, there are variations in sample numbers for each figure.

For the ASMR stimuli that elicited ASMR (5.7.8.1.), collectively, clusters are visible mainly around the head (in general but mostly the ears), neck, shoulders, and spine, while the chest, stomach/abdomen, arms, and legs are also visible (Figures 15-22). This trend is present in all 8 ASMR-eliciting stimuli. The ASMR-eliciting stimuli that elicited ASMR somatosensation most frequently was whispered speech.

For the misophonic stimuli that elicited ASMR (5.7.8.2.), collectively, clusters are visible mainly around the head (in general but mostly the ears), while the neck, shoulders, spine, stomach/abdomen, arms, and legs are also visible (Figures 23-30). This trend is present in all 8 misophonic stimuli. The misophonic stimuli that elicited ASMR somatosensation most frequently was nail filing.

5.7.8.1. ASMR-Eliciting Stimuli – ASMR Somatosensation

Figure 15

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for whispered speech (n = 35)

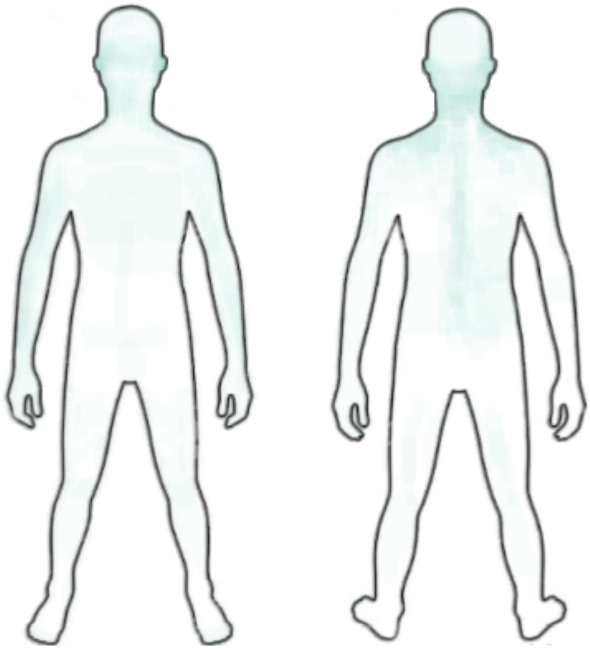


Figure 16

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for crinkling (n = 24)

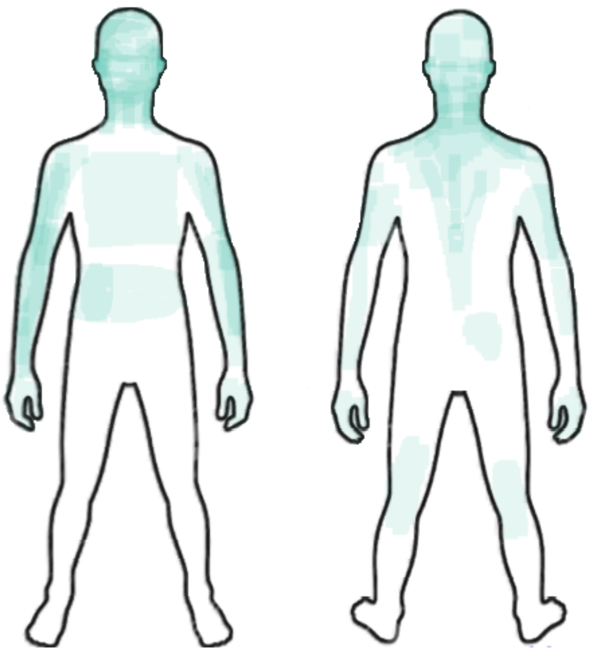


Figure 17

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for hair brushing (n = 26)

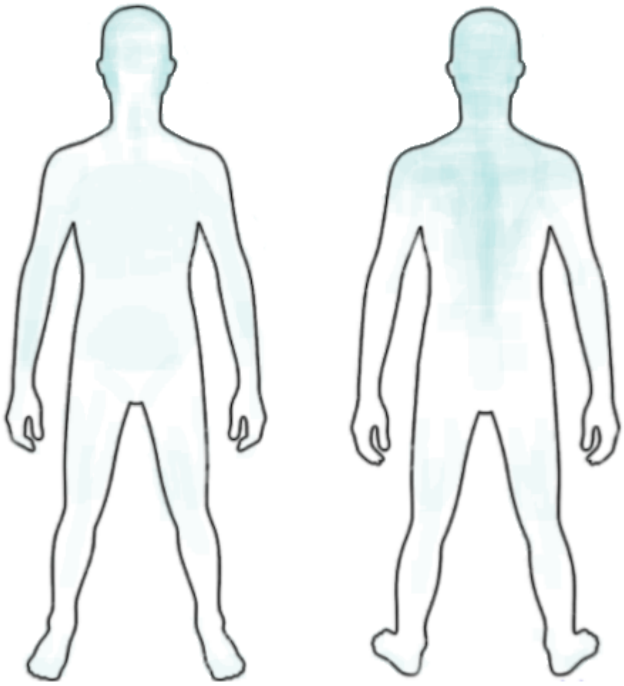


Figure 18

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for keyboard typing (n = 24)

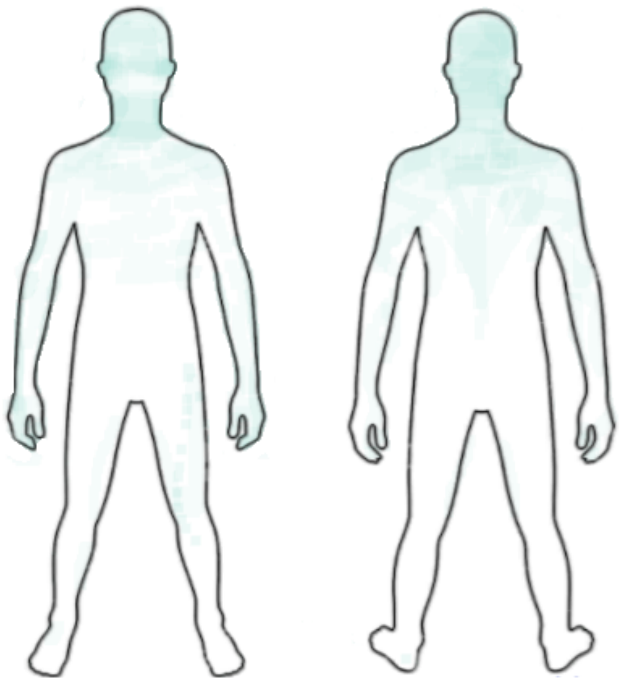


Figure 19

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for page turning (n = 15)

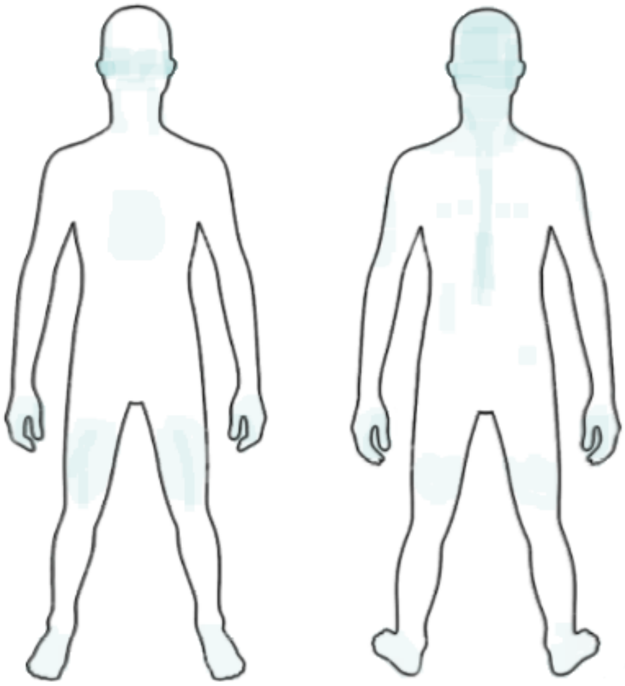


Figure 20

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for scissor snipping (n = 22)

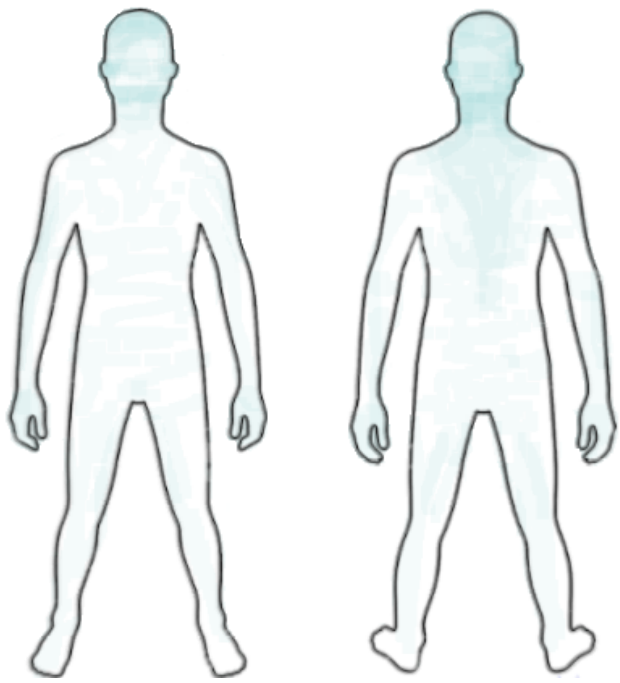


Figure 21

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for tapping (n = 16)

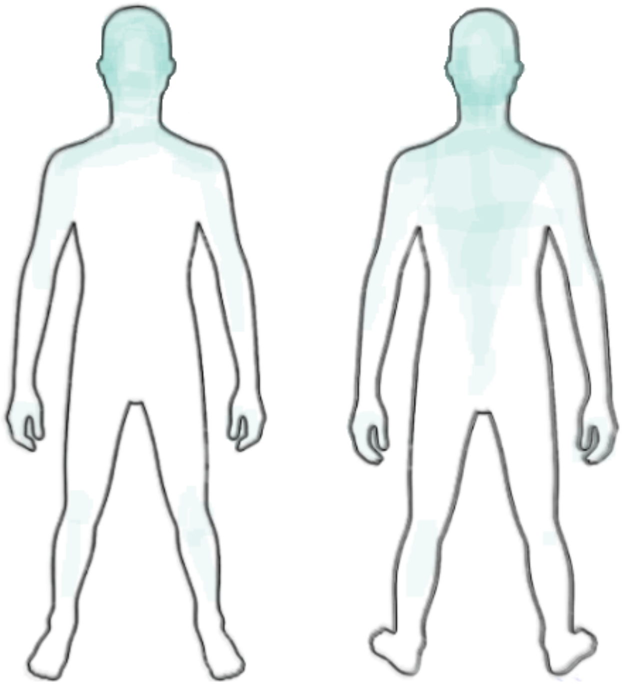
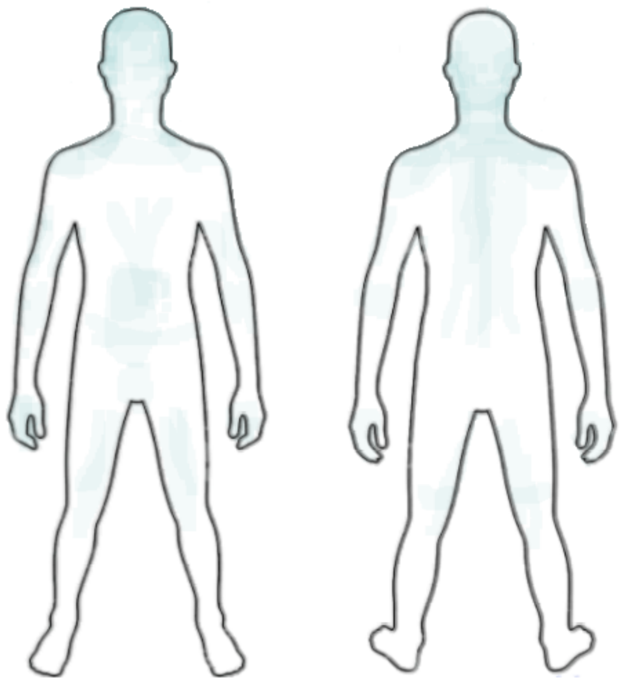


Figure 22

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for light scraping/scratching (n = 19)



5.7.8.2. Misophonic Stimuli – ASMR Somatosensation

Figure 23

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for metal scraping (n = 3)

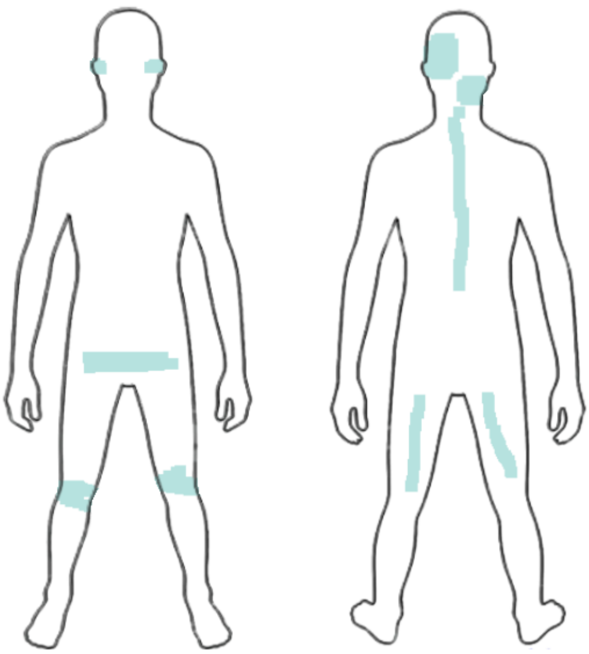


Figure 24

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for nail filing (n = 20)

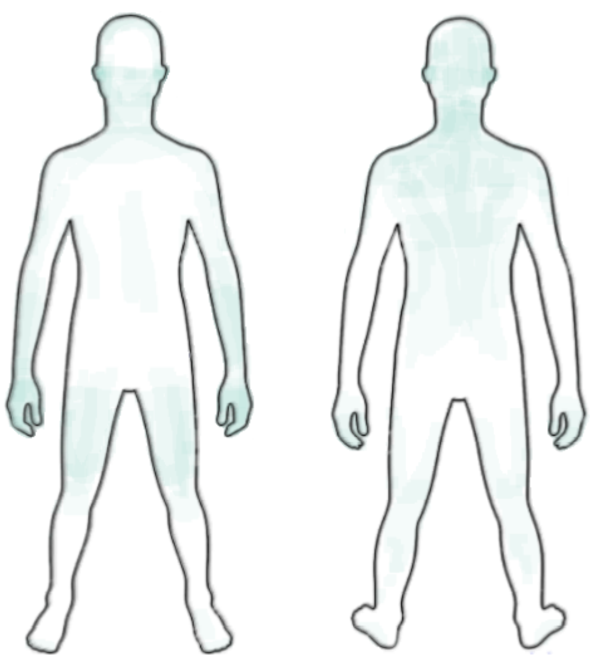


Figure 25

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for pen clicking (n = 19)

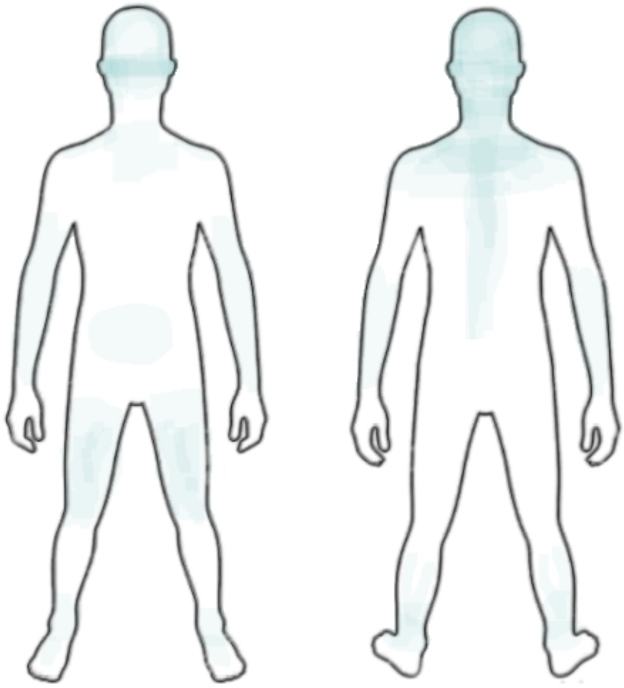


Figure 26

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for Velcro (n = 15)

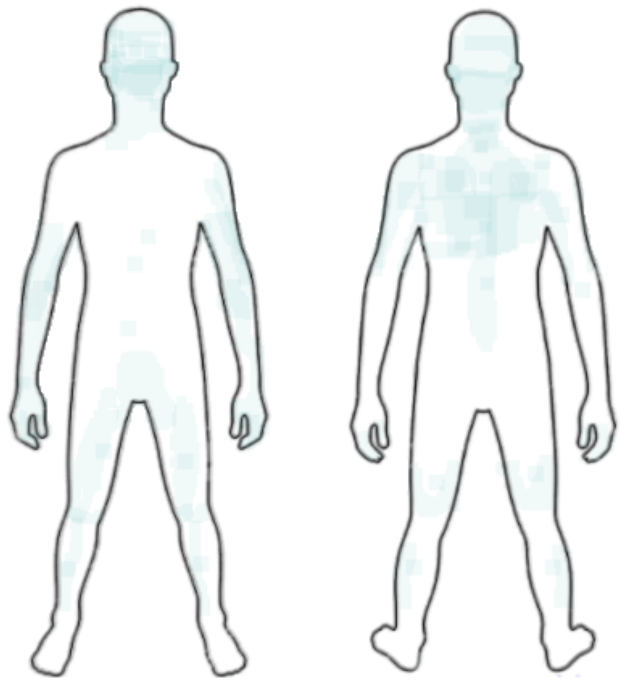


Figure 27

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for polystyrene scraping (n = 2)

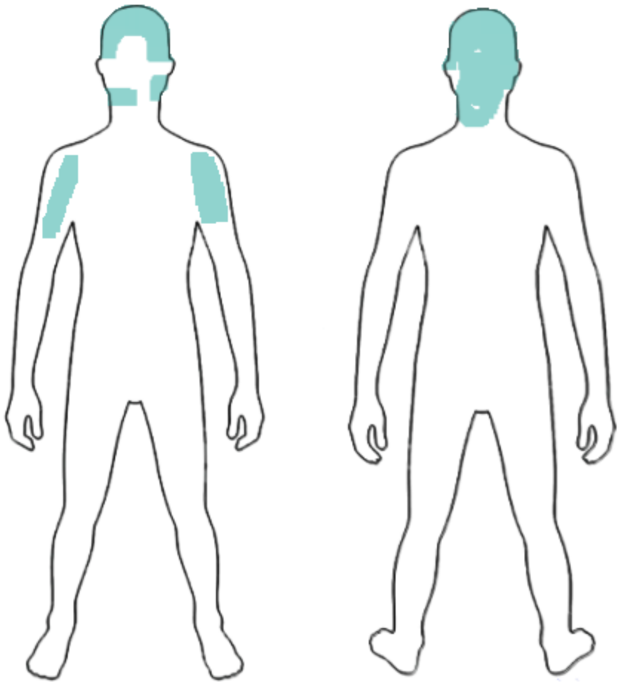


Figure 28

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for chewing gum (n = 8)

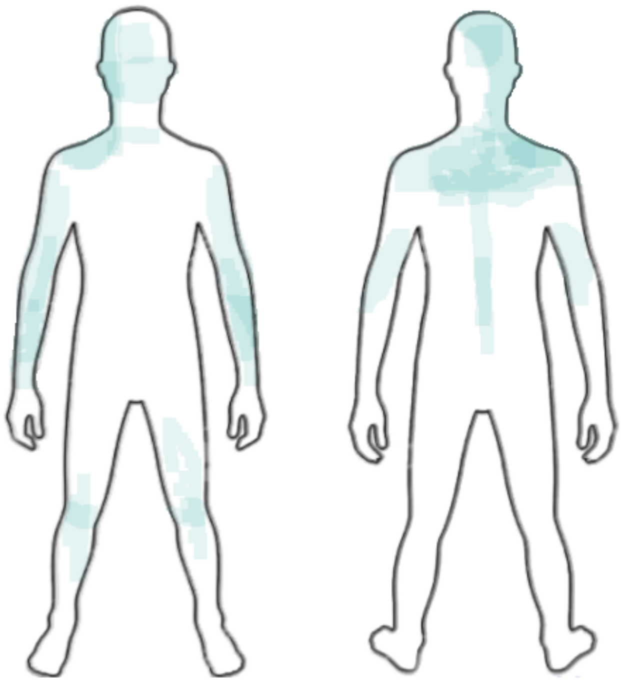


Figure 29

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for eating/crunching (crisps) (n = 17)

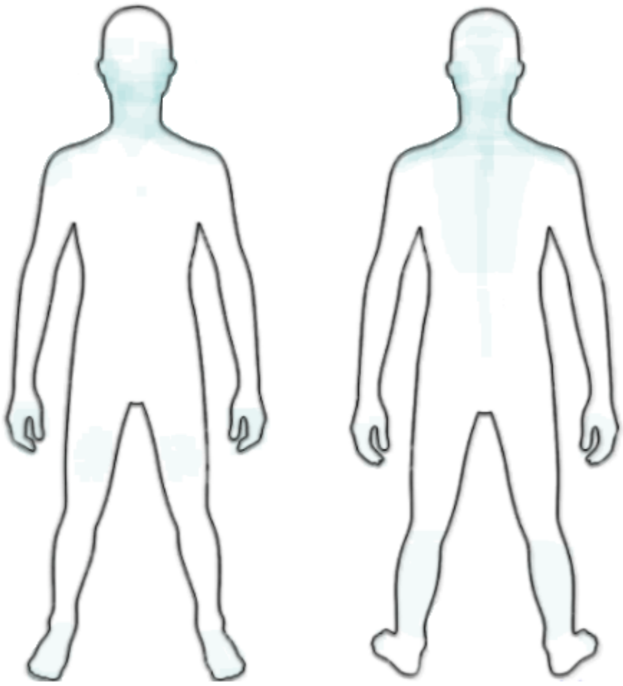
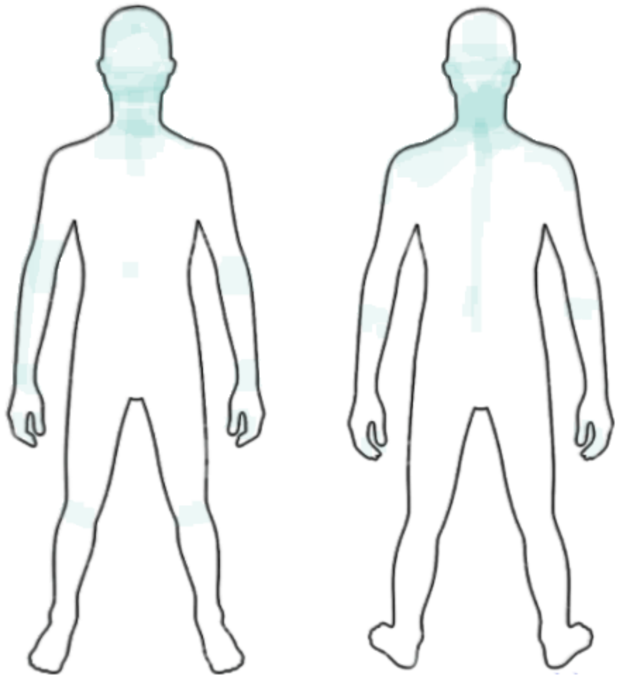


Figure 30

Collective heatmap (L-front, R-back) illustrating ASMR somatosensation for eating/crunching (apple) (n = 12)



5.7.9. Heatmap Task – Mapping the Somatic Distribution of ASMR Somatosensation on Heatmaps 2

With the present sample screened as ASMR-sensitive, they have all, at some point, experienced ASMR somatosensation. In the case of this study, specifically, the experience of ASMR somatosensation originated mainly around the head (in general), ears, neck, back, arms, and legs but also in several other areas. To note, most participants reported more than one area of origin, implying that ASMR somatosensation originated in more than one bodily area. Moreover, ASMR somatosensation was reported to spread to other bodily areas with the head (in general), ears, shoulders, and back being the most frequently reported though it also spread to several other areas. The frequency of reports on each bodily area (origin and spread) is provided in Table 26. An illustration of the areas of origin and spread reported by this ASMR-sensitive sample is provided in Figure 31.

Similar to Study-1 (5.4.5.), regarding the key areas, paired-samples t-tests enabled comparison between the somatic distribution findings for the two responses (ASMR/misophonia). For example, for the scalp, the mean was higher for ASMR ($M=1.0$, $SD=.001$) than misophonia ($M=.21$, $SD=.426$). The difference in means (difference = .786) was statistically significant, $t(13) = 6.904$, $p=.001$. Also, for the teeth, the mean was higher for misophonia ($M=1.0$, $SD=.001$) than ASMR ($M=.22$, $SD=.428$). The difference in means (difference = -.778) was statistically significant, $t(17) = -7.714$, $p=.001$. The remaining t-tests and accompanying heatmaps can be found in Appendix C.7-8.

Table 26

Reported areas of origin and spread for ASMR somatosensation in the entire sample (N = 47)

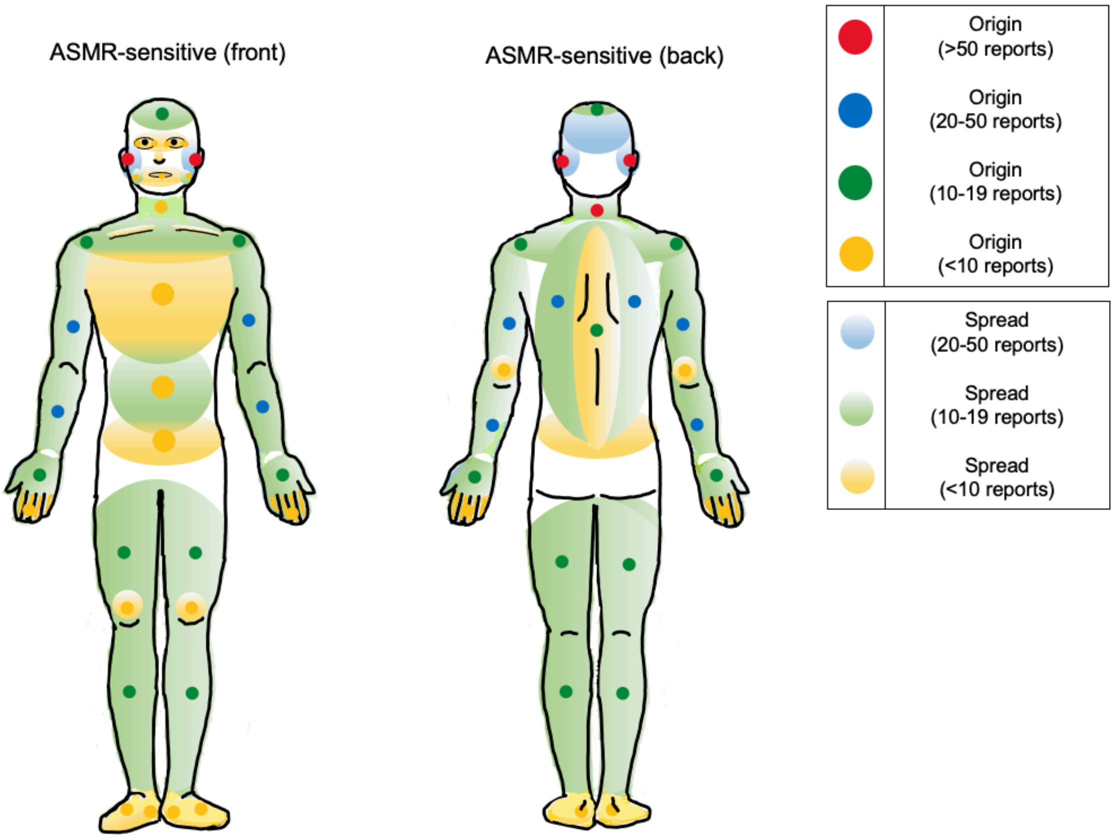
Body Area – Origin	Frequency (%)	Body Area – Spread	Frequency (%)
Head		Head	
Head (general)	42 (14.14%)	Head (general)	26 (8.75%)
Scalp/Brain	14 (4.71%)	Scalp/Brain	10 (3.37%)
Face	8 (2.69%)	Face	7 (2.36%)
Eyes	5 (1.68%)	Eyes	3 (1.01%)
Ears	73 (24.58%)	Ears	32 (10.77%)
Mouth (general)	6 (2.02%)	Nose	1 (0.34%)
Mouth (teeth)	4 (1.35%)	Mouth (general)	3 (1.01%)
Mouth (jaws)	3 (1.01%)	Mouth (teeth)	3 (1.01%)
Neck	69 (23.23%)	Mouth (jaws)	13 (4.38%)
Throat	1 (0.34%)	Neck	11 (3.70%)
Shoulders	11 (3.70%)	Throat	10 (3.37%)
Back	30 (10.10%)	Shoulders	16 (5.39%)
Spine	14 (4.71%)	Collarbones	5 (1.68%)
Chest	6 (2.02%)	Back	18 (6.06%)
Stomach/Abdomen	2 (0.67%)	Spine	5 (1.68%)
Pelvis	1 (0.34%)	Chest	7 (2.36%)
Limbs		Stomach/Abdomen	11 (3.70%)
Arms	24 (8.08%)	Pelvis	2 (0.67%)
Elbows	1 (0.34%)	Limbs	
Hands	11 (3.70%)	Arms	10 (3.37%)
Fingers	5 (1.38%)	Elbows	7 (2.36%)

Legs	18 (6.06%)	Hands	12 (4.04%)
Knees	6 (2.02%)	Fingers	7 (2.36%)
Ankles	1 (0.34%)	Legs	12 (4.04%)
Feet	3 (1.01%)	Knees	3 (1.01%)
Whole Body	1 (0.34%)	Ankles	1 (0.34%)
		Feet	3 (1.01%)
		Toes	2 (0.67%)

Note. Frequency refers to the number of times each body area was reported by the entire sample and the percentages of these frequencies are reported in parentheses. These frequencies were based on total participant responses for ASMR (297) rather than the sample (since this resulted in responses over 100%).

Figure 31

Mapping the somatic distribution of ASMR somatosensation in the entire sample



Note. An illustration of ASMR somatosensation (from both the front and back). Coloured dots represent the areas in which ASMR somatosensation was reported to originate, while the pale, transparent areas represent the spread of ASMR somatosensation to other parts of the body. Specifically, red dots represent those that had been reported more than 50 times; blue dots and pale transparent blue areas represent those that had been reported 20-50 times, green dots and pale transparent green areas for those reported between 10-19 times; and yellow dots and pale transparent yellow areas for those reported less than 10 times. Although this diagram illustrates several singular points of origin, due to the individualistic nature of the phenomenon, it was necessary to include all reported points of origin.

5.7.10. Heatmap Task – Mapping the Somatic Distribution of Misophonic Sensations on Heatmaps 1

Although the present sample were ASMR-sensitive, there were also several reports of experiencing misophonic sensations. Each stimulus elicited misophonic sensations in at least one participant. Since participants responded differently to each stimulus, there are variations in sample numbers for each figure.

For the misophonic stimuli that elicited misophonia (5.7.10.1), collectively, clusters are visible mainly around the head (in general but mostly the ears and orofacial areas), neck, spine, back, and stomach/abdomen, while the shoulders, chest, arms, and legs are also visible (Figures 32-39). This trend is present in all 8 misophonic stimuli. The misophonic stimuli that elicited misophonic sensations most frequently was scraping (both metal and polystyrene).

For the ASMR stimuli that elicited misophonia (5.7.10.2), collectively, clusters are visible mainly around the head (in general but mostly the ears), neck, spine, and shoulders, while the chest, stomach/abdomen, arms, and legs are also visible (Figures 40-47). This trend is present in all 8 ASMR-eliciting stimuli. The ASMR-eliciting stimuli that elicited misophonic sensations most frequently was page turning.

5.7.10.1. Misophonic Stimuli – Misophonic Sensations

Figure 32

Collective heatmap (L-front, R-back) illustrating misophonic sensations for metal scraping (n = 30)

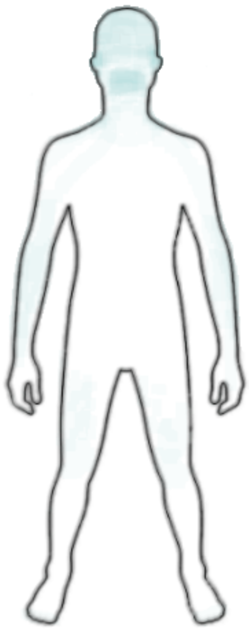


Figure 33

Collective heatmap (L-front, R-back) illustrating misophonic sensations for nail filing (n = 11)

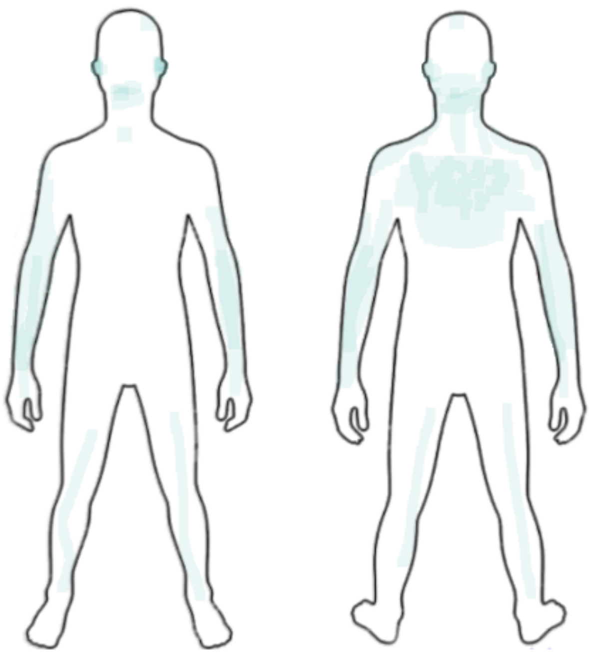


Figure 34

Collective heatmap (L-front, R-back) illustrating misophonic sensations for pen clicking (n = 4)

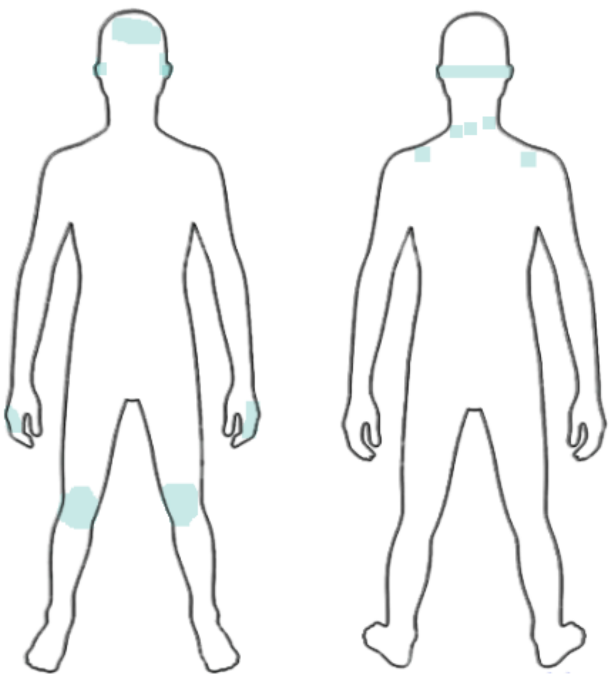


Figure 35

Collective heatmap (L-front, R-back) illustrating misophonic sensations for Velcro (n = 11)

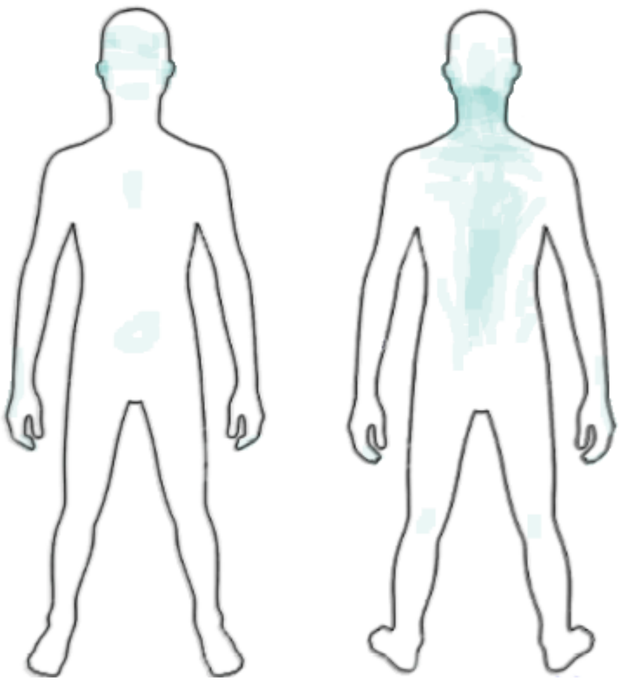


Figure 36

Collective heatmap (L-front, R-back) illustrating misophonic sensations for polystyrene scraping (n = 37)

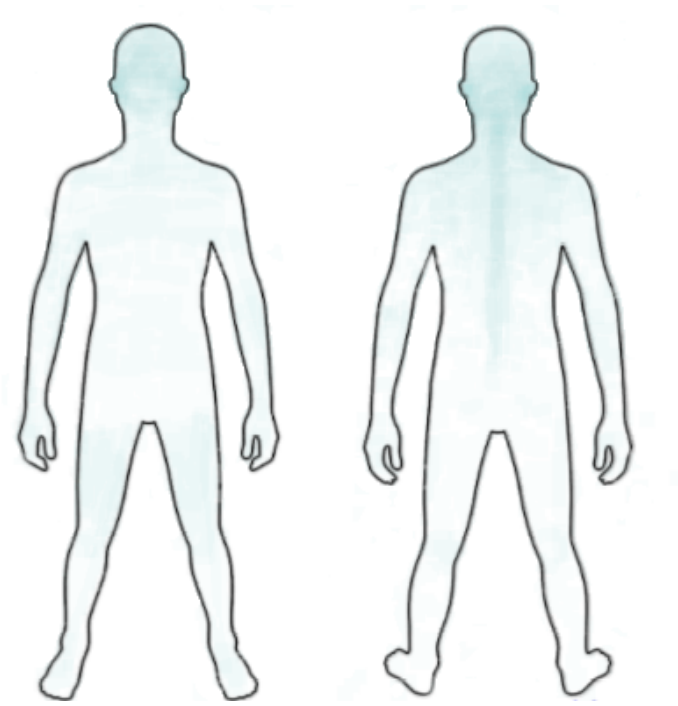


Figure 37

Collective heatmap (L-front, R-back) illustrating misophonic sensations for chewing gum (n = 18)

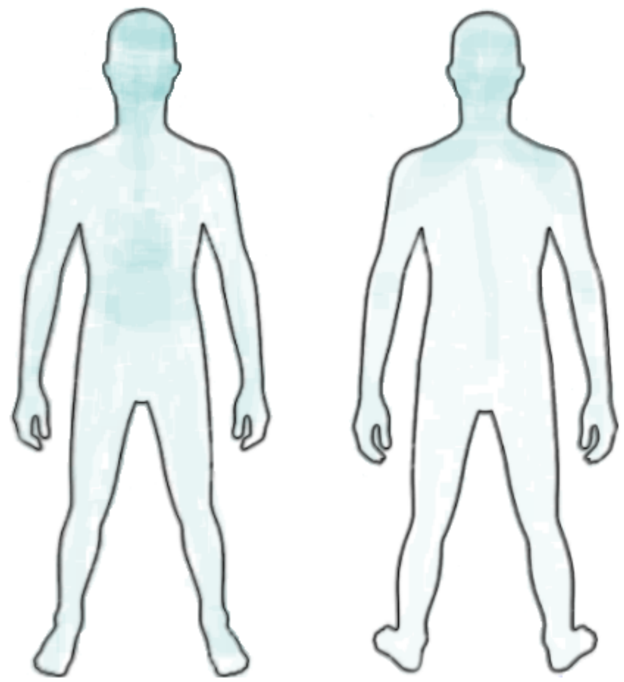


Figure 38

Collective heatmap (L-front, R-back) illustrating misophonic sensations for eating/crunching (crisps) (n = 20)

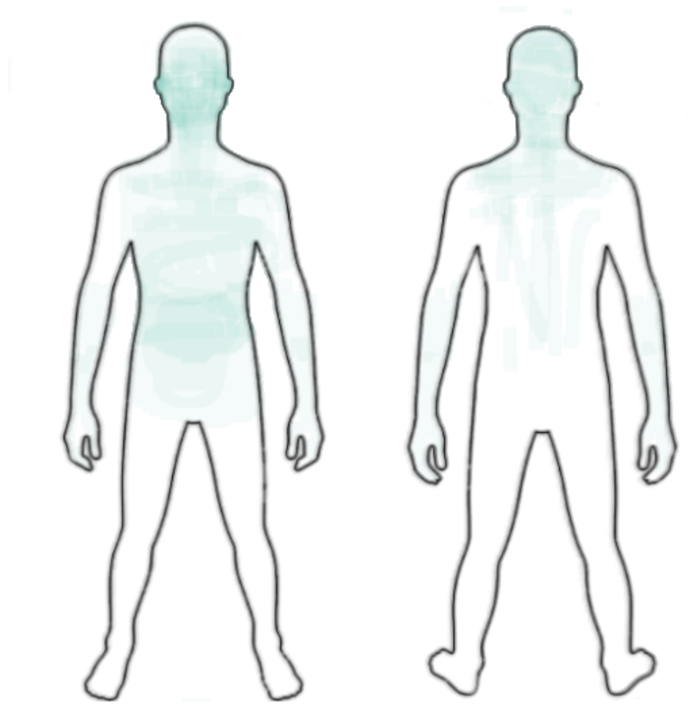
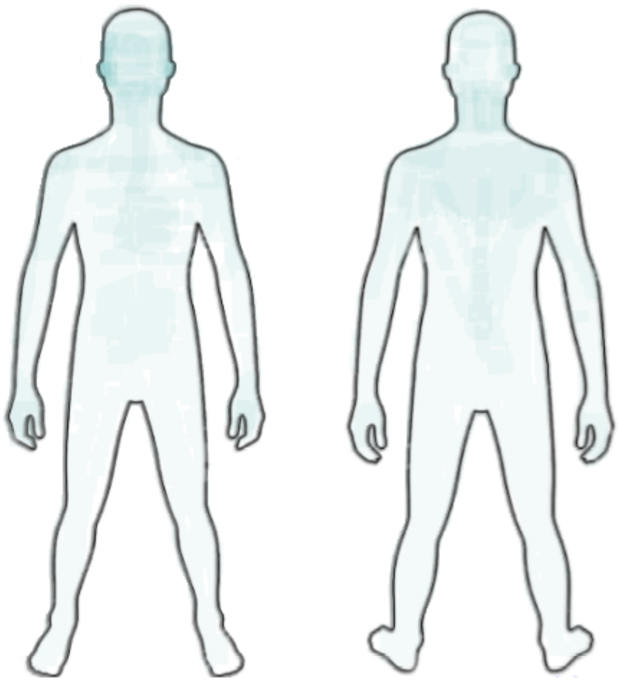


Figure 39

Collective heatmap (L-front, R-back) illustrating misophonic sensations for eating/crunching (apple) (n = 19)



5.7.10.1. ASMR-Eliciting Stimuli – Misophonic Sensations

Figure 40

Collective heatmap (L-front, R-back) illustrating misophonic sensations for whispered speech (n = 8)

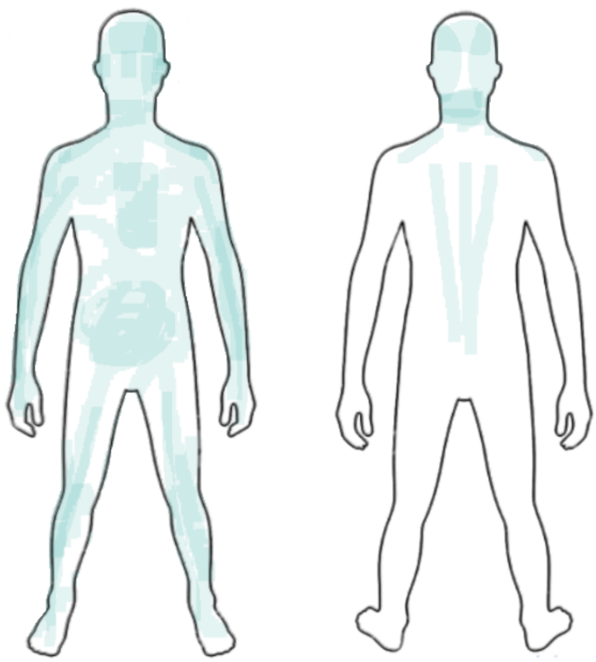


Figure 41

Collective heatmap (L-front, R-back) illustrating misophonic sensations for crinkling (n = 5)

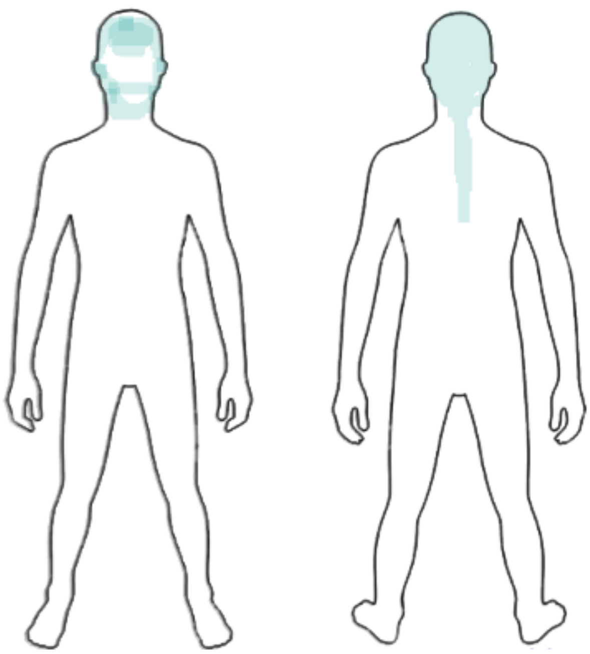


Figure 42

Collective heatmap (L-front, R-back) illustrating misophonic sensations for hair brushing (n = 4)

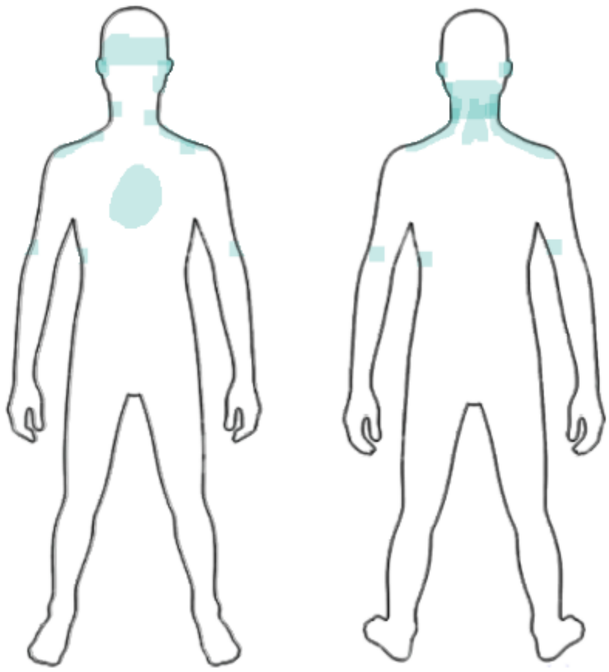


Figure 43

Collective heatmap (L-front, R-back) illustrating misophonic sensations for keyboard typing (n = 1)

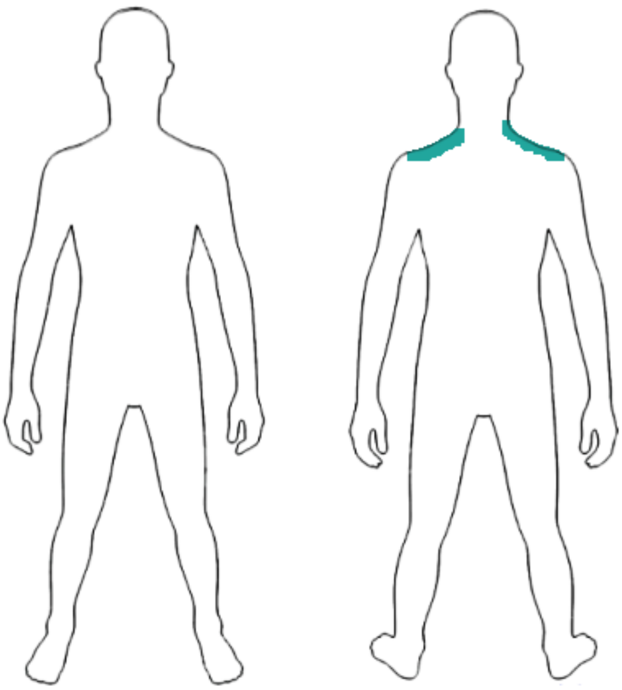


Figure 44

Collective heatmap (L-front, R-back) illustrating misophonic sensations for page turning (n = 9)

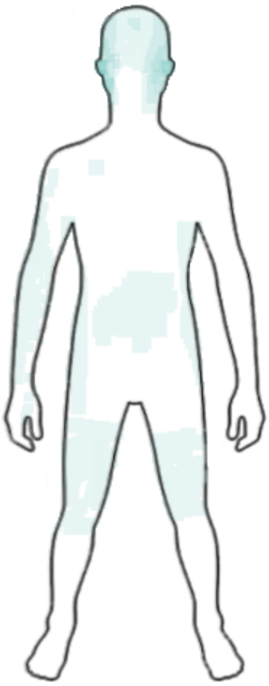


Figure 45

Collective heatmap (L-front, R-back) illustrating misophonic sensations for scissor snipping (n = 5)

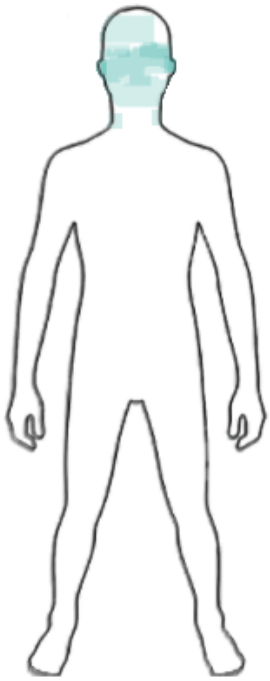


Figure 46

Collective heatmap (L-front, R-back) illustrating misophonic sensations for tapping (n = 6)

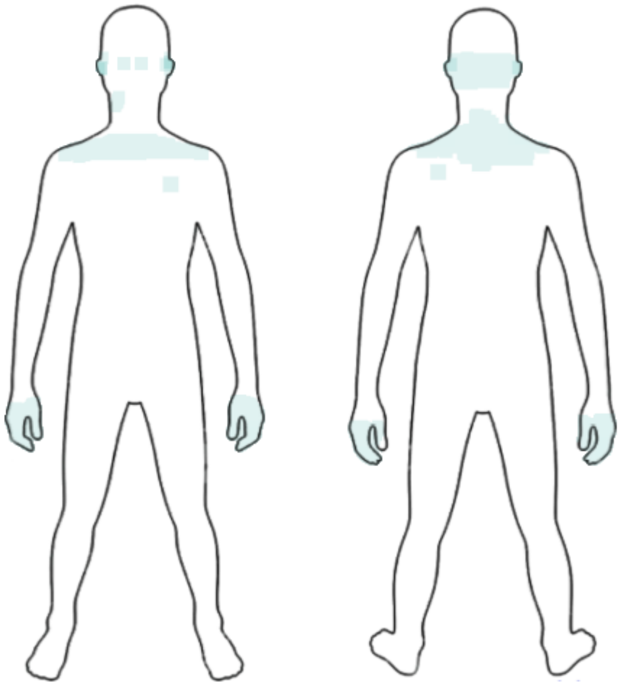
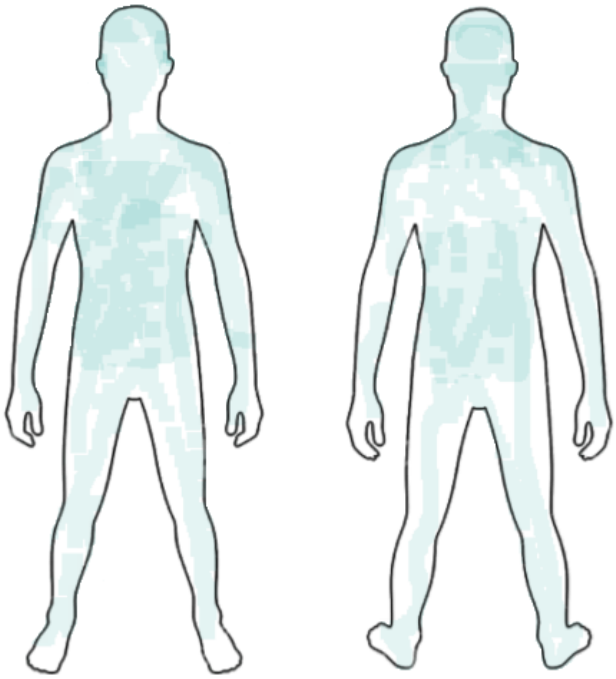


Figure 47

Collective heatmap (L-front, R-back) illustrating misophonic sensations for light scraping/scratching (n = 8)



5.7.11. Heatmap Task – Mapping the Somatic Distribution of Misophonic Sensations on Heatmaps 2

Although the present sample were ASMR-sensitive, there were also several reports of experiencing misophonic sensations in multiple bodily regions. In the case of this study, specifically, misophonic sensations originated mainly around the head (in general), ears, teeth, neck, and back but also in several other areas. To note, most participants reported more than one area of origin, implying that misophonic sensations originated in more than one bodily area. Moreover, misophonic sensations were reported to spread to other bodily areas with the head (in general), ears, neck, and shoulders being the most frequently reported though it also spread to several other areas. The frequency of reports on each bodily area (origin and spread) is provided in Table 27. An illustration of the areas of origin and spread reported by this ASMR-sensitive sample is provided in Figure 48.

Table 27

Reported areas of origin and spread for misophonic sensations in the entire sample (N = 47)

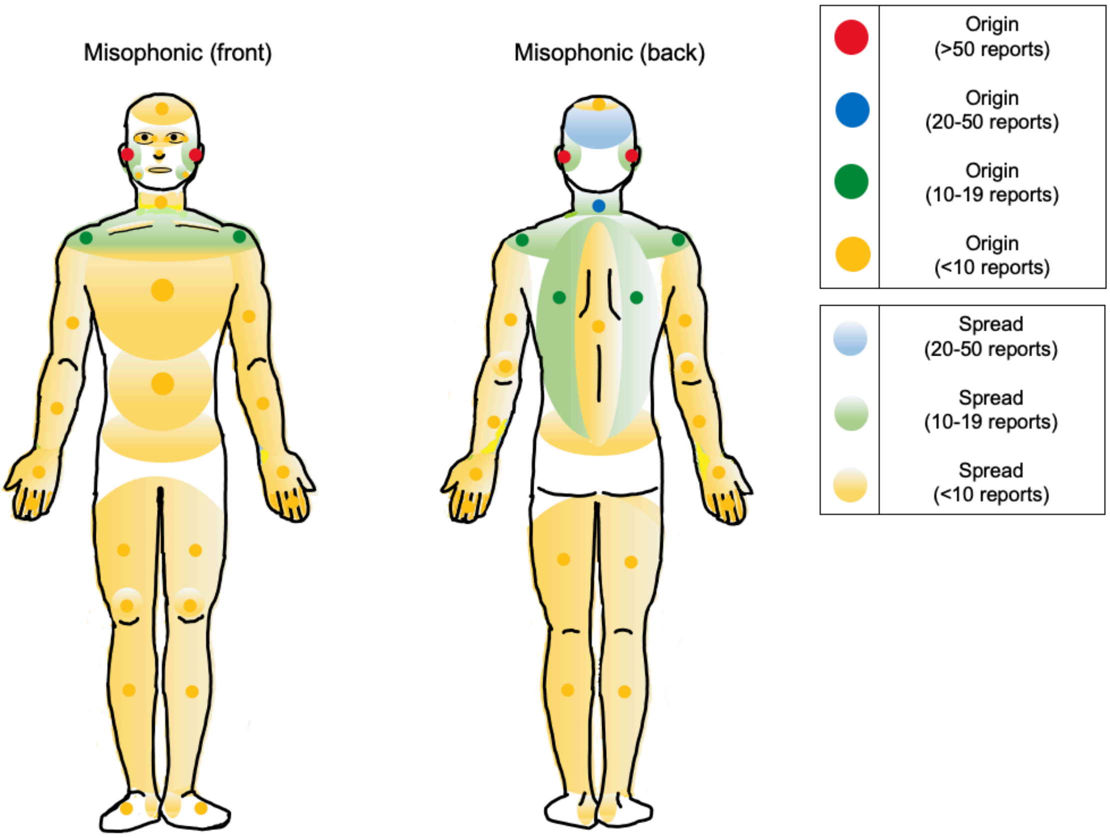
Body Area – Origin	Frequency (%)	Body Area – Spread	Frequency (%)
Head		Head	
Head (general)	49 (22.27%)	Head (general)	29 (13.18%)
Scalp/Brain	3 (1.36%)	Scalp/Brain	2 (0.91%)
Face	4 (1.82%)	Face	4 (1.82%)
Eyes	9 (4.09%)	Eyes	4 (1.82%)
Ears	55 (25%)	Ears	19 (8.64%)
Nose	1 (0.45%)	Nose	5 (2.27%)
Mouth (general)	5 (2.27%)	Mouth (teeth)	6 (2.73%)
Mouth (teeth)	18 (8.18%)	Mouth (jaws)	12 (5.45%)
Mouth (gums)	1 (0.45%)	Neck	19 (8.64%)
Mouth (jaws)	2 (0.91%)	Throat	5 (2.27%)
Neck	34 (15.45%)	Shoulders	15 (6.82%)
Throat	1 (0.45%)	Collarbones	6 (2.73%)
Shoulders	10 (4.55%)	Back	11 (5%)
Back	18 (8.18%)	Spine	9 (4.09%)
Spine	7 (3.18%)	Chest	5 (2.27%)
Chest	9 (4.09%)	Stomach/Abdomen	6 (2.73%)
Stomach/Abdomen	7 (3.18%)	Pelvis	2 (0.91%)
Limbs		Limbs	
Arms	9 (4.09%)	Arms	7 (3.18%)
Elbows	1 (0.45%)	Elbows	2 (0.91%)
Hands	2 (0.91%)	Wrists	2 (0.91%)

Fingers	2 (0.91%)	Hands	1 (0.45%)
Legs	7 (3.18%)	Fingers	3 (1.36%)
Knees	1 (0.45%)	Legs	6 (2.73%)
Feet	2 (0.91%)	Knees	2 (0.91%)
Toes	1 (0.45%)	Ankles	1 (0.45%)
Whole Body	8 (3.64%)	Whole Body	2 (0.91%)

Note. Frequency refers to the number of times each body area was reported by the entire sample and the percentages of these frequencies are reported in parentheses. These frequencies were based on total participant responses for misophonia (220) rather than the sample (since this resulted in responses over 100%).

Figure 48

Mapping the somatic distribution of misophonic sensations in the entire sample



Note. An illustration of misophonic sensations (from both the front and back). Coloured dots represent the areas in which misophonic sensations were reported to originate, while the pale, transparent areas represent the spread of misophonic sensations to other parts of the body. Specifically, red dots represent those that had been reported more than 50 times; blue dots and pale transparent blue areas represent those that had been reported 20-50 times, green dots and pale transparent green areas for those reported between 10-19 times; and yellow dots and pale transparent yellow areas for those reported less than 10 times. Although this diagram illustrates several singular points of origin, due to the individualistic nature of the phenomenon, it was necessary to include all reported points of origin.

5.8. Discussion

The current study sought to build on Study-1 by investigating the prevalence and somatic distribution of ASMR and misophonic sensations, certain aspects of response phenomenology, and the potential similarities and differences between ASMR and misophonia. A survey with a design that implemented a prevalence and heatmap task was employed to explore this.

5.8.1. Preliminary Prevalence Rates for ASMR and Misophonia

Although the present sample consisted of solely ASMR-sensitive individuals, preliminary prevalence rates were developed for ASMR and misophonia regardless. Since the Study-1 prevalence findings were hampered due to a recruitment issue leading to them not being representative of the general population, they will not be used as a comparator with the present prevalence rate findings for Study-2. The present results revealed high prevalence rates for both ASMR (97.87%) and misophonia (97.87%), as predicted, and implying possible co-occurrence, or at least, the potential universality of misophonia.

Surprisingly though, despite having an ASMR-sensitive sample, 100% prevalence for ASMR stimuli was not reported since one participant did not experience ASMR in response to any of the presented audio (ASMR-eliciting or misophonic) and likewise for misophonia. It is likely however, that this evidences the individualistic nature of the response and those sensitive to it.

Since the present sample were ASMR-sensitive, ASMR prevalence is less interesting in the case of this study. Misophonic prevalence, however, is the opposite. As mentioned above, due to the high prevalence of misophonia within an ASMR-sensitive sample, the inference that these two perceptual phenomena may indeed co-occur is reasonable. Also, the high prevalence rate is inconsistent with the existing literature though this is again likely due to differing methodologies and misophonia terminologies. Once more, this brings to attention the need to update descriptions and screening practices for this response (and ASMR), perhaps incorporating a sensitivity spectrum wherein all levels of misophonic sensitivity (from general irritation to clinically debilitating at the two extremes). It is a possibility that the high misophonic prevalence reported in this study may be a truer representation, at least, of individuals likely to have a lower, non-clinical version of misophonia.

5.8.2. Idiosyncrasy of ASMR and Misophonic Stimuli

Similar to Study-1, complementary to investigating the prevalence of both responses, ascertaining the frequency and degree of idiosyncrasy of ASMR-eliciting and misophonic stimuli was on the agenda. The findings were consistent with Study-1, each of the 16 stimuli (ASMR and misophonic) elicited either response in at least one participant, also implying once again that irrespective of the stimulus type, participants were individualistic in the response they reported to experience while the stimuli could be deemed to be idiosyncratic to an extent.

Based on the Study-1 findings, idiosyncrasy was expected to a similar degree and again, the results showed that each stimulus had the capacity to elicit both responses. Reusing the whispered speech – scraping stimuli ‘contradiction’, the traditionally ASMR-centric whispered speech (Barratt et al., 2017; Barratt & Davis; 2015; Fredborg et al., 2017; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018) was reported to elicit misophonia (19.15%), while the traditionally misophonic scraping (Cavanna & Seri, 2015; Taylor, 2017), both metal (6.38%) and polystyrene (4.26%) were conversely reported to elicit ASMR. A similar finding can also be drawn from the background questions with whispered speech reported as an ASMR stimulus that rarely/never elicits ASMR (12.77%) as well as eliciting misophonia (5.56%). What piques interest slightly more than the Study-1 counterpart to this finding is the fact that the present sample were all ASMR-sensitive, yet a stimulus such as whispering which has been shown to be the consistently most intense sound when it comes to eliciting the sensations of ASMR, elicited misophonia. Thus, as well as evidencing the idiosyncratic relation between ASMR-eliciting and misophonic stimuli, the individualistic nature of both responses and the individuals who experience them is highlighted.

Specifically drawing on the former, the collective findings again follow Barratt et al.'s (2017) claim that there is an idiosyncratic relationship between ASMR and misophonia. The researchers highlighted this in the example of mouth sounds which, as outlined (*in* 2.6.4.; 5.5.2.), is a regularly reported inducer of both phenomena with it often being the least frequent and intense ASMR-eliciting stimulus (e.g., Fredborg et al., 2017; Kovacevich & Huron, 2019; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018). As was the case with Study-1, the present background questions revealed mouth sounds as the ASMR stimulus most frequently reported to rarely/never elicit ASMR while also being the second most frequently reported misophonic stimulus as well as the ASMR stimulus most frequently reported to elicit misophonia (by the misophonic subset).

As mentioned in 5.5.2., despite idiosyncrasy, this does not completely imply co-occurrence, especially since not every ASMR-sensitive individual will respond to each ASMR-eliciting stimulus in the same way and vice versa for those sensitive to misophonia. This would disregard the individualistic nature of both responses and those sensitive to them. Referencing Barratt et al. (2017) again, there is unfortunately still no apt explanation as to why there is such disparity in responses to the same stimulus. One may suggest that due to idiosyncrasy, it is harder to blur the lines between ASMR and misophonia however, this would also not account for other factors that enable the phenomena to be considered distinct such as pleasantness and emotion. There is clearly something more complex at work, perhaps in terms of sensory properties underlying the eliciting stimuli, or even neurophysiology. Instead, as introduced in 5.5.2., the following relatively simplistic reason for the disparity is again put forward, that ASMR-sensitive individuals who do not experience ASMR from, for instance, mouth sounds, may instead experience misophonia and vice versa for those sensitive to misophonia. Used as examples previously (*in* 5.5.2.), the current findings seemingly agree with ASMR responses reported to be elicited from the three (misophonic) orofacial stimuli still being less frequent than misophonic responses to the same stimuli.

Consistent with Study-1, every stimulus was idiosyncratic to a certain degree, including the orofacial sounds. Within this, the stimuli, for the most part, elicited the response they were meant to elicit more than the alternate response (ASMR / misophonia), as predicted. This implies that there may indeed be underlying properties to the sounds enabling them to achieve this feat. As mentioned before, one need not look far with there being several sensory properties underlying ASMR audio (*see* 2.4.), while the same could be said of misophonia. To note, there were exceptions to idiosyncrasy, this time consisting of not just pen clicking but also nail filing and Velcro. Each of these stimuli displayed a greater frequency for ASMR responsivity despite their misophonic label. This held true for the emotion findings with pen clicking alone more frequently reported as eliciting positive emotion (i.e., as an ASM-eliciting stimulus would). Previously, pen clicking was outlined as a relatively novel ASMR stimulus and this holds true. The same can also be said of Velcro and nail filing. Since the present sample were solely ASMR-sensitive, they may have considered these misophonic stimuli as ASMR-eliciting, effectively highlighting the individualistic nature of the response and experiencer once more. Rather than refuting idiosyncrasy, such findings in fact support it and again lead one to ponder over the distinctness of ASMR and misophonia, at least in terms of response elicitation methods. Also, when bringing in the 'neither' responses, this time, they were mostly lower than the response counterpart (ASMR/misophonia), highlighting the expertise of the sample (at least for ASMR).

5.8.3. Auditory Elicitation of ASMR and Misophonia

Once more, complementary to the findings on prevalence and idiosyncrasy is that the presented auditory stimuli were able to elicit both responses as predicted. As outlined in 5.5.3., this adds to the idea that solely auditory stimuli can effectively elicit ASMR somatosensation ultimately supporting Koumura et al.'s (2019) prior finding (*see* 5.5.3.) as well as Barratt et al.'s (2017) suggestion that although visual aspects of ASMR-eliciting stimuli can influence the response (e.g., elicitation/intensity), they appear less vital than their auditory equivalent.

Again, this suggests reliance on audiovisual stimulation may no longer be essential which is relevant for neuroimaging. There are few studies of the auditory basis of ASMR. However, having replicated data (Study-1 and 2) showing that solely auditory stimuli (of approximately 2min durations) can effectively elicit ASMR somatosensation (and misophonic sensations) in both ASMR-sensitive and non-ASMR-sensitive (general population) samples, may invite exploration via functional imaging. Again, this may lead to developing a more mechanistic understanding of the general and auditory network(s) possibly involved in ASMR but may also help provide insight into lesser-known cross-modal interactions within the auditory system (*such as those discussed in* Chapter 1.). To reiterate 5.5.3., it would still be interesting to trial this/a similar study that presents audiovisual stimuli to see whether this would impact prevalence/idiosyncrasy.

5.8.4. Response Associations

Similar to Study-1, following each of the 16 stimuli, participants were presented with a set of questions concerning their experiences to these sounds (pleasantness, frequency, intensity, somatic distribution: origin and spread). This provided the data to analyse particular associations including response – pleasantness, frequency – intensity, and ASMR – misophonia. Again, it is worth noting that this was more in the way of complimentary data but was also useful as a comparator with the Study-1 findings.

5.8.4.1. Response – Pleasantness. As mentioned in 5.5.4.1., the literature describes ASMR positively and misophonia negatively wherein it would be appropriate to ascribe ASMR stimuli as pleasant and misophonic stimuli as unpleasant. Consistent with Study-1, the results revealed a significant effect of response type on pleasantness scores, and that pleasantness scores were significantly higher for ASMR but significantly lower for misophonia. This supports the concept that ASMR is indeed associated with sounds that are perceived as pleasant while the opposite is true for misophonia.

5.8.4.2. Frequency – Intensity. As mentioned in 5.5.4.2., the literatures of both phenomena have placed little emphasis on frequency, while focusing more on intensity. Yet, Scofield (2019) reported a weak but significant correlation between variables that included both frequency and intensity, suggesting their finding was indicative of a relationship between stronger tendencies to experience ASMR and higher levels of misophonia.

Consistent with Study-1 then, the results of the current study revealed a significant positive correlation between frequency and intensity scores when experiencing both ASMR and misophonia. Again, this hints at the association between the two factors as well as co-occurrence. Again, using Scofield's (2019) inference, the same direction of influence was put forward, that the more individuals experience ASMR / misophonia (i.e., the frequency), the more intense the experiences would be.

5.8.4.3. ASMR – Misophonia. As mentioned in 5.5.4.3., to explore the relationship between ASMR and misophonia and build on the joint investigation findings, the number of experiences for each response (per participant, ASMR-misophonia), as well as the intensity to which they are experienced (per participant, ASMR intensity-misophonia intensity) were again tested. In contrast to Study-1, based on the number of experiences of each response, results revealed a significant negative correlation between the number of times ASMR was experienced and the number of times misophonia was experienced. This suggested that individuals who more frequently reported experiencing ASMR may have less frequently reported experiencing misophonia (and vice versa). Why this is the case, is yet to be determined, especially considering the existing literature suggested co-occurrence of the two phenomena (Barratt et al., 2017;

McErlean & Banissy, 2018; Rouw & Erfanian, 2018; Scofield, 2019). It may, however, be representative of ASMR and misophonia being polar opposites, as outlined by Barratt and Davis (2015). In 5.5.4.2., it was argued that the prior non-significant result was likely a product of the study design whereby recruiting sensitive populations and/or using existing measures (of ASMR/misophonia) as the previous research had done may represent the solution. Indeed, this appears to be the case, with emphasis on the former.

A similar contrast to Study-1 is also evident for the intensity in which the responses were felt. This time, results revealed no significant relationship between ASMR and misophonia intensity scores. This meant that unlike the Study-1 findings, individuals who reported experiencing intense ASMR likely did not report experiencing intense misophonia (and vice versa). While it is not clear as to why this is the case, it may be a product of recruitment considering that the present sample were solely ASMR-sensitive. Perhaps, on top of recruiting sensitive populations, it may be sensible to implement existing measures of the two responses (e.g., MQ, Wu et al., 2014; ASMR Checklist, Fredborg et al., 2017) to better test this association.

5.8.4.3. Response – Emotion. Novel to Study-2, investigating emotion acted in a similar way to pleasantness. Unlike pleasantness though, the literatures of ASMR and misophonia have specifically associated the phenomena, both the eliciting stimuli and response sensations, with positive and negative emotion, respectively. In fact, emotional valence was a key factor in associating the two phenomena (Barratt & Davis, 2015; *see again,* 2.6.4.; 5.2.2.). Bolstering the pleasantness findings (5.5.4.1.; 5.8.4.1.), the results similarly revealed a significant effect of response type on emotion scores, and that emotion scores were significantly higher for ASMR but significantly lower for misophonia. This supports the concept that ASMR is associated with sounds that are perceived as positive while the opposite is true for misophonia. In fact, this is consistent with the A/MDCQ emotion findings from Study-1 (see 5.5.7.).

Further bolstering this association are the results from the post-stimulus/heatmap presentation question on the emotion experienced (positive, negative, neutral) in response to each stimulus. This revealed that the entirety of the present sample reported experiencing negative emotion at least once, while 97.87% reported experiencing positive emotion at least once. Interestingly though, only positive emotion was reported more than 10 times (i.e., for >10 stimuli) though this may be a product of recruiting a solely ASMR-sensitive sample.

Also, similar to response idiosyncrasy, each of the 16 stimuli were idiosyncratic in that they were found to elicit either emotion in at least one participant. A simple inference here would be co-occurrence based on such idiosyncrasy in terms of emotional valence and eliciting stimuli, similar to Barratt et al. (2017) reporting idiosyncrasy based on inducing stimuli. In fact, as highlighted in 5.8.2., idiosyncrasy does not necessarily mean co-occurrence. Despite idiosyncrasy and similar to the eliciting stimuli, emotion responses were still for the most part more frequent for sounds belonging to each stimulus type (ASMR/misophonia). This again seemingly agrees with the concept that ASMR-sensitive individuals who do not experience ASMR from a particular ASMR-eliciting stimulus may instead experience misophonia and vice versa for those sensitive to misophonia. This time experiencing ASMR can be thought of as one and the same as experiencing positive emotion and vice versa for misophonia and negative emotion. The orofacial stimuli again represent a prime example of this. Ultimately, factors like emotional valence help distinguish ASMR from misophonia.

5.8.5. Somatic Distribution of ASMR Somatosensation and Misophonic Sensations

Somatosensation is central to the sensations attributed to ASMR, and is perhaps the most defining characteristic of the phenomenon. Again, the existing research places this somatosensation as primary to the scalp and neck also spreading downwards to the shoulders, back, and limbs, reported in both ASMR-sensitive (Barratt & Davis, 2015) and non-ASMR-sensitive (Koumura et al., 2019) individuals (*refer to* 5.2.3.). As previous research and Study-1 have shown, somatosensation is not solely specific to ASMR; misophonic sensations can be physical as well as emotional. Specifically, similar areas such as the shoulders, arms and hands, neck, chest, back, abdomen, and jaw are the most frequently reported areas attributed with physical misophonic sensations (Dozier & Morrison, 2020).

As hypothesised and consistent with Study-1, the results revealed that both ASMR somatosensation and misophonic sensations were perceived in several bodily areas. This meant that the entire sample self-reported experiencing both sensations in several bodily regions in response to the presented stimuli, but also provided insight into the somatic distribution of both sensations from a specialised ASMR-sensitive population. This was based on findings that employed two methods of developing heatmaps. As outlined in 5.6.5., the first was identical to the Study-1 text-based method based on participant responses to two open-answer questions on the area/s of origin and spread of ASMR somatosensation and misophonic sensations, if either were experienced. The second method utilised the main task real-time heatmaps produced by participants during stimulus presentation.

For the text-based heatmaps for the origin of ASMR somatosensation, the head (in general), ears, neck, back, arms, and legs were the most frequent, with ears being the most. Other areas were also reported but less frequently including the scalp/brain (mostly the scalp), face, eyes, mouth (in general), teeth, jaws, throat, shoulders, spine, chest, stomach/abdomen, pelvis, elbows, hands, fingers, knees, ankles, and feet. The real-time heatmaps displaying ASMR somatosensation from the ASMR-eliciting stimuli revealed a similar somatic distribution with clusters mainly around the head (in general but mostly the ears), neck, shoulders, and spine, while the chest, stomach/abdomen, arms, and legs are also visible. This was also consistent with the real-time heatmaps displaying ASMR somatosensation from the misophonic stimuli. As predicted, this was mostly consistent with the Study-1 findings from the entire ('general') sample and the ASMR-sensitive sample within this, as well as the previous research (Barratt & Davis, 2015; Koumura et al., 2019; Swart et al., 2021).

Compared to the prior literature, previously unreported areas were again identified including the mouth (in general), teeth, jaws, throat, chest, stomach/abdomen, pelvis, elbows, hands, fingers, knees, ankles, and feet. A number of these were unreported in Study-1: the throat, elbows, knees, ankles, and feet. Also, there were slight differences in origin areas when compared to Study-1 with the shoulders and spine being less frequent in the present study while the legs were more frequent. It is important to note that these comparisons are from opposing samples, ASMR-sensitive versus non-sensitive though the overarching similarity appears to build on the concept that ASMR may indeed be more universally experienced than thought. Although the Study-1 sample size was also greater than Study-2, these unreported areas may have reached similar frequencies if a similar quantity of participants had been recruited (likewise for the Study-1 ASMR-sensitive sample). The fact that these two areas are two of the next most frequently reported in the present study seem to support this. Again, this hints at possible universality but also the need to address this via updated descriptions of ASMR and developing sensitivity spectrums and screening protocol, as discussed throughout 5.5. in Study-1.

Now, as for spread, the head (in general), ears, shoulders, and back were the most frequent, with ears being the most. Other areas were also reported but less frequently including the scalp/brain (mostly the scalp), face, eyes, nose, mouth (in general), teeth, jaws, throat, neck, collarbones, spine, chest, stomach/abdomen, pelvis, arms, elbows, hands, fingers, legs, knees, ankles, feet, and toes. Again, this was mostly consistent with the Study-1 ASMR-sensitive sample findings though previously unreported areas were identified including the face, eyes, nose, mouth (in general), teeth, jaws, throat, collarbones, pelvis, elbows, knees, ankles, feet, and toes. However, similar to the above reasoning, these unreported areas may have reached similar frequencies in Study-1 if a similar quantity of participants had been recruited. The previous research refers to ASMR somatosensation as spreading with intensity (Barratt & Davis, 2015) and Study-1 supported this idea. Since the present Study-2 did not ask a similar question on whether ASMR somatosensation spread with intensity, the same cannot be said of the current results but is likely the case. Regardless, the reported areas of origin and spread are consistent with the somatic distribution reported in Study-1 and the previous literature though future revisions are again necessary. Also, the fact that real-time heatmaps were successfully developed while also showing consistency with their text-based counterparts seemingly infers they are compatible and in fact complementary where such research may look to utilise both versions in heatmap designs going forward.

For the text-based heatmaps for the origin of misophonic sensations, the head (in general), ears, teeth, neck, and back were the most frequent areas of origin. Other areas were also reported but less frequently including the scalp/brain (mostly the scalp), face, eyes, mouth (in general), jaws, throat, shoulders, spine, chest, stomach/abdomen, elbows, hands, fingers, knees, feet, and toes. The real-time heatmaps displaying misophonic sensations from the misophonic stimuli revealed a similar somatic distribution with clusters mainly around the head (in general but mostly the ears and orofacial areas), neck, spine, back, and stomach/abdomen, while the shoulders, chest, arms, and legs are also visible. This was also consistent with the real-time heatmaps displaying misophonic sensations from the ASMR-eliciting stimuli. As predicted, this was mostly consistent with the Study-1 findings from the entire ('general') sample and the misophonic sample within this, but less so with the previous research (Dozier & Morrison, 2017).

Compared to the prior literature, while similar areas were again reported, it was the frequency of the areas that displayed dissimilarity. For instance, in the present study, the ears and orofacial regions (especially the teeth) are frequently reported while the shoulders and arms are more prevalent in Dozier and Morrison's (2017) study. Despite displaying a similar level of frequency in Study-1 (for the general sample), these two regions are less frequently reported in Study-2 (and the Study-1 misophonic sample heatmaps) while the ears and orofacial regions (excluding the jaws) were unreported by Dozier and Morrison (2017). Indeed, previously unreported areas were identified including the scalp/brain, eyes, ears, nose, mouth (in general), teeth, neck, throat, spine, elbows, fingers, knees, feet, and toes. In keeping with Study-1, such differences, especially in terms of the ears and orofacial regions may be methodological, with both recruitment and stimulus presentation being possibilities. Also, compared to Study-1, three of these were unreported: the nose, elbows, and feet though the pelvis was an exception. However, since the pelvis was only reported in the data from the Study-1 entire sample heatmap and not the misophonic subset heatmap, while also considering that the present heatmap data was based on a misophonic subset and that the prior research did not report the pelvis, not reporting the pelvis may be more representative of misophonia. With the unreported areas generally being a lot less frequent, it likely highlights the individualistic nature of misophonia, especially those sensitive to it.

As for spread, the head (in general), ears, neck, and shoulders were the most frequent, with the head (in general) being the most. Other areas were also reported but less frequently including the scalp/brain (mostly the scalp), face, eyes, nose, teeth, jaws, throat, shoulders, collarbones, back, spine, chest, stomach/abdomen, pelvis, arms, elbows, wrists, hands, fingers, legs, knees, and ankles. Again, this was mostly consistent with the Study-1 ASMR-sensitive sample findings though previously unreported areas were identified including the face, eyes, nose, teeth, jaws, throat, collarbones, pelvis, elbows, wrists, knees, and ankles. As discussed for the spread of ASMR somatosensation, the reported areas of origin and spread of misophonic sensations are consistent with the somatic distribution reported in Study-1 and the previous literature though future revisions would be ideal. Again, the fact that real-time heatmaps were successfully developed and showed consistency with their text-based counterparts suggests compatibility where future heatmap-based research may look to utilise both versions.

So, similar to 5.5.5. in Study-1, the present study has again shown that misophonic sensations can be topographically mapped. More so, the similarities with the areas reported for ASMR somatosensation were noticeable, hinting at potential overlap in the somatic distribution of response sensations between ASMR and misophonia but also with frisson. Nonetheless, differences were present. For instance, the pelvis and ankles were unreported for misophonia, while the nose and toes were unreported for ASMR. Also, orofacial areas (especially the teeth) were again a lot more frequently reported for misophonia (visible from both types of heatmap, and for both origin and spread) than ASMR with the gums again being unreported for ASMR. Again, the results of the paired-samples t-tests reveal these distinctions with orofacial regions, with there being a significant (mean) difference for misophonia versus ASMR.

In terms of the dominant orofacial difference, it is appropriate to draw on the potential explanation introduced in 5.5.5. The misophonic subset who reported on these orofacial areas may be consciously experiencing overt tactile sensations in and around these orofacial regions via mentalisation similar to MTS where support is drawn from Kumar et al.'s (2021) explanatory 'hyper-mirroring' model of misophonia in which orofacial actions of others may be mirrored via the medium of sound, and existing mirror neuron research (Buccino et al., 2001; 2004; Ferrari et al., 2003; Kohler et al., 2002; *see* 5.5.5.). As previously mentioned, a future study jointly investigating misophonia and MTS, may be better equipped to take this further. As for the differences in unreported areas, it was suggested in Study-1 that the perceptual phenomena may overlap in particular areas, while the differences may imply response specificity. This holds true for the orofacial areas. For the unreported areas however, it is likely a case of individualism since each area, regardless of response, had a frequency of 1, while areas that were previously unreported for ASMR (throat and feet) were reported for ASMR in the present Study-2.

Collectively, the current findings have again enabled the topographical mapping of ASMR somatosensation and misophonic sensations which were relatively consistent with one another, with the previous research, and with frisson. With the addition of the newly implemented real-time heatmaps, the relatively consistent mapping between them and the text-based heatmaps seemingly infer they are complementary. As suggested in Study-1, it is likely that these perceptual phenomena share a 'common path', as first suggested by Barratt and Davis (2015), wherein reported differences (i.e., in body regions such as the teeth) may highlight response specificity. Also, utilising the implemented heatmaps within screening protocol for both phenomena is also a possibility.

Likewise with Study-1, the takeaway here is the link to Barratt and Davis (2015) whose association between ASMR and misophonia (based on emotion) was hampered by the so-called tangibility of concurrents where ASMR somatosensation was unaccounted, as to was proper consideration of a misophonic equivalent. Instead, the present study has again, for the most part, shown consistency with Dozier and Morrison (2017), evidencing the somatic distribution of misophonic sensations. Despite this somewhat resolving the issue of tangibility, it again neglects the role of emotion which is key to both phenomena. As introduced in 5.5.5. in Study-1, one may actually see emotional responses as secondary to somatosensation (Valtakari et al., 2019), or similarly that 'physical' responses (i.e., somatosensation) are the initial response but are masked by emotional responses (Dozier & Morrison, 2017). Research previously conducted by Nummenmaa et al. (2014; 2018) seemingly ties emotion and somatosensation together in mapping emotions to specific bodily areas. Again, as an example, happiness and relaxation were expressed around the head and chest, while disgust, distress and anger were expressed in the mouth, chest, and upper body. Similar to Study-1, this also resembles the present somatic distribution and emotion findings, while also helping to explain response specific areas such as the teeth for misophonia. More so, the results of the paired-samples t-tests again highlight these distinctions with orofacial and chest regions being a significant (mean) difference for misophonia versus ASMR. This way, ASMR and misophonia may indeed be polar opposites that represent opposing ends of the same spectrum of experience. Yet, applying a similar design in future to map the emotions attributed to ASMR and misophonia may help provide more insight into this association.

5.8.6. Background Questions

Similar to 5.5.6., the 'background questions' provided insight into response sensitivity and stimulus preferences. For the former, since the sample consisted of solely ASMR-sensitive individuals, 100% self-reported as ASMR-sensitive (though a surprising 44.68% reported regular engagement in ASMR media), while 78.72% self-reported as misophonic. Despite the subjectiveness and difficulty in justifying their authenticity, these high prevalence rates are consistent with the findings from the above prevalence task (5.8.1.) and the Study-2 counterparts (5.5.1.; 5.5.6.).

For the latter, responses were mixed in comparison to Study-2. For ASMR stimuli, whispered speech was the most frequently reported, followed by crinkling/crisp sounds, scratching, tapping, mouth sounds, brushing, personal attention, and other. Although the order of frequency is not the same as Study-1 (5.5.6.), whispered speech again places as the most frequently reported ASMR-sensitive stimulus. In fact, this holds true for the existing literature whereby whispered speech ranks highest while other stimuli such as those presently reported on place differently per study (Barratt et al., 2017; Fredborg et al., 2017; Kovacevich & Huron, 2019; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018). When accounting for clear individualism between ASMR-sensitive individuals, such differences must be expected though the continued placing of whispered speech is indeed perplexing.

As outlined in 5.5.6., possible reasons may include the interpersonal properties underlying this stimulus (*see* 2.4.4.); sensory properties underlying the sound (*see* 2.4.) which may highlight lesser-known cross-modal interactions; or simply that this stimulus has become so deeply imbedded within ASMR media. Again, this finding is mirrored for the stimuli that rarely/never elicits ASMR with mouth sounds as the most frequent, followed by personal attention, tapping, scratching, crinkling, brushing, whispered speech, and other. As previously noted, mouth sounds are often reported as one of the most frequently reported misophonic stimuli while also being one of the least frequent ASMR-eliciting stimuli (*see* 2.3.; 2.6.4.) and the present findings are consistent with Study-1 and this literature. The fact that the other stimuli were also reported however, only highlights the individualistic nature of the response and of those sensitive to it.

As for the misophonic stimuli, scratching/scraping was the most frequently reported misophonia eliciting stimulus, with mouth sounds being the next most frequent. Also, whether there are ASMR-eliciting stimuli that trigger misophonia, 38.30% agreed, with mouth sounds as the most frequent followed by scratching/scraping. This is consistent with the existing research (Cavanna & Seri, 2015; Edelstein et al., 2013; Rouw & Erfanian, 2018; Taylor, 2017; Wu et al., 2014), the Study-1 counterpart findings (5.5.6.), and the above findings that mouth sounds were one of the less frequently reported ASMR eliciting stimuli and the most frequently reported ASMR stimulus to rarely/never elicit ASMR (followed by scratching/scraping). As was the case in 5.5.6., similar to the ASMR stimuli, other misophonic triggers (including whispered speech) were reported but a lot less frequently than stimuli in their category and compared to those reported for the ASMR questions and thus, are likely a product of individualism.

Collectively, the findings for both ASMR and misophonic stimuli were again consistent with the previous research (Barratt & Davis, 2015; Scofield, 2019). Again, it is important to highlight how every so often, research should implement questions on the stimuli that elicit each phenomenon to account for potential shifts in the eliciting stimuli, (for ASMR) to account for stimulus preferences, and in helping develop understanding on the underlying properties of such stimuli and phenomena.

5.8.7. Study Limitations

As was the case with Study-1, despite successfully reporting on the preliminary prevalence of ASMR and misophonia, and the somatic distribution of ASMR somatosensation and misophonic sensations, from an ASMR-sensitive population, there were still issues.

Starting with methodological confounds, the present sample was smaller than that of Study-1. This was an issue with Study-1 in which the general population was recruited to gauge ASMR and misophonic prevalence wherein the sample was a lot smaller compared to the existing misophonic prevalence literature. This meant that despite the high prevalence of misophonia within the study, it was and still is unclear whether the misophonic subset was representative of the entirety of the proposed spectrum of misophonia where it is likely that most represent the lower end of the misophonic spectrum. Regardless, ethics and restrictions on posting studies on misophonia platforms were in the way of correcting this. For Study-2, the same issue applies to the high misophonic prevalence rate but is instead hampered by recruitment since solely ASMR-sensitive individuals were selected. Following this, although participants were screened for ASMR-sensitivity, the protocol (merely answering 'yes' to experiencing ASMR), like the majority of ASMR research was simplistic at best. In fact, since more than half the sample either responded no (24) or don't know (2) to the background question on 'consuming ASMR media', may question the level of ASMR-sensitivity in the present sample. This again builds on a principal issue within ASMR research, the need to develop standardised screening protocol and sensitivity spectrums, and update descriptions of ASMR. The same is true for misophonia.

Now, there were a few issues with the study design, all of which differed from Study-1. First, the binaural beat test (gorilla.sc) was removed to account for a Prolific policy and to minimise study costs (*see* 5.6.3.2.). This meant the false-positive rate was higher. Despite this, the headphone screening task alone is still more than efficacious with a headphone detection rate of 80% (20% false-positive rate). Yet, future studies would do better in implementing both. Second, the control stimuli were removed, though with a lessened focus on misophonic sounds, the misophonic sounds essentially played the role of control audio.

Along these lines, one must also consider the present dual heatmap design (text-based and real-time heatmaps). One of the goals for Study-2 was to run the somatic distribution design implemented in Study-1 but on an ASMR-sensitive sample while also accommodating the possible utility of real-time heatmaps. The somatic distribution of both ASMR somatosensation and misophonic sensations were successfully mapped on composite body maps (termed heatmaps), showed consistency, and were relatively complementary (*see* 5.8.5.). Arguably, the real-time heatmaps specifically enabled the mapping of ASMR somatosensation and misophonic sensations during their occurrence while they also lessened, if not removed, experimenter involvement since the design enabled participants to map their sensations to the initial body maps turned heatmaps themselves. Though true, it does not rule out the possibility that the real-time heatmaps may have also inhibited or lessened the elicitation and/or intensity of response sensations to a certain degree. Similarly, considering that the text-based heatmaps were developed based on participant responses post-stimulus presentation, possible sensations for specific bodily regions may have been lost if this method alone was utilised.

Another divisive factor between these two heatmap methodologies lies in the reported areas of sensation. For example, the real-time heatmaps make it easier to discern laterality and positioning (e.g., whether the arms are bilateral sites of either response's sensations, or where on the arms this is felt, or identifying responses for the back versus the spine). Alternatively, the text-based heatmaps are better suited for gauging specificity (e.g., specific orofacial regions such as the teeth and gums which could not be pinpointed via the presently used body maps for the real-time heatmaps). This way, utilising both heatmaps seems the better option though for misophonia specifically, implementing facial maps may be useful in future.

Also, there was another issue with the real-time heatmaps, that participants had no way of erasing heatmap colouring so there may have been errors. While this was flagged pre-task (participants were presented with a description of issue), it does not guarantee the resulting data was error-free. This, however, is an issue on Gorilla's end. Utilising Nummenmaa et al.'s (2018) open-access software, emBODY (*see* 5.5.9.), may represent an alternative to the dual heatmaps. Further, participants had the option to remove their ear/headphones if the presented sounds were too 'intense'. This was relevant more so for misophonic sounds since they are often regarded as unpleasant (e.g., metal/polystyrene scraping may be rather 'painful' to hear). While it is important to protect participants, it also meant that 'intense' heatmap data may have gone unreported. This is seemingly supported by the fact that metal scraping, the second most effective misophonia-eliciting stimulus, had the most blank heatmaps (followed by polystyrene scraping, *see* Appendix B.15.).

Last for heatmaps clarifies a limitation outlined in a previous study. In their mapping of the somatic distribution of ASMR somatosensation, Barratt and Davis (2015) highlighted the distribution could only represent a 'common path' due to the individualistic nature of the response and those sensitive to it (i.e., the 'route' of such sensations will never be the same). In 5.5.5., it was suggested that this may similarly apply to misophonia while the solution may only be possible via a case-by-case basis (i.e., individual heatmaps). Arguably, this could have been achieved with the present real-time heatmaps though it would have only reported individual paths of ASMR somatosensation and misophonic sensations. In fact, laying these maps to form composite maps, if anything, has shown that paths are relatively similar while the text-based heatmaps discern the lesser reported areas. This way, going forward, reporting on the common path of such sensations does not appear to be a problem.

Last and similar to Study-1 is again the overall subjectiveness of the present findings. As outlined in the Study-1 limitations (5.5.8.), the majority of both the ASMR and misophonia literatures, including the more objective research, has relied on and/or utilised self-report measures. Study-2 was no different and the current findings should be taken as such.

5.8.8. Conclusion

To conclude, building on Study-1, this study also sought to jointly investigate ASMR and misophonia. Both ASMR and misophonia were highly prevalent wherein potential universality of the two responses was suggested. Again, the solely auditory stimuli were again found to elicit both responses and despite initial idiosyncrasy, were all (except pen clicking, nail filing, and Velcro) able to elicit the response they were meant to elicit.

Moreover, the somatic distribution findings showed consistency with Study-1, the existing ASMR and misophonic literatures, and frisson. Within this, misophonic sensations were again shown to be topographically mappable while also sharing a similar 'path' to ASMR somatosensation. Specifically, both heatmap methodologies were successful and complementary, and their dual use was suggested in future. Again, it is possible, that based on the collective findings to conclude of ASMR and misophonia can co-occur though ASMR should generally start to be considered as its own distinct response. The current study thus has built on Study-1, this time reporting on an ASMR-sensitive population wherein such findings can be taken further with future ASMR and misophonia research, both individually and together.

5.9. Overall Discussion – Study-1-2

5.9.1. Conclusion

Combined, both Study-1 and Study-2 sought to jointly investigate ASMR and misophonia. Interestingly, analyses revealed relative consistency between the studies despite the clear divide in sample, (mostly) non-ASMR-sensitive versus ASMR-sensitive, implying possible universality of each response. Briefly, both phenomena were highly prevalent; the developed solely auditory stimuli successfully elicited both responses; the somatic distribution of both phenomena were mapped, and findings were consistent with each other, the existing ASMR and misophonic literatures, and frisson; and survey findings showed consistency with the existing literatures.

These results suggest that at the stimulus level, sound can generate ASMR or misophonia across different participants. Also, the need to consider ASMR as distinct from misophonia and other similar perceptual phenomena was expressed. Differences in inducing stimuli, somatic distribution (especially orofacial regions), phenomenological characteristics (e.g., pitch), and emotional valence may lead to this response specificity. Also, the Study-1 survey responses highlight factors (e.g., pitch) to control for those looking to develop effective ASMR and misophonic stimuli. The studies thus, have built on the existing research and provided novel insights. Below, the future directions are conveyed.

5.9.2. Future Directions

The present studies have opened more avenues of research for both phenomena, as separate and joint investigations.

To confirm the present findings, replications would be necessary. More so, developing sensitivity spectrums for both ASMR and misophonia would aid future research, particularly in participant recruitment per study requirements. Similarly, more frequent use of the AEQ (Swart et al., 2021) is another possibility in this regard. For instance, if a study were to further explore the prevalence rates of ASMR and/or misophonia in the general population, recruiting individuals from across the spectrums would be best (i.e., low to high response sensitivity). If this is to be taken further, it may also be worth factoring in habituation (i.e., declining response sensitivity and/or intensity over time) and potentially even investigating this as standalone research.

Similarly, as discussed alongside this (*in* 5.5.1.; 5.8.1.), such spectrums would also be useful in screening protocol for both phenomena which also needs addressing. A good start thus would be to develop sensitivity spectrums for both phenomena and build on the existing research on screening protocol (at least in the case of ASMR – Hostler et al., 2019; Roberts et al., 2019; Swart et al., 2021) before implementing the two together and perhaps alongside physiological parameters such as heart rate and skin conductance (as an additional protocol). This would help justifying the current as well as future prevalence studies and benefit studies investigating both phenomena overall due to high likelihood of it providing a more efficient and reliable method of gauging response sensitivity. In turn, this may help in the recruitment of more appropriate and well-matched samples (per study requirements) as well as in fuelling the debate on whether control samples are necessary (if both phenomena are consistently highly prevalent in the general population) and within this, if individuals can truly be insensitive to ASMR or misophonia. This could also be taken into the scanner where neuroimaging could be used to assess whether there are differences in structural and functional connectivity between individuals who place on opposing ends of each sensitivity spectrum (for both ASMR and misophonia).

Similar to the development of screening protocol but specific to ASMR, it may be appropriate to update the description of ASMR. Typically, descriptions encompass the somatic distribution of the response, usually by referring to the precursor location of the scalp with ASMR somatosensation spreading in a downwards fashion to a few notable areas. Considering the present findings as well as the general individualistic nature of the response, it may be best to either list key or perhaps even collective areas and how it spreads to other areas (and again list the key/collective areas) with intensity (1), or simply and ambiguously refer to how the response can originate in several bodily locations while also spreading to other areas with intensity (2). Also, it may be fitting to add a somatic distribution of misophonic sensations 'descriptor' to general descriptions of misophonia in future. Similarly, it may be beneficial to change the initialism 'ASMR' to more meaningful terminology but solely within research where the aforementioned 'AVES' is one such proposition. Regardless, as explicated in 5.8.5., future investigations of the somatic distribution of both responses should look to utilising the dual heatmap method from Study-2 and/or Nummenmaa et al.'s (2018) design.

Further, based on both study's findings, the stimuli developed and presented to participants were able to elicit both phenomena and with the exception of pen clicking in Study-1 and pen clicking, nail filing, and Velcro in Study-2 (*which was explained in* 5.5.2. *and* 5.8.2., *respectively*), were, despite initial idiosyncrasy, all able to elicit the response they were meant to elicit. The majority, if not all the published ASMR research takes ASMR media found on online platforms and presents them as part of their study design. It also seems as though the content taken and presented are from hosts who would be considered more popular in the online communities. For instance, although they did not present ASMR stimuli, Barratt and Davis (2015) reported on the most popular ASMR YouTube channels at the time (from 2014) by views. Subsequent studies have appeared to adopt a similar approach for the stimuli they present. However, whether there is a correlation between host popularity and successful elicitation of response (in this case, ASMR) has yet to be determined.

Ultimately, this calls for future research to attempt developing their own stimuli rather than taking and using pre-made stimuli posted on online platforms. There currently exists a preliminary video library of 60 ASMR-eliciting stimuli and a recommended for research video library of 12 ASMR-eliciting stimuli established by Liu and Zhou (2019) and an earlier 14-stimulus library by Fredborg et al. (2017). Arguably, this could and should be taken further. The Study-1 questionnaire responses (*in* 5.4.6.1-2.; 5.4.6.7-9.; 5.4.9.1. *and explained in* 5.5.7.; *see also*, Barratt & Davis, 2015; Barratt et al., 2017; Fredborg et al., 2017; Smith et al., 2017) and general methodology (5.3.3.3.) could be replicated or used to develop both ASMR and misophonic stimuli in future studies. Alternatively, hosts could be approached to work with researchers to generate ASMR stimuli (at least for ASMR) similar to Poerio et al. (2018).

In line with this discussion on stimuli, as touched on above, both studies showed that *solely auditory* stimuli were able to elicit both ASMR and misophonia. This is especially interesting in the case of ASMR since it is usually described as a response triggered via *audiovisual* stimulation. First and foremost, this is a nod to an earlier discussion (*in* 2.4.3.) detailing how visual properties of ASMR stimuli may influence the elicitation of ASMR sensations but are not vital to the process (Barratt et al., 2017).

More so, as previously outlined (*in* 3.1.1.; 5.5.3.), this has implications in neuroimaging whereby brain regions associated with audition have been overlooked. Knowing that solely auditory stimuli are able to elicit the response may call for functional imaging research to implement solely auditory ASMR-eliciting stimuli within their study designs, perhaps not unlike the concept described by Smith et al. (2019a) whereby the auditory properties of the solely auditory stimuli could be manipulated. As discussed, current and previous questionnaire responses and the current stimulus development methodology could be used to identify appropriate and justify such auditory manipulations (e.g., altering pitch). In fact, Smith et al.'s (2019a) concept design was based on a secondary explanation to their observed activity in the auditory cortex. Based on previous research highlighting the possibility of ASMR being more easily triggered by sounds with a lower pitch (Barratt et al., 2017), the authors related activity in auditory regions, specifically the superior temporal lobe, to an enhanced sensitivity to the typically low-frequency (low-pitch) of ASMR audio. A future functional investigation of auditory regions via the presentation of solely auditory stimuli could lead to new insights into not only the neural correlates of ASMR, specifically underlying auditory mechanisms involved in ASMR elicitation and experiences but also lesser-known cross-modal interactions within the auditory system (*again, like those discussed in* Chapter 1.). The same design could also apply to misophonic stimuli, especially in consideration of Kumar et al.'s (2017) previous finding of AIC activity in their misophonic sample in response to solely auditory misophonic stimuli. Following, the noted design may also shed light on why/how the different types of stimuli from the present study were still able to elicit the response they were meant to elicit despite initial idiosyncrasy since there may indeed be underlying auditory properties to the sounds that enable them to have this ability.

Building on this talk around potential future neuroimaging investigations, one may also look to undertake ROI analyses on specific brain regions (versus systems) that have been reported in functional investigations of both ASMR and misophonia. As noted in 2.6.4., Kumar et al. (2017) reported on increased AIC activity and functional connectivity between the AIC and core areas of the DMN. The DMN is a network that is frequently reported among the ASMR-fMRI literature, but its activation has also been reported in synaesthetes (e.g., Dovern et al., 2012). The implication thus, is that of a potential shared network between these and potentially other perceptual phenomena. While studies have clearly reported differences in structural and functional connectivity (*refer to* 2.6.4.; 3.1.1.; 3.1.2.), it may be that in a similar way to the reasoning provided for the similarities and differences in the somatic distribution of ASMR somatosensation and misophonic sensations, perceptual phenomena may overlap in the DMN, with the differences possibly implying response specificity. Perhaps it may be more appropriate to start with joint functional investigations of both phenomena to ensure consistency with the previous research while also potentially revealing further regions of interest.

Additionally, drawing on the potential of ASMR and misophonia being polar opposites and therefore their potentially complementary nature, ASMR may be a viable intervention for attenuating misophonia symptomology. Recently, research focused on the application and therapeutic utility of ASMR as an intervention has been gaining traction (e.g., Cash et al., 2018; Lee et al., 2019; Vardhan et al., 2020; *see* 2.7.1.). Linking to this, the association between ASMR and mindfulness is gaining support (e.g., Fredborg et al., 2018; Ko Wai, 2020; *for* *a more in-depth overview, see* 2.7.2.) whereby mindfulness has been incorporated into several interventions within clinical settings (Baer et al., 2004).

Regarding misophonia, since its documentation, research centred around treatment has been elusive (Cavanna & Seri, 2015; Edelstein et al., 2013) and still is. Current approaches are typically behavioural (*see* Cavanna & Seri, 2015; Rouw & Erfanian, 2018) yet, and likely a product of its individualistic nature, it has been argued that the chances of there being a single intervention that is able to treat all cases of misophonia are slim (Cavanna & Seri, 2015; Rouw & Erfanian, 2018). Hence, there is an obvious need for more novel interventions where Cavanna and Seri (2015) suggested mindfulness-based approaches as a possibility. As outlined throughout 2.7., implementing ASMR as an intervention, even complimentary to a more well-established treatment option or mindfulness is worth exploring but particularly so in the context of misophonia. Perhaps in a similar way to the coping strategy of drowning out misophonic sounds with other sounds, ASMR may be a more effective alternative. Regardless, pursuing the therapeutic utility of ASMR may prove interesting and have applications to conditions other than insomnia, anxiety, and depression such as tinnitus.

Last, Study-1 thematic analyses on both questionnaires revealed several novel avenues of research worth pursuing in future. For ASMR, habituation (theme 2) and the effect of medication on ASMR elicitation and experiences (theme 6) stood out. For misophonia, the relationship between age and misophonic sensitivity (i.e., the older someone gets, the more their misophonia is heightened) (theme 3) and the influence of other factors (including emotional state, stress, previous trauma) on misophonic episodes (theme 6) stood out.

CHAPTER 6: Conclusions and Future Research

6.1. Thesis Conclusion

This thesis sought to investigate the role of perception in audiovisual elicitation of somatosensation (AVES) with the emphasis on exploration of the somatic distribution and individual differences in ASMR experiences. The thesis began with literature reviews of relevant research. The first review linked ASMR to a recent attempt at cortical auditory modelling. The caudal auditory fields have been theorised to play a role in auditory-somatosensory and auditory-spatial convergence in humans but is yet to be demonstrated empirically. ASMR was theorised as a candidate to explore these neural cross-modal relationships. The following two reviews outlined the collective ASMR literature. Despite a growing literature, there is still no mechanistic account of ASMR. Also, ASMR is still being compared with similar perceptual phenomena such as synaesthesia and misophonia. This way, ASMR's association with these phenomena and whether ASMR can be seen as a standalone response is yet to be determined.

The following two chapters consisted of three research studies. The first consisted of investigating the personality and empathic profiles of both ASMR and MTS and the potential associations between the two phenomena. Results revealed individual differences in relation to the personality and empathic profiles of the two phenomena. Both shared elevated openness to experience, fantasising, and empathic concern, but differences revealed enhanced agreeableness and low extraversion associated with only MTS versus enhanced perspective taking associated with only ASMR. Further, a positive association between ASMR and MTS was reported with 80% of the sample who self-reported as MT synaesthetes also reporting as ASMR-sensitive though the reason behind this association is yet to be determined. Similarities in phenomenological characteristics (e.g., inducing stimuli), sharing a similar personality and empathic profile, and sharing a similar neural profile (e.g., atypical functional connectivity of the DMN and/or atypical thalamic activity) were suggested as possible explanations (*see* 4.5.5.) which may be worth pursuing. A functional neuroimaging investigation of MTS alone and alongside ASMR could help explain their association.

The second of these chapters consisted of two complementary studies investigating the relationship between ASMR and misophonia. The first consisted of investigating the prevalence and somatic distribution (as well as phenomenological characteristics) of ASMR and misophonia in the general population. Several findings arose from this study. First, ASMR and misophonia were highly prevalent, and solely auditory stimuli had the ability to elicit ASMR or misophonia across different participants. Second, ASMR and misophonia shared a similar (but not identical) somatic distribution. The sites of somatosensation (i.e., bodily areas) were also consistent with those reported in previous ASMR and misophonia research (Barratt & Davis, 2015; Dozier & Morrison, 2017; Koumura et al., 2019). Third, participants' responses highlighted consistency with the literature on the phenomenological characteristics for both ASMR (e.g., ASMR viewing habits) and misophonia (e.g., emotion experienced during misophonic experiences). These responses also provided insight into considerations for factors to control (e.g., pitch and spatial location of sound) for those looking to develop effective ASMR and misophonic stimuli. The second study adapted the design to investigate the somatic distribution of ASMR somatosensation and misophonic sensations in a solely ASMR-sensitive sample. Results were highly consistent with the first study. Overall, it was suggested that at the stimulus level, sound can generate ASMR or misophonia across different participants where the highlighted differences between the phenomena (inducing stimuli, somatic distribution, phenomenological characteristics, emotional valence) may lead to this response specificity. Based on this response specificity, the idea that ASMR should be considered as a distinct response instead of being continually conflated with similar perceptual phenomena was expressed.

Collectively, this research has highlighted not only individual differences (phenomenological characteristics as well as personality and empathic profiles) attributable to ASMR compared to MTS and misophonia, but also the somatic distribution of ASMR somatosensation (and misophonic sensations). An association was found between ASMR and MTS, and likewise between ASMR and misophonia, wherein the reported similarities between the phenomena leads one to think that there is something a lot more complex underpinning multiple perceptual phenomena such as a shared neural network (e.g., the DMN) as previously alluded. The reported similarities between ASMR and MTS/misophonia do not however, mean that they are one and the same and the reported differences between phenomena attest to this. Now, while the present research was limited in that no functional imaging took place, the present findings may indeed be useful to future attempts at identifying and developing mechanistic models of the response sensations and thus evidence for Jasmin et al.'s (2019) computational model of cortical auditory processing.

6.2. Future Research

6.2.1. Neurophysiological Research

The first potential neuroimaging study was an fMRI study that could not happen due to Covid-19. This was intended to be an investigation of the spatial and somatosensory properties of the caudal auditory fields utilising ASMR stimuli. As part of the outlined design, such an experiment was proposed to take two sets of sounds: those associated with ASMR-sensitivity (i.e., sounds that can effectively elicit ASMR) and controls. Regarding stimulus development, it was suggested that exemplars of these sounds would need to be recorded, via in-ear microphones, at proximal locations to the head (i.e., to trigger ASMR responses). Likewise, the opposite would also be required, recordings that are distal to the head (i.e., unlikely to trigger ASMR), as well as mixing auditory versions that have no spatial location (i.e., mono recordings). Sparse scanning would be the fMRI method of choice with the stimuli being solely auditory and to lessen the potentiality of acoustic scanner noise contaminating possible brain activation in response to the task stimuli (and thus ASMR sensations), while also accounting for the preference for a quiet environment attributed to best eliciting ASMR. The aim thus, would be to identify potential neural responses associated with sounds that have a spatial location with sounds that have none, while it may also be possible to contrast proximal from distal neural responses. One may also be able to identify ASMR responses from an interaction of sound type with spatial location (where the two sound types do not differ when the sounds are presented distally, but an enhanced response is seen to ASMR class sounds when presented proximally). Based on the review in Chapter 1, it is likely that these effects will be seen in the caudal auditory fields and somatosensory cortex, while one may also observe the involvement of other potential sensory recruitment (e.g., visual cortex) although sensory localisers would need piloting. Thus, such research would have implications for ASMR research, as well as models of auditory processing and cross-modal integration.

A second potential fMRI study relates to the recurring point outlined throughout the thesis (*in* 3.1.1.; 5.5.3.; 5.9.2.), that brain regions associated with audition are relatively overlooked in the ASMR functional imaging literature. If the present reviews and research findings elucidated anything regarding ASMR, it is the central role audition plays in eliciting and intensifying ASMR sensations. Yet, the available task-based fMRI-ASMR findings are almost completely devoid of any mention of auditory-related regions outside typical auditory cortex and STG activity, simplistically explained as being observed due to the auditory/audiovisual nature of the task and task stimuli (Lochte et al., 2018; Smith et al., 2019a). In fact, even the resting-state fMRI research failed to detect the auditory network (Smith et al., 2019b). The lack of activity in auditory regions and failure to focus on auditory networks in functional imaging investigations of a phenomenon where sound is key, is puzzling. Drawing on the auditory properties of ASMR-eliciting stimuli highlighted in 2.4.2., and the review of cross-modal processing within the caudal auditory fields in Chapter 1, one possibility could be down to the complexity of ASMR-eliciting sounds, and that lesser-known cross-modal interactions are being overlooked.

In light of this, Smith et al. (2019a) represents the closest attempt at designing a study that could identify the auditory networks underpinning ASMR sensations by suggesting the manipulation of auditory properties of several ASMR-eliciting stimuli and presenting this in-scanner. Although the authors themselves primarily referred to the more simplistic mechanism of auditory cortical activation being triggered by the presentation of auditory stimuli in-scanner, they also provided an alternative explanation which they used as the groundwork for their concept fMRI design. Based on existing survey research that reported on the possibility of ASMR being more easily triggered by sounds with a lower pitch (Barratt et al., 2017), Smith et al. (2019a) related activity in auditory regions, specifically the superior temporal lobe, to an enhanced sensitivity to the typically low-frequency (low-pitch) of ASMR audio. Taking this into consideration, and the fact that previous (Koumura et al., 2019) and the present research have shown that auditory ASMR stimuli alone are able to effectively elicit the response in both ASMR-sensitive and non-ASMR-sensitive individuals, one could implement a design not unlike that described by Smith and colleagues (2019a). This way, future research could look to manipulate the pitch of ASMR audio to test the effect it may have on ASMR-sensitive participants in-scanner. Similarly, other auditory manipulations such as the audio-spatial manipulations (proximal versus distal spatial location of sound) suggested above could also work in a similar way. The implications of such research findings would echo those noted above but would also help reveal potential neural correlates of ASMR, specifically (in this case) underlying auditory mechanisms and the overlooked auditory properties that elicit and intensify ASMR sensations. Relatedly, a study with a similar design but with audiovisual and/or solely visual ASMR stimuli may achieve similar outcomes. Likewise, a similar study design may also apply to investigations of similar perceptual phenomena such as misophonia (*briefly discussed in* 5.9.2.).

There are other possibilities for future functional imaging research conducted around ASMR. Although the studies suggested above would be deemed necessary, it is important to note that there are still only a total of eight research publications (6 fMRI, 3 EEG; *refer to* 3.1.1.; 3.1.2.) that have investigated the response. This way, replications are essential and so too are focused investigations on brain regions and networks that have shown activation, especially those that have been observed more than once such as the DMN which has also been observed in other similar perceptual phenomena including synaesthesia (Dovern et al., 2012) and misophonia (Kumar et al., 2017). While replications would bolster existing findings and possibly identify novel activations, if joint investigations of ASMR and other perceptual phenomena also took place, it may highlight shared networks (for similarities) and/or response specificity (for differences) (*see* 5.9.2.).

Other studies may look to utilise alternative neuroimaging methodologies including TMS and tDCS, while investigating the potential role of neurotransmitters such as dopamine and oxytocin on ASMR experiences would be novel but could add substance to the social/interpersonal qualities often ascribed to the phenomenon.

In argument that fMRI may prove challenging due to ASMR requiring quiet relaxed conditions to be experienced (which has since been proven to not be the case), Barratt and Davis (2015) proposed transcranial direct current stimulation (tDCS) and transcranial magnetic stimulation (TMS) as alternatives. The researchers suggested that such methods could be used to modulate brain activity during ASMR experiences.

Transcranial DCS is a form of non-invasive electrical brain stimulation that involves delivering a low-intensity direct current to cortical regions via two electrodes (an anode and a cathode) attached to specific areas of the scalp (Bolognini et al., 2013b; Brunoni et al., 2012; George & Aston-Jones, 2010; Utz, Dimova, Oppenländer & Kerkhoff, 2010). TMS on the other hand, is a form of non-invasive brain stimulation that involves passing an electric current through specific brain regions via pulsed magnetic fields generated in coils placed on the scalp (George & Aston-Jones, 2010; Hallett, 2000; 2007).

Both methods have been reported to induce multisensory experiences (Davis, Gold, Pascual-Leone & Bracewell, 2013) and may thus be compatible with ASMR. Previous research has even used tDCS and TMS to investigate other similar perceptual phenomena such as synaesthesia (e.g., Esterman, Verstynen, Ivry & Robertson, 2006; Terhune et al., 2011) and frisson (e.g., Mas-Herrero, Dagher, & Zatorre, 2018). Considering this research, one way to investigate ASMR could be to use TMS and/or tDCS to investigate whether ASMR-sensitive individuals exhibit enhanced cortical excitability and how the modulation of such cortical excitability affects their ASMR experiences. One could excite and/or inhibit a specific area (possibly using the ASMR-fMRI literature as reference points) while subjects are presented with ASMR stimuli to test this. With both methods being modulatory, it is entirely possible that ASMR experiences could be enhanced/intensified or even inhibited in ASMR-sensitive individuals, and that ASMR-like sensations emerge in non-ASMR-sensitive individuals (*see* Bolognini, Miniussi, Gallo & Vallar, 2013a; Esterman et al., 2006; Terhune et al., 2011).

Neurotransmitters may also play a role in ASMR experiences and the ASMR literature is not devoid of such a theory. Based on their fMRI findings and prior frisson literature, Lochte et al. (2018) referred to dopamine and oxytocin in light of observed increases in NAcc and mPFC activity, respectively. As noted in 3.1.1., this was collectively associated with affiliative behaviours since the release of such neurochemicals has been linked with contributing to relaxation and social bonding. Not only do ASMR stimuli mirror such behaviours, but research outside ASMR can attest to this idea (*see* Feldman, 2012). Also, similar findings can be drawn from the neuroimaging literatures of frisson (Salimpoor et al., 2011) as Lochte et al. (2018) discussed.

Briefly, Salimpoor and colleagues reported on dopamine release in the NAcc during frisson episodes. Thus, one can draw on the frisson literature to formulate a potential working role of neurotransmitters in the inducing and experience of ASMR. As part of their study, Salimpoor et al. (2011) aimed to explore dopaminergic activity based on the distinction of anatomical circuits underlying phases of reward responses. In particular, if dopamine is released, is it associated with reward or anticipation. Their results revealed the functional dissociation between the caudate in anticipation and the NAcc during peak frisson but that both anticipation and reward can lead to dopaminergic neurotransmission. Interestingly, Blood and Zatorre (2001) previously reported on not only activation in regions associated with reward such as the NAcc but also those related to emotion and arousal, including the midbrain, ventral striatum, amygdala, and ventral mPFC. The researchers thus linked such brain circuitry to essentially an anticipatory reflex not unlike that observed in response to stimuli including food, sex, and drugs of abuse. Based on the two studies, the possibility of developing an affinity for frisson stimuli stemming from experiencing a frisson episode in response to a particular stimulus (e.g., music) and the dopaminergic anticipation for experiencing it again, was suggested in a review paper (*see* Harrison & Loui, 2014).

Considering the brain regions reported in the highlighted studies, it is true that ASMR research has only identified NAcc activity while mPFC activity is the inverse of that observed during frisson episodes (increased activity during ASMR and the opposite for frisson, *see* 2.6.3.). Yet, it has identified brain regions associated with emotion and arousal (*refer to* 3.1.1.) thereby possibly adopting a different network from that discussed for frisson. Thus, it is possible for ASMR to also have an underlying dopaminergic anticipation for ASMR sensations (particularly the tingling somatosensory experience) from engaging in ASMR media. This is bolstered by the typical ‘anticipatory’ stimuli found in more recent ASMR media circulating online and could account for the habituation that supposedly occurs from frequent engagement in ASMR media (*outlined in* 6.2.2.). Ultimately then, a novel form of addiction.

This way, one could argue that neurotransmitters including dopamine and oxytocin may underlie ASMR responses with the relaxing and interpersonal and/or the addicting -nature of the phenomenon as reasons for their release. Of course, focused investigation, perhaps similar to the framework of Salimpoor et al. (2011) is the requirement to take this further.

As for physiology, it would be beneficial to replicate the existing research (Engelbregt et al., 2022; Poerio et al., 2018; Valtakari et al., 2019; *see* 3.2.). Particularly, replicating Poerio et al.’s (2018) physiological investigation of ASMR by measuring the parameters of heart rate and skin conductance while participants engage in ASMR media. This may help confirm their seemingly contradictory finding of reduced heart rate and increased skin conductance (*see* 3.2.) since this is the only aspect of physiology differentiating ASMR from the likes of frisson and misophonia where increased heart rate and skin conductance have been reported (*see* 2.6.3.; 2.6.4.). Also, future research that employs alternative physiological parameters such as respiratory measures (e.g., rate and depth, similar to Salimpoor et al.’s 2009 study of frisson), blood pressure, and cortisol levels as previously suggested by Lochte et al. (2018), may yield interesting results that could also be compared against other similar perceptual phenomena. Another potential is trialling the implementation of these physiological measures alongside or as a standalone ASMR-sensitivity screening protocol.

6.2.2. Behavioural Research

The present studies could be adapted. First is the Chapter 4 study that investigated the personality and empathic profiles of ASMR and MTS and the relationship between these two phenomena. The study can be expanded by implementing more well-established measures of ASMR (e.g., ASMR Checklist, Fredborg et al., 2017) and MTS (e.g., the full MTS Visual Validation Task, Ward et al., 2018). Also, measures of individual trait domains (BFI/IRI), and/or measures of more nuanced sub-facets of core trait domains (e.g., absorption over openness to experience) could be included. Inclusion of these measures may yield findings with stronger levels of significance and may deepen current understanding of the personality and empathic profiles of ASMR and MTS, perhaps even eliminating non-consistent traits. A similar design could also be utilised to investigate frisson and misophonia which both lack such exploration.

More importantly perhaps, is replicating the Chapter 5 research studies. As detailed throughout Chapter 5, mapping the somatic distribution of somatosensation which is attributed as one of the key sensations of both ASMR and misophonia, is relatively overlooked from a research perspective with only one misophonic and two ASMR studies having subjectively explored this (Barratt & Davis, 2015; Dozier & Morrison, 2017; Koumura et al., 2019; *see also* 2.1.; 5.2.). A similar case can also be made for prevalence (*see* 5.2.). A wider-scale replication that recruits a solely ASMR-sensitive sample like Study-2 would help to either confirm or refute the present findings. One could also adapt the present research to investigate frisson due to its similarity in somatic distribution. Also, replacing the solely auditory ASMR-eliciting stimuli to audiovisual and/or solely visual ASMR-eliciting (and misophonic) stimuli may be worth trialling to generate comparisons. If researched, one may expect the audiovisual stimuli to generate more responses for both prevalence and somatic distribution of ASMR sensations based on typical descriptions of ASMR referring to its elicitation in this way as well as the present (Study-1) survey research identifying a preference for audiovisual stimulation.

Another idea would be to adapt existing ASMR measures such as Fredborg et al.'s (2017) ASMR Checklist and Roberts et al.'s (2019) ASMR-15. Similar to how the ADCQ was developed, one should look to adapt the ASMR Checklist while considering questions and research areas from ASMR-driven survey research (e.g., Barratt et al., 2017) while adhering to the criteria set out by Hostler et al. (2019) for studies measuring state ASMR via questionnaire (frequency and time course of ASMR somatosensation, intensity, somatic distribution, and emotional responses). Trialling the ADCQ once again but with a solely ASMR-sensitive sample and on a larger-scale may also be applicable since Study-1 in Chapter 5 was limited to only 26 ASMR-sensitive subjects. With ASMR research continually on the rise and with it having been a few years since a measure of the demographic and phenomenological characteristics was used in the study of ASMR, would prove useful in deepening our understanding of such factors associated with the phenomenon (e.g., stimulus properties, *see* 2.4.). This would then be useful for those looking to develop novel questionnaires, and especially effective ASMR-eliciting stimuli (for research or media purposes). In turn, this could benefit the more objective research such as those looking to explore the neural aetiology of ASMR sensations (e.g., understanding the properties associated with stimuli that are effective at eliciting and intensifying ASMR sensations may help with stimulus development for such stimuli to be presented in-scanner) as well as theorising possible explanations for observed neural activity or lack thereof (based on the phenomenological understanding).

Briefly, similar to the need for advancements in the development of standardised screening protocol for gauging ASMR-sensitivity (to enable appropriate participant recruitment), it may also be wise to develop ASMR sensitivity spectrums and update the description of ASMR to one such as AVES for the purposes of research, as outlined in Chapter 5 (*in* 5.9.2.). Similar to screening protocol, the former would improve recruitment practices whereby ASMR-sensitive individuals would be screened as ASMR-sensitive based on their degree of sensitivity to ASMR stimulation thereby ensuring the data collected and subsequent research findings are indeed representative of ASMR. A scale would need to be developed to gauge this. Perhaps, this could be achieved by presenting ASMR-sensitive individuals with multiple categories of ASMR media and scoring factors such as frequency and intensity (of ASMR sensations) where they would then be placed on a scale (from low-to-high ASMR-sensitivity) based on their outcome to each of the stimuli presented. As previously noted in Chapter 5 (5.5.1.; 5.8.1.), Poerio et al. (2022a) made reference to 'stronger' ASMR, while Swart et al.'s (2021) AEQ could also be utilised in a similar way to the proposed design to classify ASMR-sensitivity with weak and strong distinctions, differentiated by ASMR propensity and intensity. This way, participants could be matched and grouped as closely as possible. This could be used in a similar capacity to the potential survey-based screening protocol wherein subjects could be tested prior to participation. Updating the description though, may lessen the degree of scepticism around ASMR and may lead to further ASMR-driven research.

Referring back to stimulus development, building on existing attempts at developing stimulus libraries (Fredborg et al., 2017; Liu & Zhou, 2019) of effective researcher-developed ASMR-eliciting stimuli would be beneficial to ASMR research in the long-term. This would diminish reliance on the typically used ASMR media taken from online platforms. Such stimuli could also be tailored to suit specific research requirements such as auditory manipulations as noted above. ASMR researchers could develop a repository where they upload their task stimuli and methodology, especially if tailored for specific areas of investigation within ASMR (e.g., auditory manipulations). An alternative would be to approach hosts who develop ASMR media online to work with researchers to generate ASMR stimuli similar to Poerio et al. (2018) (*see also* 2.3.; 5.9.2.). As previously noted above, (*and in* 5.9.2.) survey findings could be used to develop such stimuli where findings on stimulus properties (i.e., preferences of ASMR-sensitive individuals, *see* 2.4.) would be key.

Finally, novel investigation of possible ASMR habituation may be interesting. Why do some people become 'immune' to ASMR (Ahuja, 2016)? This does not refer to individuals who are ASMR-insensitive, but rather, a gradual reduction in the ability to experience ASMR and also in the intensity of the ASMR experience. Ultimately, the idea is that the more an ASMR-sensitive individual consumes ASMR media over time, the less they experience ASMR, up to the point of potentially becoming numb to the response and the stimuli that elicit it.

Barratt and Davis (2015) originally referred to this idea of ASMR-sensitive individuals becoming habituated to ASMR-eliciting stimuli from re-viewing/watching ASMR media – hence the term ASMR immunity or habituation. As a countermeasure, hosts occasionally tend to create content to 'cure' this so-called tingle immunity by essentially 'experimenting' with new ASMR-eliciting stimuli or methods of presenting them (e.g., overlaying the sound of the stimulus continuously at specific intervals). This way, one could liken this to extinction of a learned response over time (the decline in ASMR experience/s due to overuse) and spontaneous recovery of the previously extinct response (via novel ASMR-eliciting stimuli and/or presentation methods) though ASMR does not appear to be based on previously learned associations (Barratt & Davis, 2015). Despite such habituation being rather niche, it is worth mentioning since it can be detrimental to ASMR and the supposed benefits the response provides (*see* 2.7.1.). Also, in consideration of studies that employ ASMR-sensitive samples, having those who are or close to becoming -habituated may impact study findings. For thought, one could investigate ASMR immunity subjectively (by surveying ASMR-sensitive populations) to generate statistics on, for instance, the average number of experiencers who report this happening and on average, after how much time, the immunity starts to kick in. Since such investigation may prove challenging, a longitudinal study may be appropriate here.

6.2.3. Clinical Research

The final suggestion for future research considers the therapeutic utility of ASMR. Survey research has consistently revealed reasons for ASMR engagement such as the attenuation of symptomology for conditions including stress, depression, and insomnia (Barratt & Davis, 2015; Eid et al., 2022; Kovacevich & Huron, 2019; McErlean & Banissy, 2017; McErlean & Osborne-Ford, 2020; Poerio et al., 2018; Smejka & Wiggs, 2022; *see also* 2.7.1.), and research has begun to test this experimentally (Cash et al., 2018; Lee et al., 2019; Vardhan et al., 2020) (*for an overview, see* 2.7.1.). As previously detailed (*in* 2.7.1.), replicating or continuing this research is paramount. Novel approaches to potential alleviation of the symptoms of conditions such as those linked to ASMR would always be worth trialling considering the individualistic nature of interventions where possible ASMR-based approaches may benefit some individuals or even ‘work’ in cases where other interventions have proven unsuccessful. As Cash et al. (2018) suggested, designing an ASMR-based treatment plan would be ideal before trialling this within clinical settings with clinical populations where the link between ASMR and mindfulness (Fredborg et al., 2018; Ko Wai, 2020; *see also* 2.7.2.) may even aid the development of such a plan. Though this needs careful consideration and an insight into the general clinical and health literatures, it is likely that ASMR will not be viable as a standalone intervention but rather, as a novel and complementary approach where it could be utilised alongside a more widely accepted and reliable treatment such as the suggested MBSR and binaural beats.

While attenuating the symptomology of conditions such as stress and insomnia would likely take precedence, ASMR may also be useful in a similar capacity to other conditions such as misophonia, as introduced in Chapter 5 (5.9.2.). Briefly, in a similar way to how ASMR and misophonia have been described as polar opposites (e.g., Barratt & Davis, 2015) and therefore, complementary, ASMR could be utilised to attenuate misophonia symptomology. Misophonia treatment approaches are elusive (Cavanna & Seri, 2015; Edelstein et al., 2013) and the literature has argued that the chances of there being a single intervention able to treat all cases of the phenomenon are slim (Cavanna & Seri, 2015; Rouw & Erfanian, 2018). Clearly, novel interventions would be welcome and in fact, seem to be a necessity and Cavanna and Seri (2015) even suggested mindfulness-based approaches as a possibility, an approach linked to ASMR. Alternatively, one could also trial ASMR similar to the misophonic coping mechanism of drowning out misophonic sounds with other sounds. This could then have implications for tinnitus research.

Others may look to similarly investigate the anecdotal claims, and survey findings from past (Kovacevich & Huron, 2019) and present (Chapter 5, Study-1) research, that ASMR may be useful as a work/study aid study. This could be trialled by presenting ASMR-sensitive and control participants with ASMR media (audiovisual, audio only, and/or visual only), control non-ASMR-eliciting stimuli, and/or no stimuli at all, followed by a specific test (e.g., questionnaire, short mock exam) depending on what is being investigated and to measured (e.g., mood states, work/academic performance/productivity).

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APPENDIX

Appendix A: ASMR-MTS

Appendix A.1. Participant Information Sheet

Participant Information Sheet

Title of Study: An Investigation of Atypical Multisensory Experiences.

If you would like to receive a copy of this information by email, please enter your email address below:

This study has been approved by the UCL Research Ethics Committee as Project ID Number: 1584/003

You are invited to take part in a research project investigating perceptual influences of sounds. Before you decide to participate, it is important that you understand why this research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish.

Name and Contact Details of the Researchers:

Name and Contact Details of the Principal Researcher:

What is the project's purpose?

- Our research focuses on understanding the relationship between different anomalous sensory experiences.

Do I have to take part?

- It is up to you to decide whether or not you take part. If you do not decide to participate, this will not disadvantage you in any way. If you do decide to take part, you will be asked to sign (tick box) a consent form.
- Even after agreeing to take part, you can still withdraw at any time and without giving a reason. If you withdraw before the end of the experiment, we will not retain your data and it will not be analysed.

What will happen to me if I take part?

- If you choose to participate in this research project, your participation will entail a single session lasting no more than 30 minutes. The research involves completing one questionnaire that you can complete in a place and at a time that best suits you.
- You be asked to watch eight short videos (15 seconds each) and answer a set of standard questions in response to each video. You will also be asked to complete two short assessments which measure personality traits and different components of empathy, respectively. The final part of the survey will ask you about two different anomalous sensory experiences to assess whether you experiences these.
- There are no anticipated risks or benefits associated with participation in this study, but your participation will contribute to the knowledge in this area of research.

Data Protection and Confidentiality:

- All the information that we collect about you during the course of the research will be kept strictly confidential. All data will be collected and stored in accordance with the General Data Protection Regulations 2018. The results of this study will be seen only by other professional researchers and for teaching purposes.
- Your responses will be coded by an identifying code, and data will be confidentially secured and accessed only by our research staff. If appropriate, results may be published in scientific journals or be presented at scientific meetings. However, your name will not be identified in any public forum, and you will not be able to be identified in any ensuing reports or publications.

If you wish to raise a complaint:

- Should you wish to raise a complaint about this research project, please contact. If you feel that your concerns have not been met, you are welcome to contact the Chair of the UCL Research Ethics Committee.

Contact for further information:

- Following your participation in the study you may contact the researcher if you desire more information at any time.

Thank you for reading this information sheet and for considering to take part in this research study.

Appendix A.2. Informed Consent Form

Consent Form

Title of Study: An Investigation of Atypical Multisensory Experiences.

If you would like to receive a copy of this consent form by email, please enter your email address here:

This study has been approved by the UCL Research Ethics Committee as Project ID Number: 1584/003

Thank you for your interest in taking part in this research. If you have any questions arising from the Information Sheet that you have already seen, please contact one of the researchers before you decide whether to continue.

Please Note: You will need to consent to every item listed below to proceed with this survey.

Please confirm the following:

- I have read the Information Sheet.
- I have had the opportunity to contact the researcher to ask questions and discuss the study.
- I have received satisfactory answers to my questions or have been advised of an individual to contact for answers to pertinent questions about the research and my rights as a participant.

- I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with all applicable data protection legislation.
- I agree that my anonymised research data may be used by others for future research. I understand that no one will be able to identify me when this data is shared
- **I hereby consent to take part in this study.**

Appendix A.3. Debrief Form

Debrief Form

Thank you for taking the time to complete this questionnaire! This sheet explains in more detail the reason we are running this survey.

- The purpose of this survey was to explore the overlapping personality traits associated with Mirror-Touch synaesthesia. This survey will also assess these personality traits in respect to two other atypical sensory experiences: ASMR and Frisson.
- Mirror-Touch synaesthesia is a conscious touch sensation on one's body when observing someone else being touched. Individuals with mirror-touch synaesthesia typically experience the vicarious touch sensation on the same observed body part.
- ASMR describes a relaxing and/or calming tingling sensation, typically centred on the scalp and down the back of the neck, and occurs in response to a variety of audiovisual triggers like whispering and tapping.
- Previous research has identified potential overlap between ASMR and frisson. Frisson, also known as musical chills, describes a pleasurable tingling sensation, centred on the back of the neck and spreads to the scalp and down the spine, and occurs in response to music.
- All three atypical sensory experiences have been connected with the same personality trait (i.e. openness to experience) and individuals who self-report these experiences tend to score highly on measures of empathy.

How are we protecting your data and how will the results be used?

- As mentioned in the information sheet, the data from this experiment will be anonymised and you will not be identifiable from the data. You have a right to withdraw your participation at any time, even after you have completed the experiment. The results might be used at conferences and published in academic journals.

If you have any further questions, or decide at any point that you wish to withdraw consent for your data to be used, please email.

If you have any comments, please use the space below.

Appendix A.4. ASMR Scale-B

Please note the term 'sound' does not refer to music.

Please rate how much you personally agree or disagree with the following statements:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. Visually seeing someone produce non-verbal sounds (e.g., tapping, scratching, clicking etc.) while listening to these sounds can sometimes make me feel a pleasant tingling sensation around my body.
2. Some sounds make me feel a pleasant tingling sensation around my body.
3. Some sounds give me the same feeling of being touched by someone else.
4. A whispered voice is pleasant.
5. Listening to non-verbal sounds (e.g., tapping, scratching, clicking etc.) can sometimes make me feel a pleasant tingling sensation around my body.
6. Some sounds make me feel relaxed.
7. Visually seeing someone produce non-verbal sounds (e.g., tapping, scratching, clicking etc.) but without hearing the sound, can sometimes make me feel a pleasant tingling sensation around my body.

Post-ASMR scale:

These questions have been assessing whether you have ASMR. ASMR describes a relaxing and/or calming tingling sensation, typically centred on the scalp and down the back of the neck and occurs in response to a variety of audiovisual triggers like whispering and tapping.

Based on this description do you think you might experience ASMR?

- Yes
- No

Appendix A.5. 50-item IPIP

How Accurately Can You Describe Yourself?

Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Indicate for each statement whether it is 1. Very Inaccurate, 2. Moderately Inaccurate, 3. Neither Accurate nor Inaccurate, 4. Moderately Accurate, or 5. Very Accurate as a description of you.

	Very Inaccurate	Moderately Inaccurate	Neither Accurate nor Inaccurate	Moderately Accurate	Very Accurate	Scale and Direction
Am the life of the party.	1	2	3	4	5	1+
Feel little concern for others.	1	2	3	4	5	2-
Am always prepared.	1	2	3	4	5	3+
Get stressed out easily.	1	2	3	4	5	4-

Have a rich vocabulary.	1	2	3	4	5	5+
Don't talk a lot.	1	2	3	4	5	1-
Am interested in people.	1	2	3	4	5	2+
Leave my belongings around.	1	2	3	4	5	3-
Am relaxed most of the time.	1	2	3	4	5	4+
Have difficulty understanding abstract ideas.	1	2	3	4	5	5-
Feel comfortable around people.	1	2	3	4	5	1+
Insult people.	1	2	3	4	5	2-
Pay attention to details.	1	2	3	4	5	3+

Worry about things.	1	2	3	4	5	4-
Have a vivid imagination.	1	2	3	4	5	5+
Keep in the background.	1	2	3	4	5	1-
Sympathize with others' feelings.	1	2	3	4	5	2+
Make a mess of things.	1	2	3	4	5	3-
Seldom feel blue.	1	2	3	4	5	4+
Am not interested in abstract ideas.	1	2	3	4	5	5-
Start conversations.	1	2	3	4	5	1+
Am not interested in	1	2	3	4	5	2-

other people's problems.						
Get chores done right away.	1	2	3	4	5	3+
Am easily disturbed.	1	2	3	4	5	4-
Have excellent ideas.	1	2	3	4	5	5+
Have little to say.	1	2	3	4	5	1-
Have a soft heart.	1	2	3	4	5	2+
Often forget to put things back in their proper place.	1	2	3	4	5	3-
Get upset easily.	1	2	3	4	5	4-

Do not have a good imagination.	1	2	3	4	5	5-
Talk to a lot of different people at parties.	1	2	3	4	5	1+
Am not really interested in others.	1	2	3	4	5	2-
Like order.	1	2	3	4	5	3+
Change my mood a lot.	1	2	3	4	5	4-
Am quick to understand things.	1	2	3	4	5	5+
Don't like to draw attention to myself.	1	2	3	4	5	1-
Take time out for others.	1	2	3	4	5	2+

Shirk my duties.	1	2	3	4	5	3-
Have frequent mood swings.	1	2	3	4	5	4-
Use difficult words.	1	2	3	4	5	5+
Don't mind being the centre of attention.	1	2	3	4	5	1+
Feel others' emotions.	1	2	3	4	5	2+
Follow a schedule.	1	2	3	4	5	3+
Get irritated easily.	1	2	3	4	5	4-
Spend time reflecting on things.	1	2	3	4	5	5+
Am quiet around strangers.	1	2	3	4	5	1-

Make people feel at ease.	1	2	3	4	5	2+
Am exacting in my work.	1	2	3	4	5	3+
Often feel blue.	1	2	3	4	5	4-
Am full of ideas.	1	2	3	4	5	5+

Nb. The greyed numbers in the column after the scoring scale for each item indicates the scale on which that item is scored (i.e., of the five factors): Extraversion (1), Agreeableness (2), Conscientiousness (3), Emotional Stability (4), or Intellect/Imagination (5) and its direction of scoring (+ or -). These numbers and symbols should not be included in the actual survey questionnaire.

Appendix A.6. IRI

The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate letter on the scale at the top of the page: A, B, C, D, or E. When you have decided on your answer, fill in the letter next to the item number. READ EACH ITEM CAREFULLY BEFORE RESPONDING. Answer as honestly as you can. Thank you.

	Does not describe me very well	Does not describe me well	Neither	Describes me well	Describes me very well	Scale and Direction
I daydream and fantasize, with some regularity, about things that might happen to me.	1	2	3	4	5	F+
I often have tender,	1	2	3	4	5	EC+

concerned feelings for people less fortunate than me.						
I sometimes find it difficult to see things from the "other guy's" point of view.	1	2	3	4	5	PT-
Sometimes I don't feel very sorry for other people when they are having problems.	1	2	3	4	5	EC-

I really get involved with the feelings of the characters in a novel.	1	2	3	4	5	F+
In emergency situations, I feel apprehensive and ill-at-ease.	1	2	3	4	5	PD+
I am usually objective when I watch a movie or play, and I don't often get completely	1	2	3	4	5	F-

caught up in it.						
I try to look at everybody's side of a disagreement before I make a decision.	1	2	3	4	5	PT+
When I see someone being taken advantage of, I feel protective towards them.	1	2	3	4	5	EC+
I sometimes feel helpless when I am	1	2	3	4	5	PD+

in the middle of a very emotional situation.						
I sometimes try to understand my friends better by imagining how things look from their perspective.	1	2	3	4	5	PT+
Becoming extremely involved in a good book or movie is somewhat	1	2	3	4	5	F-

rare for me.						
When I see someone get hurt, I tend to remain calm.	1	2	3	4	5	PD-
Other people's misfortunes do not usually disturb me a great deal.	1	2	3	4	5	EC-
If I'm sure I'm right about something, I don't waste much time listening to	1	2	3	4	5	PT-

other people's arguments.						
After seeing a play or movie, I have felt as though I were one of the characters.	1	2	3	4	5	F+
Being in a tense emotional situation scares me.	1	2	3	4	5	PD+
When I see someone being treated unfairly, I sometimes don't feel	1	2	3	4	5	EC-

very much pity for them.						
I am usually pretty effective in dealing with emergenci es.	1	2	3	4	5	PD-
I am often quite touched by things that I see happen.	1	2	3	4	5	EC+
I believe that there are two sides to every question and try to	1	2	3	4	5	PT+

look at them both.						
I would describe myself as a pretty soft-hearted person.	1	2	3	4	5	EC+
When I watch a good movie, I can very easily put myself in the place of a leading character.	1	2	3	4	5	F+
I tend to lose control during	1	2	3	4	5	PD+

emergencies.						
When I'm upset at someone, I usually try to "put myself in his shoes" for a while.	1	2	3	4	5	PT+
When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.	1	2	3	4	5	F+

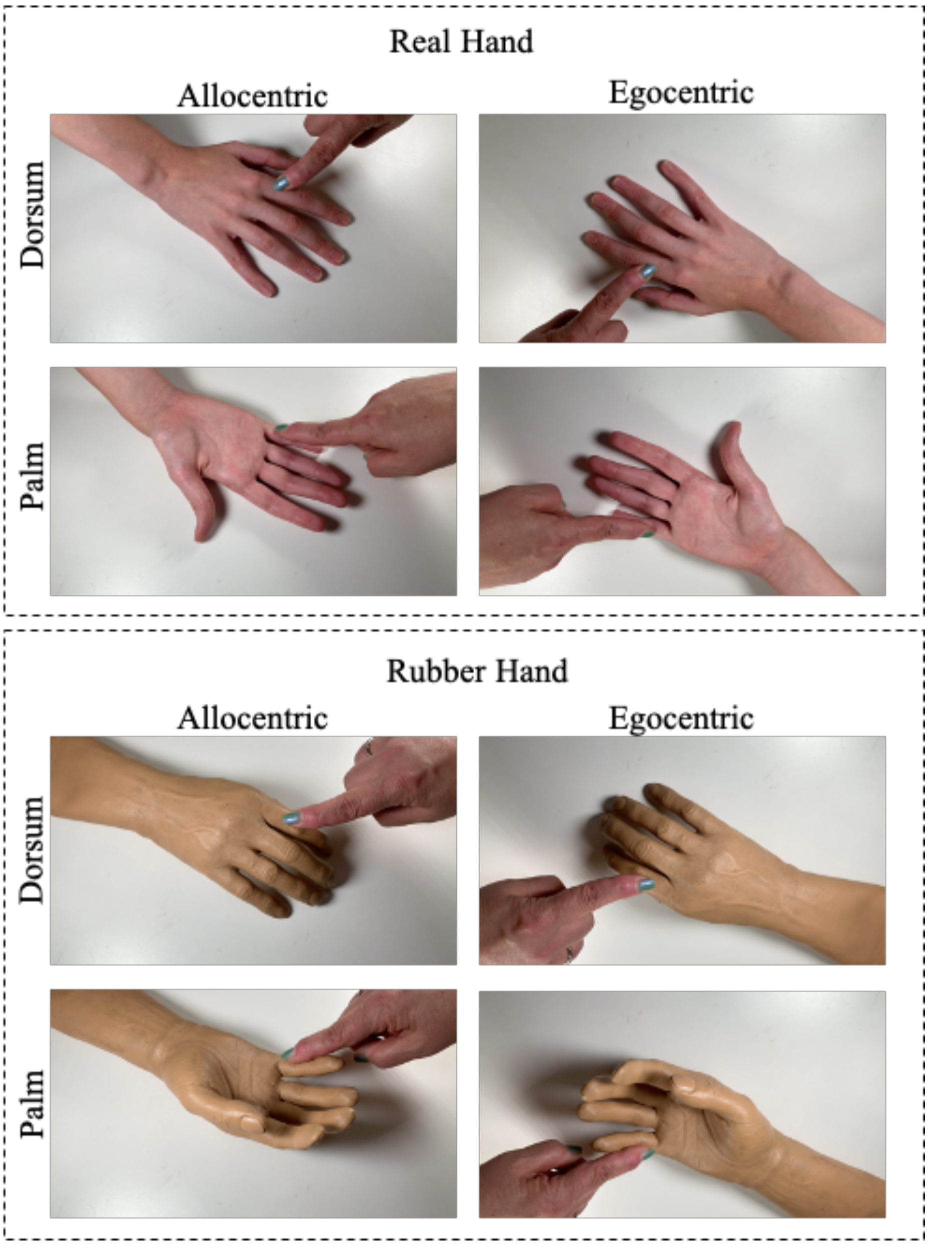
When I see someone who badly needs help in an emergency, I go to pieces.	1	2	3	4	5	PD+
Before criticizing somebody, I try to imagine how I would feel if I were in their place.	1	2	3	4	5	PT+

Nb. The greyed initials in the column after the scoring scale for each item indicates the subscale on which that item is scored (i.e., of the four factors): Perspective Taking/PT (1), Fantasising/F (2), Empathic Concern/EC (3), or Personal Distress/PD (4) and its direction of scoring (+ or -). These initials and symbols should not be included in the actual survey questionnaire.

Appendix A.7. MTS Visual Validation Task

Video Instructions:

- *In this part of the survey, you will be presented with a series of eight short videos displaying touch. After each video you will be asked to complete a set of standard questions. You should base your responses to these questions on the video you have just watched.*
- *Please watch the video once and then proceed to the next page of the survey.*
- *Please note you do <u>not</u> need headphones/earphones as there is no sound in any of the videos.*



Post-video question(s):

Did you experience any bodily sensation of touch whilst observing this video?

- Yes
- No

- If the participant selected ‘no’ then they moved on to the next video.
- If the participant selected ‘yes’ then they were asked further questions about their synaesthetic tactile experience:

Please rate the intensity of the touch sensation you experienced (1= not at all intense, 10= very intense).

1 2 3 4 5 6 7 8 9 10

Was the touch sensation in a specific location or a more general bodily experience?

- Generalised sensation
- Specific location - <u>not</u> the same body part as the touch in the video
- Specific location - the same body part as the touch in the video

- If the participant selected ‘Generalised sensation’, or ‘specific location – not the same body part as the touch in the vide’ then they moved on to the next video.
- If the participant selected ‘Specific location – the same body part as the touch in the video’ then they were prompted with:

Did you experience the touch sensation on the left-hand side of your body or the right?

- Left
- Right

- The participants who got to this stage then moved on to the next video.

After watching all 8 videos and completing the accompanying questions:

These videos have been assessing whether you have mirror-touch synaesthesia.

Mirror-touch synaesthesia is a conscious touch sensation on one's body when observing someone else being touched. Individuals with this condition typically experience the vicarious touch sensation on the same observed body part. The experience is usually not intense and might simply be a slight tingling sensation.

Based on this description, and your experience watching the videos, do you think you might have mirror-touch synaesthesia?

- Yes
- No

If you have any other thoughts or comments about the videos and/or your vicarious sensory experiences in daily life, then please note them in the comment box _____

Appendix A.8. ASMR Scale-A

Please rate how much you personally agree or disagree with the following statements:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. Some sounds make me feel like someone is touching me (A+)
2. Some sounds make it feel like I am being stroked (A+)
3. I never feel any pleasant sensation when I hear/listen to sounds (A-)
4. If sounds are close to my head, it sometimes feels like I am being touched (A+)
5. Some sounds make my teeth go on edge (M+)
6. Some sounds get on my nerves (M+)
7. I cannot bear the sound of someone eating noisily (M+)
8. When I listen to music I like, I sometimes get the 'chills' (F+)
9. I sometimes feel a pleasant sensation when I hear particular sounds (A+)
10. Some sounds make me feel relaxed (A+)
11. A whispered voice is relaxing (A+)
12. A whispered voice is pleasant (A+)
13. When someone whispers close to my ear, I sometimes feel a pleasant static-like sensation around my body (A+)
14. When someone whispers close to my ear, I sometimes feel a pleasant tingling sensation around my body (A+)
15. A male voice is more soothing than a female voice (O+)

16. A female voice is more soothing than a male voice (O+)
17. Some sounds make me feel angry (M+)
18. Some sounds make me verbally aggressive (M+)
19. Some sounds make me leave the room (M+)
20. Some sounds make me feel highly anxious (M+)
21. I try to avoid sounds that make me feel anxious (M+)
22. I try to avoid sounds that make me feel angry (M+)
23. Some sounds make me feel a pleasant static-like sensation around my body (A+)
24. Some sounds make me feel a pleasant tingling sensation around my body (A+)
25. Some sounds are 'euphoric' (A+)
26. Some sounds make me recall positive events in my life (A+)
27. Some words make me recall positive events in my life (A+)
28. Some sounds give me goosebumps (F+)
29. Some sounds make me shiver (F+)
30. Some sounds give off a specific colour (S+)
31. For some words, the thought of that word makes it feel like it has a colour (S+)
32. For some words, seeing and/or reading them makes me feel like it has a colour (S+)
33. When I listen to music I like, I sometimes feel a shivery sensation down my spine (F+)
34. When I listen to music I like, I sometimes get goosebumps (F+)
35. Some words have their own taste (S+)
36. Some words have their own smell (S+)

37. Seeing someone while they talk is better than just hearing their voice (O+)
38. Hearing a mosquito near me, makes me shiver (O+)
39. Hearing a fly near me, makes me shiver (O+)
40. A quiet voice is more relaxing than a loud voice (A+)
41. I cannot bear the sound of someone scraping (M+)
42. I cannot bear the sound of someone chewing (M+)
43. I cannot bear the sound of someone lip smacking (M+)
44. I cannot bear the sound of someone whispering (M+)
45. Listening to someone talk slowly is relaxing (A+)
46. Listening to someone talk slowly can sometimes make me feel a pleasant static-like sensation around my body (A+)
47. Listening to someone talk slowly can sometimes make me feel a pleasant tingling sensation around my body (A+)
48. Some sounds make me feel negative thoughts towards someone or something (M+)
49. Seeing someone get touched sometimes makes me feel as if I am also being touched (S+)
50. I like to listen to sounds that make me feel relaxed (A+)
51. Listening to someone repeat the same phrase several times is relaxing (A+)
52. Listening to someone repeat the same phrase several times can sometimes make me feel a pleasant static-like sensation around my body (A+)
53. Listening to someone repeat the same phrase several times can sometimes make me feel a pleasant tingling sensation around my body (A+)

54. Some sounds 'make the hairs on the back of my neck stand up' (A+)
55. Some sounds 'make my hairs stand on end' (A+)
56. Talking with a group of people makes me anxious (O+)
57. If I am having trouble getting to sleep, I sometimes listen to 'relaxing' sounds (A+)
58. Before I go to sleep, I like to listen to 'relaxing' sounds (A+)
59. While working/studying, I like to listen to 'relaxing' sounds in the background (A+)
60. While working/studying, I like to listen to music in the background (O+)
61. When I am feeling anxious, I like to listen to 'relaxing' sounds (A+)
62. When I am feeling down, I like to listen to 'relaxing' sounds (A+)
63. I never experience relaxation from hearing/listening to sounds (A-)
64. I never feel a pleasant static-like sensation around my body, when I hear/listen to sounds (A-)
65. I never feel a pleasant tingling sensation around my body when I hear/listen to sounds (A-)
66. Listening to someone talk slowly is irritating (A-)
67. Listening to someone repeat the same phrase several times is irritating (A-)
68. A whispered voice is unpleasant (A-)
69. When I listen to a song I have not heard before, I sometimes get the 'chills' (F+)
70. When I listen to a song I have not heard before, I sometimes feel a shivery sensation down my spine (F+)
71. When I listen to a song I have not heard before, I sometimes get goosebumps (F+)

72. I never get the 'chills' when I listen to music I like (F-)
73. I never get goosebumps when I listen to music I like (F-)
74. I never feel a shivery sensation down my spine when I listen to music I like (F-)
75. Some sounds make me emotional (S+)
76. One-on-one talks with authority figures (e.g., a doctor) make me feel anxious (O+)
77. Some sounds make me feel a static-like sensation around my head/scalp that may descend down my neck, shoulders, back, and/or limbs (A+)
78. Some sounds make me feel a tingling sensation around my head/scalp that may descend down my neck, shoulders, back, and/or limbs (A+)
79. There are some sounds that I can't help but hate (M+)
80. There are no sounds that I hate (M-)
81. Some sounds can irritate me, but not enough to trigger me emotionally (M-)
82. In the past, there has been an instance/s where I have felt a pleasant sensation from hearing a sound/s (A+)
83. When I was a child/adolescent, I can recall experiencing any pleasant sensation from hearing a particular sound/s (A+)
84. When I was a child/adolescent, I can recall experiencing a pleasant static-like sensation around my body, from hearing a particular sound/s (A+)
85. When I was a child/adolescent, I can recall experiencing a pleasant tingling sensation around my body, from hearing a particular sound/s (A+)
86. Seeing someone while listening to them speak in a whispered voice, can sometimes make me feel a pleasant static-like sensation around my body (A+)

87. Seeing someone while listening to them speak in a whispered voice, can sometimes make me feel a pleasant tingling sensation around my body (A+)
88. Seeing someone while listening to them repeat the same phrase several times, can sometimes make me feel a pleasant static-like sensation around my body (A+)
89. Seeing someone while listening to them repeat the same phrase several times, can sometimes make me feel a pleasant tingling sensation around my body (A+)
90. Listening to sounds while wearing ear/headphones sometimes make me feel a pleasant tingling sensation around my body (A+)
91. Listening to sounds while wearing ear/headphones sometimes make me feel a pleasant static-like sensation around my body (A+)
92. High-pitched sounds (e.g., scraping on a plate) make me feel disgust (M+)
93. High-pitched sounds (e.g., scraping on a plate) 'make my skin crawl' (M+)
94. Listening to someone speaking in a whispered voice can make me feel sleepy (A+)
95. Listening to someone speaking in a whispered voice can make me feel calm (A+)
96. Some sounds make me feel sleepy (A+)
97. Some sounds make me feel calm (A+)
98. There are no sounds that make me feel sleepy (A-)
99. High-pitched sounds (e.g., scraping on a plate) have no effect on me whatsoever (M-)
100. I never get the 'chills' when I listen to music, even when hearing/listening to a song for the first time (F-)

101. I never get goosebumps when I listen to music, even when hearing/listening to a song for the first time (F-)

102. I never feel a shivery sensation when I listen to music, even when hearing/listening to a song for the first time (F-)

103. Some sounds give me the same feeling of being touched by someone else (A+)

104. If sounds are close to my head, it sometimes gives me the same feeling of being touched by someone else (A+)

105. When someone touches me, I sometimes feel a tingling sensation (A+)

106. When someone touches me, I sometimes feel a static-like sensation (A+)

107. When someone touches me, I sometimes feel relaxation (A+)

108. If I am having trouble getting to sleep, I sometimes listen to human speech/conversation that i find relaxing (e.g., listening to someone speak in a whispered voice) (A+)

109. Before I go to sleep, I like to listen to human speech/conversation that I find relaxing (e.g., listening to someone speak in a whispered voice) (A+)

110. While working/studying, I like to listen to human speech/conversation that I find relaxing (e.g., listening to someone speak in a whispered voice), in the background (A+)

111. When I am feeling anxious, I like to listen to human speech/conversation that I find relaxing (e.g., listening to someone speak in a whispered voice) (A+)

112. When I am feeling down, I like to listen to human speech/conversation that I find relaxing (e.g., listening to someone speak in a whispered voice) (A+)

113. Listening to non-verbal sounds (e.g., tapping, scratching, clicking etc.) is relaxing (A+)

114. Listening to non-verbal sounds (e.g., tapping, scratching, clicking etc.) can sometimes make me feel a pleasant static-like sensation around my body (A+)

115. Listening to non-verbal sounds (e.g., tapping, scratching, clicking etc.) can sometimes make me feel a pleasant tingling sensation around my body (A+)

116. Seeing someone in physical pain sometimes makes me feel a mild pain sensation (S+)

117. Listening to someone's physically painful experience/s sometimes makes me feel a mild pain sensation (S+)

118. Listening to someone's physically painful experience/s sometimes makes me feel as if I am sharing their feelings from that time (S+)

119. Seeing someone get touched somewhere on their body sometimes makes me feel as if I am also being touched in the same area (S+)

120. When I am feeling anxious, I like to listen to music (O+)

121. When I am feeling down, I like to listen to music (O+)

122. Naturalistic sounds (e.g., the sound of rain) make me feel relaxed (O+)

123. Seeing someone produce non-verbal sounds (e.g., tapping, scratching, clicking etc.) While listening to these sounds is relaxing (A+)

124. Seeing someone produce non-verbal sounds (e.g., tapping, scratching, clicking etc.) while listening to these sounds can sometimes make me feel a pleasant static-like sensation around my body (A+)

125. Seeing someone produce non-verbal sounds (e.g., tapping, scratching, clicking etc.) while listening to these sounds can sometimes make me feel a pleasant tingling sensation around my body (A+)

126. Seeing someone produce non-verbal sounds (e.g., tapping, scratching, clicking etc.) but without hearing the sound, is relaxing (A+)

127. Seeing someone produce non-verbal sounds (e.g., tapping, scratching, clicking etc.) but without hearing the sound, can sometimes make me feel a pleasant static-like sensation around my body (A+)

128. Seeing someone produce non-verbal sounds (e.g., tapping, scratching, clicking etc.) but without hearing the sound, can sometimes make me feel a pleasant tingling sensation around my body (A+)

129. While working/studying, I like to listen to podcasts in the background (O+)

130. I have felt a pleasant static-like sensation from watching roleplay/simulation videos (e.g., a doctor's appointment) (A+)

131. I have felt relaxation from watching roleplay/simulation videos (e.g., a doctor's appointment) (A+)

132. I have felt a pleasant tingling sensation from watching roleplay/simulation videos (e.g., a doctor's appointment) (A+)

133. When I view art (of any kind), I sometimes get the 'chills' (F+)

134. When I view art (of any kind), I sometimes feel a shivery sensation down my spine (F+)

135. When I view art (of any kind), I sometimes get goosebumps (F+)

136. I never get the 'chills' when I view art (of any kind) (F-)

137. I never get goosebumps when I view art (of any kind) (F-)

138. I never feel a shivery sensation down my spine when I view art (of any kind) (F-)

139. Certain scenes in a film/play sometimes give me the 'chills' (F+)

140. Certain scenes in a film/play sometimes give me a shivery sensation down my spine (F+)

141. Certain scenes in a film/play sometimes give me goosebumps (F+)

142. I never get the 'chills' from watching a film/play (F-)

143. I never get goosebumps from watching a film/play (F-)

144. I never feel a shivery sensation down my spine from watching a film/play (F-)

Nb. The letters in parentheses at the end of each item indicate the phenomenon the item is based on and scored: ASMR/A, Misophonia/M, Synaesthesia/S, and Frisson/F, or an aspect associated with these phenomena: Other/O, and its direction of scoring (+ or -). These letters and symbols should not be included in the actual survey questionnaire.

Appendix B: ASMR-Misophonia

Appendix B.1. Study-1 Participant Information Sheet

Information sheet

This study has been approved by the UCL Research Ethics Committee as Project ID Number: 1584/003

You are invited to take part in a research project investigating two atypical auditory perceptual phenomena (ASMR and misophonia). Before you decide to participate, it is important that you understand why this research is being done and what your participation will involve. Please take time to read the following information carefully.

Name and Contact Details of the Researchers:

Name and Contact Details of the Principal Researcher:

Do I have to take part?

- It is up to you to decide whether or not you take part. If you do not decide to participate, this will not disadvantage you in any way. If you do decide to take part, you will be asked to accept this consent form.
- Even after agreeing to take part, you can still withdraw at any time and without giving a reason. If you withdraw before the end of the experiment, we will not retain your data and it will not be analysed.

What will happen to me if I take part?

- If you choose to participate in this research project, your participation will entail a single session lasting no more than 60 minutes.
- You will be asked to listen to 24 short audio clips (~2min each) and answer a set of standard questions in response to each audio. These questions will ask you to report if you have experienced either of the perceptual phenomena and about how pleasant the sound was.
- You will be informed of what ASMR and misophonia are and what they entail. If you were already familiar with these two perceptual phenomena, you might be asked to complete a short questionnaire on them.
- There are no anticipated risks or benefits associated with participation in this study, but your participation will contribute to the knowledge in this area of research.

Data Protection and Confidentiality:

- All the information that we collect about you during the course of the research will be kept strictly confidential. All data will be collected and stored in accordance with the General Data Protection Regulations 2018. The results of this study will be seen only by other professional researchers and for teaching purposes.
- Your responses will be coded by an identifying code, and data will be confidentially secured and accessed only by our research staff. If appropriate, results may be published in scientific journals or be presented at scientific meetings. However, your name will not be identified in any public forum, and you will not be able to be identified in any ensuing reports or publications.

If you wish to raise a complaint:

- Should you wish to raise a complaint about this research project, please contact. If you feel that your concerns have not been met, you are welcome to contact the Chair of the UCL Research Ethics Committee.

Appendix B.2. Study-1 Informed Consent Form

Consent form

If you would like to receive a copy of this consent form by email, please enter your email address here:

This study has been approved by the UCL Research Ethics Committee as Project ID Number: 1584/003

Thank you for your interest in taking part in this research. If you have any questions arising from the Information Sheet that you have already seen, please contact one of the researchers before you decide whether to continue.

Please Note: You will need to consent to every item listed below to proceed with this survey.

Please confirm the following:

- I have read the Information Sheet.
- I have had the opportunity to contact the researcher to ask questions and discuss the study.
- I have received satisfactory answers to my questions or have been advised of an individual to contact for answers to pertinent questions about the research and my rights as a participant.
- I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with all applicable data protection legislation.

- I agree that my anonymised research data may be used by others for future research. I understand that no one will be able to identify me when this data is shared.
- **I hereby consent to take part in this study.**

Appendix B.3. Study-2 Participant Information Sheet

Information Sheet

If you would like to receive a copy of this consent form by email, please enter your email address here:

This study has been approved by the UCL Research Ethics Committee as Project ID Number: 1584/003

You are invited to take part in a research project investigating the perceptual influences of sounds, specifically ASMR and misophonia. Prior to your decision to participate, it is important that you understand why this research is being conducted and what your participation will involve. Please take your time in reading the following information carefully.

Name and Contact Details of the Researchers:

Name and Contact Details of the Principal Researcher:

What is the project's purpose?

- Our research focuses on understanding the relationship between two auditory-related perceptual phenomena.

Do I have to take part?

- It is up to you to decide whether or not you take part. If you do not decide to participate, this will not disadvantage you in any way. If you do decide to take part, you will be asked to sign (tick box) a consent form.
- Even after agreeing to take part, you can still withdraw at any time and without giving a reason. If you withdraw before the end of the experiment, we will not retain your data and it will not be analysed.

What will happen to me if I take part?

- If you choose to participate in this research project, your participation will entail a single session lasting no more than 40 minutes.
- You will be asked to listen to 16 short audio clips (around 2 minutes each) and mark on an image of a body map presented alongside each audio clip whether you experienced any kind of sensation in response to the presented audio. You will also be asked to answer a set of standard questions in response to each audio. These questions will ask you to report if you have experienced either of the perceptual phenomena (ASMR, misophonia, or neither) and about how pleasant the sound was.
- There are no anticipated risks or benefits associated with participation in this study, but your participation will contribute to the knowledge in this area of research.

Data Protection and Confidentiality:

- All the information that we collect about you during the course of the research will be kept strictly confidential. All data will be collected and stored in accordance with the General Data Protection Regulations 2018. The results of this study will be seen only by other professional researchers and for teaching purposes.
- Your responses will be coded by an identifying code, and data will be confidentially secured and accessed only by our research staff. If appropriate, results may be published in scientific journals or be presented at scientific meetings. However, your name will not be identified in any public forum, and you will not be able to be identified in any ensuing reports or publications.

If you wish to raise a complaint:

- Should you wish to raise a complaint about this research project, please contact. If you feel that your concerns have not been met, you are welcome to contact the Chair of the UCL Research Ethics Committee.

Contact for further information:

- Following your participation in the study you may contact one of the researchers if you desire more information at any time.

Thank you for reading this information sheet and for considering to take part in this research study.

Appendix B.4. Study-2 Informed Consent Form

Consent form

If you would like to receive a copy of this consent form by email, please enter your email address here:

This study has been approved by the UCL Research Ethics Committee as Project ID Number: 1584/003

Thank you for your interest in taking part in this research. If you have any questions arising from the Information Sheet that you have already seen, please contact one of the researchers before you decide whether to continue.

Please Note: You will need to consent to every item listed below to proceed with this survey.

Please confirm the following:

- I have read the Information Sheet.
- I have had the opportunity to contact the researcher to ask questions and discuss the study.
- I have received satisfactory answers to my questions or have been advised of an individual to contact for answers to pertinent questions about the research and my rights as a participant.
- I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with all applicable data protection legislation.

- I agree that my anonymised research data may be used by others for future research. I understand that no one will be able to identify me when this data is shared.
- **I hereby consent to take part in this study.**

Appendix B.5. Study-2 Debrief Form

Debrief form

You have now completed all the questions. Thank you for participating.

This page explains in more detail the reason that we are running this survey.

- The purpose of this survey was to explore the effectiveness of using a heatmap design to measure the location of ASMR sensations in ASMR-sensitive people. Moreover, it will help contribute to existing literature on the topical distribution of ASMR sensations in response to sounds.
- During a heatmap design in an experiment, participants will be asked to draw on diagrams to indicate where in the body they have felt sensations.
- ASMR describes a relaxing and/or calming tingling sensation, typically reported to be centred on the scalp and down the back of the neck and occurs in response to a variety of audiovisual triggers like whispering and tapping.
- Previous research has asked participants to report the locations of their ASMR sensations, but this has only been done through writing the names of bodily areas. A heatmap design has not yet been implemented in ASMR research. This survey will compare heatmap data to written answers to see whether the heatmap data is an appropriate measure.
- Furthermore, this data will add to existing topical distribution data from previous studies on the location of ASMR sensations.

How are we protecting your data and how will the results be used?

- As mentioned in the information sheet, given before the start of this survey, the data from this experiment will be anonymised and you will not be identifiable from the data. You have a right to withdraw your participation at any time, even after you have completed the experiment. The results might be used at conferences and published in academic journals.

If you have any further questions, or decide at any point that you wish to withdraw consent for your data to be used, please email.

If you have any comments, please use the space below.

Appendix B.6. Study-1 Background Questions

- Age ___
- Sex
    - Male
    - Female
    - Non-binary
    - Other (please specify _____)
- ASMR refers to a sensory experience where a sensitive person may experience a tingling sensation and relaxation from audiovisual content (e.g., whispered speech, tapping). Reading this description, would you say that you experience ASMR?

  Yes No Don't know

    - If so, which of the below triggers would you say most triggers your ASMR?
        - Whispering
        - Tapping
        - Crinkling / Crisp sounds
        - Scratching
        - Brushing
        - Personal Attention (roleplays)
        - Mouth Sounds
        - Other, please specify _____

- Likewise, are there any ASMR triggers that you find rarely or never trigger triggers your ASMR?
  - Whispering
  - Tapping
  - Crinkling / Crisp sounds
  - Scratching
  - Brushing
  - Personal Attention (roleplays)
  - Mouth Sounds
  - Other, please specify _____
- Do you regularly watch/listen to ASMR?

Yes No Don't know

- Misophonia translates to a 'hatred of sound' and is typically described as a sensitivity to certain sounds which can be unpleasant to the listener. For example, the sound of scraping metal which may make you feel annoyance or anger and you may feel as if the sound is piercing your ears or putting your teeth on edge. Reading this description, would you say you ever experience misophonia?

Yes No Don't know

- If so, what sound(s) would you say most triggers its occurrence? _____
- Now thinking about both ASMR and misophonia, is there an ASMR trigger that triggers your misophonia?

Yes No Don't know

- If so, what ASMR trigger(s) produce your misophonia? ______

- Synaesthesia refers to a blending of the senses, where stimulating one specific sense involuntarily triggers a response in one or more other senses. Here is an example of a synaesthetic associations: grapheme-colour synaesthesia where specific colours are perceived and associated with letters, words and/or numerals. Reading the description and example, would you say that ever experience synaesthesia?

  Yes No Don't know

- Would you describe yourself as open to new experiences?

  Yes No Don't know

Appendix B.7. Study-2 Pre-Screen Survey and Background Questions

Pre-Screen Survey:

ASMR refers to a sensory experience where a sensitive person may experience a tingling sensation and relaxation from audiovisual content (e.g., whispered speech, tapping).

- Reading this description, would you say that you experience ASMR?

  Yes   No   Don't know

Background Questions:

- Age ___
- Sex
  - Male
  - Female
  - Non-binary
  - Other (please specify _____)
- ASMR refers to a sensory experience where a sensitive person may experience a tingling sensation and relaxation from audiovisual content (e.g., whispered speech, tapping).
  - Which of the below triggers would you say most triggers your ASMR?
    - Whispering

        - Tapping
        - Crinkling / Crisp sounds
        - Scratching
        - Brushing
        - Personal Attention (roleplays)
        - Mouth Sounds
        - Other, please specify ______

    - Likewise, are there any ASMR triggers that you find rarely or never trigger triggers your ASMR?
        - Whispering
        - Tapping
        - Crinkling / Crisp sounds
        - Scratching
        - Brushing
        - Personal Attention (roleplays)
        - Mouth Sounds
        - Other, please specify ______

    - Do you regularly watch/listen to ASMR?

Yes No Don't know

- Misophonia translates to a 'hatred of sound' and is typically described as a sensitivity to certain sounds which can be unpleasant to the listener. For example, the sound of scraping metal which may make you feel annoyance or anger and you may feel as if the sound is piercing your ears or putting your teeth on edge. Reading this description, would you say you ever experience misophonia?

Yes No Don't know

- If so, what sound(s) would you say most triggers its occurrence? ______

- Now thinking about both ASMR and misophonia, is there an ASMR trigger that triggers your misophonia?

  Yes No Don't know

  - If so, what ASMR trigger(s) produce your misophonia? ______

Appendix B.8. ADCQ

Thinking about ASMR content and your viewing habits, please answer the below questions:

- Approximately, how old were you when you first discovered ASMR? _____
- Approximately, how many days per week do you listen to ASMR video/audio?

0 1 2 3 4 5 6 7

- In a single session, how many ASMR videos/audios do you typically watch/listen to? _____
- Approximately, of the choices below, what would you consider to be your optimal duration for a single ASMR video/audio?

1-5min 6-10min 11-20min 21+min

- Approximately, for a single ASMR video/audio, what would be your preferred amount of ASMR 'triggers'?

1 trigger 2 triggers 3 triggers 4+ triggers

- On average, how long into engaging in an ASMR video/audio would you say you tend to experience ASMR?

0-1min 1-5min 5-10min 10-20min 20+min

- When during the day would you say that you usually watch/listen to ASMR? _____
- Would you say you listen to ASMR while working, studying, or similar?

Yes | No | Don't know

→ If so, please specify _____

- Would you say that you have experienced ASMR outside of watching/listening to ASMR content?

Yes | No | Don't know

→ If so, please specify what triggered your ASMR _____

Thinking about the sensations you feel from watching/listening to ASMR content, please answer the below questions:

- When experiencing the tingling sensation of ASMR, where on your body would you say this tingling sensation originates? _____
    - Still thinking about the tingling sensation, would you say it consistently originates in the area you reported?

      Yes | No | Don't know

    - Would you say the tingling sensation spread to other areas?

      Yes | No | Don't know

      → If so, could you list the area(s) it spreads to? _____

    - Do you find that the more intense your ASMR becomes, the more it spreads to different areas?

      Yes | No | Don't know

- When you consume ASMR content, how frequently do you experience tingling sensations during one single video/audio?

None of the time | All of the time

1	2	3	4	5

- When you experience tingling sensations, how long do they typically last for? (min/sec) _____

- Typically, how pleasurable are ASMR experiences?

Very Unpleasurable	Unpleasurable	Neither Pleasurable nor Unpleasurable	Pleasurable	Very Pleasurable

- Would you say you experience emotion (e.g., happiness) from watching/listening to ASMR video/audio?

Yes	No	Don't know

→ If so, what emotion(s) do you feel? _____

Thinking about ASMR content, please answer the below questions. For each question, click on the response that best characterises how you feel about the statement.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I experience a tingling sensation when I watch/listen to ASMR content	1	2	3	4	5
I find watching/listening to ASMR content relaxing	1	2	3	4	5
ASMR sensations are more intense when the trigger is sound only	1	2	3	4	5
ASMR sensations are more intense when the trigger is video only	1	2	3	4	5
ASMR sensations are more intense when the trigger is audiovisual	1	2	3	4	5

Visually seeing where ASMR sounds originate (e.g., from a person or object) are just as important in experiencing ASMR as hearing the sounds	1	2	3	4	5
ASMR trigger sounds (e.g., whispered speech, tapping) that have been recorded close to the microphone give me more intense ASMR sensations	1	2	3	4	5
The pitch of ASMR triggers affect how strongly I experience ASMR	1	2	3	4	5
Lower pitched sounds give me more intense ASMR	1	2	3	4	5
Higher pitched sounds give me more intense ASMR	1	2	3	4	5

I regularly watch/listen to binaurally recorded ASMR content	1	2	3	4	5
Binaurally recorded ASMR content is more effective in triggering my ASMR than regularly recorded ASMR	1	2	3	4	5
Binaurally recorded ASMR content gives me more intense ASMR	1	2	3	4	5
I wear ear/headphones while watching/listening to ASMR content	1	2	3	4	5
Wearing ear/headphones is more effective in triggering my ASMR than not wearing them	1	2	3	4	5
Wearing ear/headphones gives me more intense ASMR	1	2	3	4	5

ASMR sensations are more intense when the focus is directed towards me (e.g., when whispering is directed to you)	1	2	3	4	5
When watching/listening to ASMR content, I feel a connection to the person who is attempting to give me ASMR (e.g., feeling as if the person is directly next to you, whispering in your ear)	1	2	3	4	5
When I feel the tingling sensation, it originates in the same area	1	2	3	4	5
The more intense my ASMR becomes, the more the tingling sensation spreads to other areas	1	2	3	4	5

- This comment box offers a chance for you to further discuss your responses to the questions above. Any more information that you want to share about your ASMR experiences would be appreciated. _____

Appendix B.9. MDCQ

Thinking about misophonia and the source of the sounds that trigger your misophonia, please answer the following questions:

- What is generally the source of the sounds that you would find misophonic?

Yourself	Other people	Animals	Inanimate objects	Other (please specify _____)

→ If there is any particular person, animal, object or action that triggers your misophonia, please specify _____

Thinking about the characteristics of the sounds triggering misophonia, please answer the following questions. For each question, click on the response that best characterises how you feel about the statement, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree. The comment column offers a chance for you to discuss your responses to the questions further which would be appreciated.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The pitch of misophonic sounds affects how	1	2	3	4	5

intensely I experience misophonia					
Lower pitched sounds trigger more intense misophonia	1	2	3	4	5
Higher pitched sounds trigger more intense misophonia	1	2	3	4	5
Distance from the sound affects how misophonic I perceive it to be	1	2	3	4	5
Misophonic sounds close to me trigger more intense misophonia	1	2	3	4	5
Misophonic sounds further away from me trigger more intense misophonia	1	2	3	4	5

Thinking now about the physical and emotional responses to misophonia, please answer the following questions:

- How much time do you spend thinking about these misophonic sounds?

None	A little (less than 1h per day)	Moderate (1-3h per day)	Frequently (3-8h per day)	Very frequently (8h+ per day)

- When you hear a misophonic sound, do you feel a specific sensation localised in a particular part of your body?

  Yes No Don't know

  → If yes, could you describe where? _____

  → If yes, could you describe what do you feel? _____

  → Does the sensation spread to other areas as your misophonia becomes more intense?

  Yes No Don't know

  - If you answered yes, could you list the area(s) it spreads to? _____

- Would you say you experience emotion from hearing a misophonic sound?

  Yes No Don't know

  → If so, what emotion(s) do you feel? _____

- In the presence of misophonic sounds, do you experience a physical response to it, such as heart racing, trembling or intense breathing?

  Yes No Don't know

  → If so, what do you experience? _____

- When you hear a misophonic sound, do you ever feel aversion towards the source of the sound?

  Yes No Don't know

Thinking now about how you cope with misophonic experiences and how it affects your day-to-day life, please answer the following questions. For each question, click on the response that best characterises how you feel about the statement.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I feel the need to leave an area when a misophonic sound is present	1	2	3	4	5
I believe my reactions to misophonic sounds can sometimes be exaggerated	1	2	3	4	5
I actively avoid activities or people to avoid being exposed to misophonic sounds	1	2	3	4	5
I use other sounds to drown the misophonic sounds (e.g. turn on the TV, producing other sounds myself such as humming, etc.)	1	2	3	4	5

I use other mechanisms to drown the misophonic sounds (e.g. cover my ears, noise cancelling headphones, etc.)	1	2	3	4	5
Misophonic sounds can interfere with my social and/or work functioning	1	2	3	4	5
I feel I have control over the misophonic experience (i.e. I am successful at stopping or diverting thoughts about misophonic sounds)	1	2	3	4	5

- What do you think would happen if you were not able to avoid the misophonic sounds? _____
- This comment box offers a chance for you to further discuss your responses to the questions above. Any more information that you want to share about your misophonia experiences would be appreciated. _____

Appendix B.10. Description of Each Stimuli Presented in Study-1 and 2

Descriptions of each of the 24 stimuli

Stimuli	Description
ASMR Stimuli	
Whispered Speech	A series of goldfinch facts in a whispered voice
Crinkling	Repeatedly using hands to crinkle a plastic bag
Hair Brushing	Repeatedly brushing human hair
Keyboard Typing	Repetitive keyboard typing
Page Turning	Slowly turning pages, occasionally pressing down on a page, and gliding it before turning it
Scissor Snipping	Repetitive scissor snipping (i.e., no actual cutting)
Tapping	Repetitive finger/nail tapping on a cardboard tube
Light Scraping/Scratching	Gentle and quiet finger/nail scraping on a hard surface
Misophonic Stimuli	
Metal Scraping	Repeatedly using metal cutlery to scrape against a ceramic plate
Nail Filing	Repetitive fingernail filing
Pen Clicking	Repeatedly clicking a pen with a thumb
Velcro	Repeatedly peeling then sticking back Velcro
Polystyrene (scraping)	Repeatedly using fingernails to scrape against polystyrene
Chewing (gum)	Repeatedly chewing gum (with emphasis)

Eating/Crunching (crisps)	Repeatedly eating crisps – crunch noises (with emphasis)
Eating/Crunching (apple)	Repeatedly eating an apple – some crunch noises (with emphasis)

Control Stimuli

Non-Whispered Speech	The same goldfinch facts but in a normal voice
Opening doors/drawers etc.	Repeatedly opening and closing doors and furniture drawers
Ambient Noises 1	Noise in proximity to a busy road and shopping centre
Ambient Noises 2	More noise in proximity to a busy road and shopping centre
Wrapping Paper	Unrolling then repeatedly ripping strips/pieces of wrapping paper
Appliance Sound	Turning a fan on and off
Water Sounds	Running a tap, hand washing, and toilet flushing
White Noise	White noise generated on the audio software Audacity

Appendix B.11. Study-1 ADCQ Question Set 1 – Categories

***Demographics and viewing habits*.** This category included questions relating to the approximate age in which participants were when they first discovered ASMR; the number of days participants typically engage (watch/listen) in ASMR media per week; the number of ASMR media participants typically engage in per session; participants optimal duration for single ASMR media; participants preferred number of ASMR stimuli per single ASMR media; the time of day participants tend to engage in ASMR media; and if participants engage in ASMR media while working, studying or similar and to specify the accompanying task/activity.

***ASMR somatosensation onset, frequency, and duration*.** This category included questions on the onset time of ASMR somatosensation, the frequency of ASMR somatosensation, and approximate duration of ASMR somatosensation in sec/min.

***Somatic distribution of ASMR somatosensation*.** This category included questions relating to the bodily region(s) in which participants report ASMR somatosensation as originating; whether ASMR somatosensation consistently originates in the reported area(s); if the sensation spread to another area(s) and to report the area(s); and whether ASMR somatosensation spread with intensity (i.e., the more intense the ASMR stimulus becomes, the more it spreads).

***ASMR outside*.** This category included questions relating to whether participants had experienced ASMR outside of ASMR media and to specify the triggering stimulus.

***Pleasure*.** This category included a question relating to how pleasurable participants find ASMR experiences.

Emotion**.** This category included questions relating to whether participants experienced emotion(s) from engagement in ASMR media and to specify the emotion(s) felt.

Appendix B.12. Study-1 ADCQ Question Set 2 – Categories

ASMR sensations. This category included questions relating to the typical sensations attributed to ASMR including whether participants ever experience ASMR somatosensation and relaxation from engaging in ASMR media; whether ASMR somatosensation originates in the same area; and whether ASMR somatosensation spreads to other areas with intensity (items 1-2 and 19-20).

Sensory properties of ASMR stimuli. This category included questions relating to participant preferences in the sensory properties of ASMR-eliciting stimuli. This included whether ASMR experiences are more intense if the stimuli is solely auditory, solely visual, or audiovisual stimuli; whether seeing where a sound originates is as important in experiencing ASMR as hearing the sound itself; if proximal spatial location (i.e., how close to the microphone have ASMR sounds been recorded) intensifies ASMR experiences; whether the pitch of ASMR stimuli influences the intensity of ASMR experiences; whether lower or higher pitched ASMR stimuli intensify ASMR experiences; whether ASMR experiences are more intense if attention (of the ASMR host) is directed to the participant; and if the participant feels any sort of connection to the ASMR host (items 3-10 and 17-18).

Equipment. This category included questions relating to preferences for how ASMR stimuli were recorded and ear/headphone usage. This included whether participants regularly engaged in binaurally recorded ASMR media; whether binaurally recorded ASMR media is more effective in triggering ASMR experiences than regularly recorded ASMR media; whether binaurally recorded ASMR media intensify ASMR experiences; whether participants wear ear/headphones while engaging in ASMR media; whether wearing ear/headphones while engaging in ASMR media is more effective in triggering ASMR experiences than not wearing ear/headphones; and whether wearing ear/headphones intensify ASMR experiences (items 11-16).

Appendix B.13. Study-1 MDCQ Question Set 1 – Categories

Misophonic source, aversion, non-avoidance, and time. This category included questions on the source of misophonic sounds; whether participants have a particular person, animal, object, or action that triggers misophonia; if participants feel aversion towards the source of misophonia (as a sound); what participants believe would be the consequence of being unable to avoid misophonic stimuli (as a sound); and the amount of time spent thinking about misophonic sounds (per day).

Somatic distribution of misophonic sensations. This category included questions relating to whether participants experienced bodily sensations in response to misophonic stimulation; the bodily region(s) in which participants report misophonic sensations as originating and report what the sensation(s) experienced was; and whether misophonic sensations spread to another area(s) and to report the area(s).

Physical responses to misophonia. This category included questions on whether participants experienced a physical response(s) from exposure to a misophonic sound and to specify the response(s) felt.

Emotion. This category included questions on whether participants experienced emotion(s) from exposure to a misophonic sound and to specify the emotion(s) felt.

Appendix B.14. Study-1 MDCQ Question Set 2 – Categories

Sensory properties of misophonic stimuli. This category included questions pertaining the sensory properties of misophonic stimuli. This included whether the pitch of misophonic stimuli influences the intensity of misophonic sensations; whether lower or higher pitched misophonic stimuli intensify misophonic sensations; if distance from a sound influences the extent to which it is perceived as misophonic; and whether proximal or distal spatial location (i.e., how close, or far away to the source of misophonia is to the person) intensifies misophonic sensations (items 1-6 of the first set of Likert-based questions).

***Coping mechanisms for misophonia*.** This category included questions pertaining how participants cope with misophonia (vacating a room when a misophonic stimulus is present, avoiding certain activities/people to avoid risk of exposure to misophonic sounds, use of other sounds to drown out misophonic sounds, alternative methods of drowning out misophonic sounds); whether participants thought their reactions to misophonic stimuli (sounds) could at times be exaggerated; if misophonia affects day-to-day functioning (social/work); and if participants feel that that have control over their misophonia (items 1-7 of the second set of Likert-based questions).

Appendix B.15. Study-2 Heatmap Samples per Stimulus

ASMR-Eliciting Stimuli – ASMR Somatosensation:

- Hair brushing: n = 26 (1 blank heatmap)
- Keyboard typing: n = 24 (1 blank heatmap)
- Page turning: n = 15 (3 blank heatmaps)
- Plastic bag crinkling: n = 24
- Scissor snipping: n = 22 (3 blank heatmaps)
- Cardboard tube scraping: n = 19 (1 blank heatmap)
- Cardboard tube tapping: n = 16
- Whispering: n = 35 (1 blank heatmap)

Misophonic Stimuli – ASMR Somatosensation:

- Gum chewing: n = 8 (1 blank heatmap)
- Eating apple: n = 12 (3 blank heatmaps)
- Eating crisps: n = 17 (2 blank heatmaps)
- Metal scraping: n = 3
- Nail filing: n = 20 (1 blank heatmap)
- Pen clicking: n = 19
- Polystyrene: n = 2
- Velcro: n = 15 (3 blank heatmaps)

ASMR-Eliciting Stimuli – Misophonic Sensations:

- Hair brushing: n = 4
- Keyboard typing: n = 1
- Page turning: n = 9 (1 blank heatmap)
- Plastic bag crinkling: n = 5 (1 blank heatmap)
- Scissors snipping: n = 5
- Cardboard tube scraping: n = 8
- Cardboard tube tapping: n = 6 (1 blank heatmap)
- Whispering: n = 8 (1 blank heatmap)

Misophonic Stimuli – Misophonic Sensations:

- Gum chewing: n = 18 (2 blank heatmaps)
- Eating apple: n = 19 (1 blank heatmap)
- Eating crisps: n = 20 (1 blank heatmap)
- Metal scraping: n = 30 (7 blank heatmaps)
- Nail filing: n = 11 (2 blank heatmaps)
- Pen clicking: n = 4
- Polystyrene: n = 37 (4 blank heatmaps, 1 corrupted image)
- Velcro: n = 11 (2 blank heatmaps)

Appendix C: Supplementary Data

Appendix C.1. ASMR-Misophonia ADCQ Thematic Analysis

Conceptual framework of ASMR-sensitive participant's general experiences and thoughts centred around the phenomenon

Themes	Codes	Description	Example Quotes:
Age of onset and being unaware of a descriptive term and that others also experienced ASMR	ASMR Naivety	Since the initialism ASMR was coined what can still be considered to be relatively recently, some individuals sensitive to ASMR may report experiencing the phenomenon pre-coining, perhaps even during earlier life, when they were unaware of a descriptive term for the phenomenon and that other individuals also	*"I began experiencing ASMR at a young age, but I did not know what it was called, or if others experienced it, until I was older." "I first experienced ASMR in first class in elementary school when I listened to my teacher read a book. When I was younger I tried to explain ASMR (not knowing the term) by saying "do you know the feeling*

		experienced it, something that coining the initialism of ASMR has quite obviously aided. A few participants from the current study recalled such experiences.	*when you suddenly feel really good".”*
Accompanying Movement	Voluntary	On more than one occasion did a participant refer to accompanying movements alongside ASMR, both involuntary and voluntary.	*“I usually accompany ASMR with absentminded light scratching of my arms/legs/head. It feels pleasurable and relaxing.”*
	Involuntary		*“Normally my arms move unwittingly with the asmr and I laugh for the same reason”*

Habituation	Numbness	The intensity of ASMR sensations has been said to dissipate over time. One participant in particular touched on this and noted that the effect of consuming too much ASMR media (online) had a similar habituating effect on experiencing ASMR in the real world. One participant outlined the decline in their ASMR as a result of over-engagement in ASMR media.	*"The more I have watched ASMR videos the more numb I have become to tingles. I try not to watch ASMR too often. Usually I just get a generally nice/relaxed feeling when watching ASMR and the specific tingling is more rare, lasting maybe from 30sec. to 1min. Usually it takes some time and I need to focus on the video…Nowadays when I frequently watch ASMR videos I get less ASMR tingles in real life."*

Bilingualism	English/Finnish	While this has not been discussed in the literature, there may be preferences for spoken ASMR in different languages (where, for instance, there may be acoustic differences driving such preferences) and individuals who are bi/multilingual may be a good intermediary. One participant refers to their ability to benefit from ASMR worded in two languages.	*"My mother tongue is Finnish and I watch and enjoy ASMR videos both in Finnish and in English."*
Therapeutic Utility	(general) Relaxation Anxiety	There is a current trend in the literature which is investigating the	*"it relaxes me!"*

		therapeutic utility and application of ASMR which is generally based on the relaxing sensation typically attributed with the phenomenon. Research that has reported on reasons for ASMR engagement also mention alleviation of symptoms of conditions such as anxiety, depression, and insomnia as key reasons for consumption of ASMR media. With regards to this, the current sample mentioned relaxation (in general), anxiety	*"I personally find ASMR therapeutic, it helps me tone down my anxiety and wind down after a long day of work or studying. It also helps me detach from my work space since I live in a small apartment and don't have a separate room for it, almost like it helps me escape into another, calming world!"*
	Sleep		*"I enjoy watching/listening to ASMR before bed because it helps me fall asleep much faster and easier."*

		relief, and use as a sleep aid.	
Effect of Medication	Antidepressants	While this has not been discussed in the literature, there has been speculation that neurotransmitter (e.g., dopamine) release accompanies ASMR in a similar way that has been reported in frisson, and how neuroimaging findings have been shown to support this theory. One participant discussed their experience of antidepressants inhibiting their ASMR experiences and	*"…I used to experience ASMR more frequently and more intensely a few years ago; the only thing that changed was that I was on anti-depressants for a few months during which my ASMR experiences dulled. I have now been off them for 3+ years and my ASMR experiences are still nearly non-existent or severely dulled."*

		the long-term effect this has had.	
Task Limitations / Improvements	Overstimulation Pause Function Interface	Some participants discussed limitations to the study task and how they can be improved upon.	*"At some point during the trigger test part, some of the triggers were boring or disgusting, and some of them caused me good ASMR but then became overstimulating and had to mute the device. To solve this and related problems with other users, I may suggest: Add a pause button so I can go to the restroom or attend something without affecting the test; Add a stop button so users can skip*

		disgusting, non-stimulating or overstimulating sounds. Also, try adding a light grid to tables or lists in the forms, this will help older or impaired people to fill the forms (like this one where it's hard to find which radio buttons belong to certain questions).”

Note. For themes that have multiple codes, evidence is presented in order of the code such that each individual piece of evidence (quote from participant) corresponds with a particular code.

Appendix C.2. ASMR-Misophonia MDCQ Thematic Analysis

Conceptual framework of misophonic participant's general experiences and thoughts centred around the phenomenon

Themes	Codes	Description	Example Quotes
Coping Mechanisms	Meditation/Mindfulness	The misophonic literature has reported on coping mechanisms that those sensitive to the phenomenon employ as countermeasures for misophonic episodes. Some participants discussed their strategies and/or quirks they may do in response to misophonic episodes.	*"Practising mindfulness, consciously breathing and meditation help me during misophonia experiences"*
	Avoidance		*"the sound of metal scratching together really triggers my misophonia. Most of the time I need to immediately leave the room."*

	Physical Touch		*"Experiencing sounds that trigger misophonia makes me cringe in multiple areas of my body, and sometimes I'll grab onto other parts of my body or bite down hard."*
Association with other perceptual phenomena	ASMR	One participant mentioned how they engage in ASMR media and enjoy it (potentially experience the relaxation and/or positive emotionality attributed with it) but have never experienced ASMR	*"I usually enjoy some ASMR sounds, but can never seem to feel the tingling."*
	Frisson		*"I usually get goosebumps when I feel misophonia."*

		somatosensation. Another mentioned experiencing goosebumps which is characteristic of frisson though arguably may not represent frisson due to the phenomenon being described in a positive manner while misophonia clearly draws on the negative, emotion-wise.	
Heightened Misophonia	Age	One participant noted how their misophonia had become more intense with age.	*"My reactions to misophonia became stronger with age (19 years onwards)."*
Feeling Trapped	Fight or Flight Response	Feeling trapped and escape is typically reported within the	*"When I'm overwhelmed by it and cannot escape, it can*

		misophonia literature, and one participant referred to fight or flight in response to misophonic overstimulation.	*sometimes feel like my fight or flight response is triggered."*
Effect on Life	Work/School	The misophonic literature has reported on misophonia having a negative impact on aspects of an individual's life and some participants discussed such influences.	*"Some people cannot concentrate if they are hearing loud annoying sound, is different for everyone but that can affect everything since work/ school production and mood as well."*
	Family		*"Misophonia has definitely affected other*

			areas of my life, including family relationships. I also chose a job where I could work from home well before the pandemic to avoid the sounds of working in an office."
Effect of other factors	Stress	Some participants described how their misophonic episodes can be influenced by other factors including stress, trauma, and emotional state.	*"I don't know if what I experience is actually misophonia or simply a response to stressors when i'm already stressed. When I'm in a good mood I don't have any*

		responses to eating/ mouth sounds; scraping furniture or cutlery on plates; or people talking when the radio is on; or the sounds of being in a crowd - but when I'm feeling stressed or anxious the sounds will make me extremely frustrated and, frankly, slightly hysterical and i have to leave and go somewhere quiet to calm down."

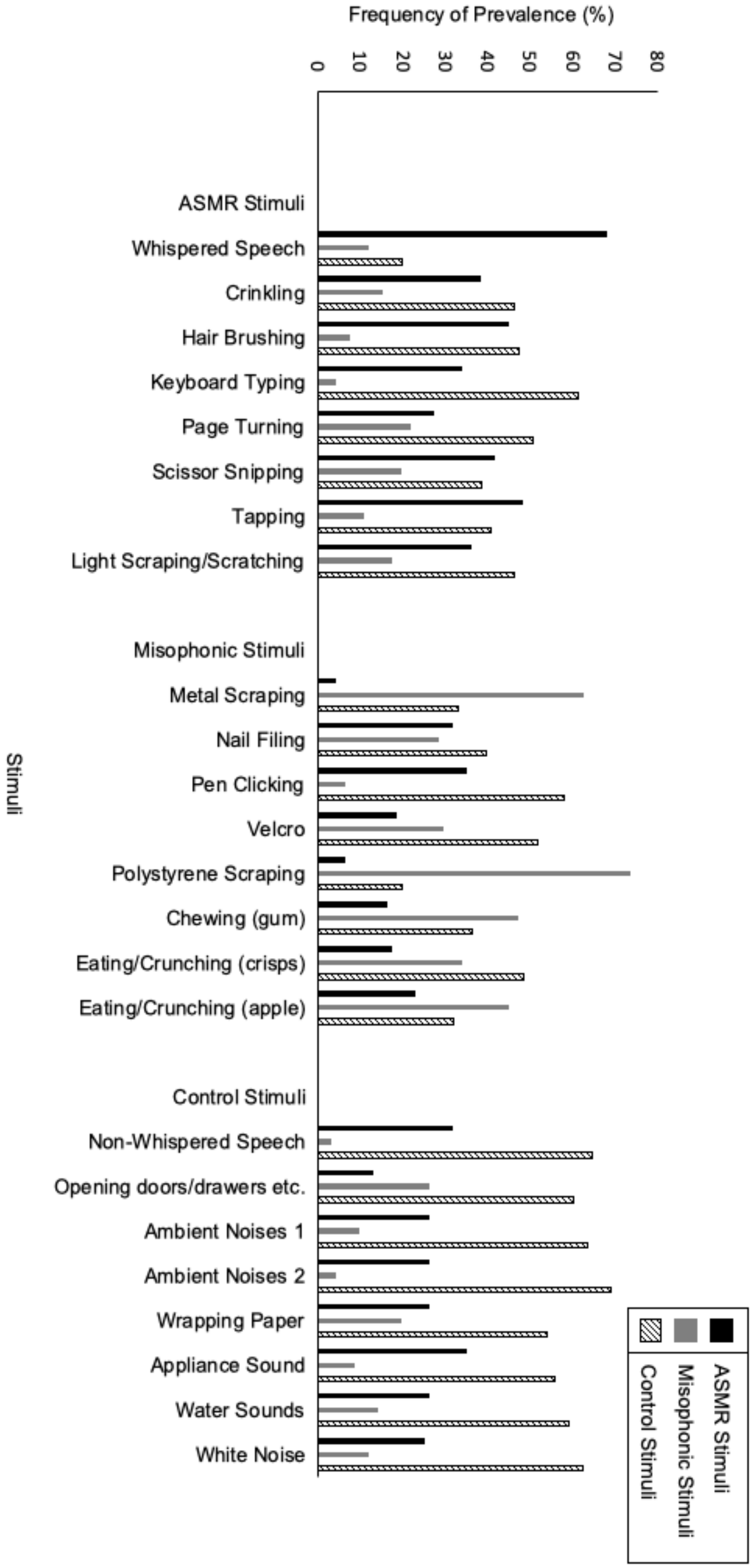
	Trauma		*"I also have fear of certain metallic scraping sounds as they remind me of earlier medical trauma."*
	Emotion		*"My reaction to a lot of sounds depends heavily on my emotional state at the time, and it tends to be emotional rather than physical."*
Being unaware of a descriptive term and that others also	Misophonic Naivety	Similar to ASMR, the term misophonia was coined not too long ago (within the last decade or so) where some	*"I spent a decade or so assuming I experienced this because I was a difficult person, and*

experienced misophonia		individuals sensitive to misophonia may report experiencing the phenomenon pre-coining when they were unaware of a descriptive term for the phenomenon and that other individuals also experienced it. One participant from the current study recalled such experiences.	*was quite relived to find that other people experience misophonia too."*
Misophonic Stimulation	Experiment versus Real life	One participant mentioned a difference in their difference in their experience of misophonia from the study task compared to real life, that the study stimuli (mouth	*"I was surprised that even the chewing sounds here didn't bother me as much as they might 'in the wild'. Somehow, knowing that*

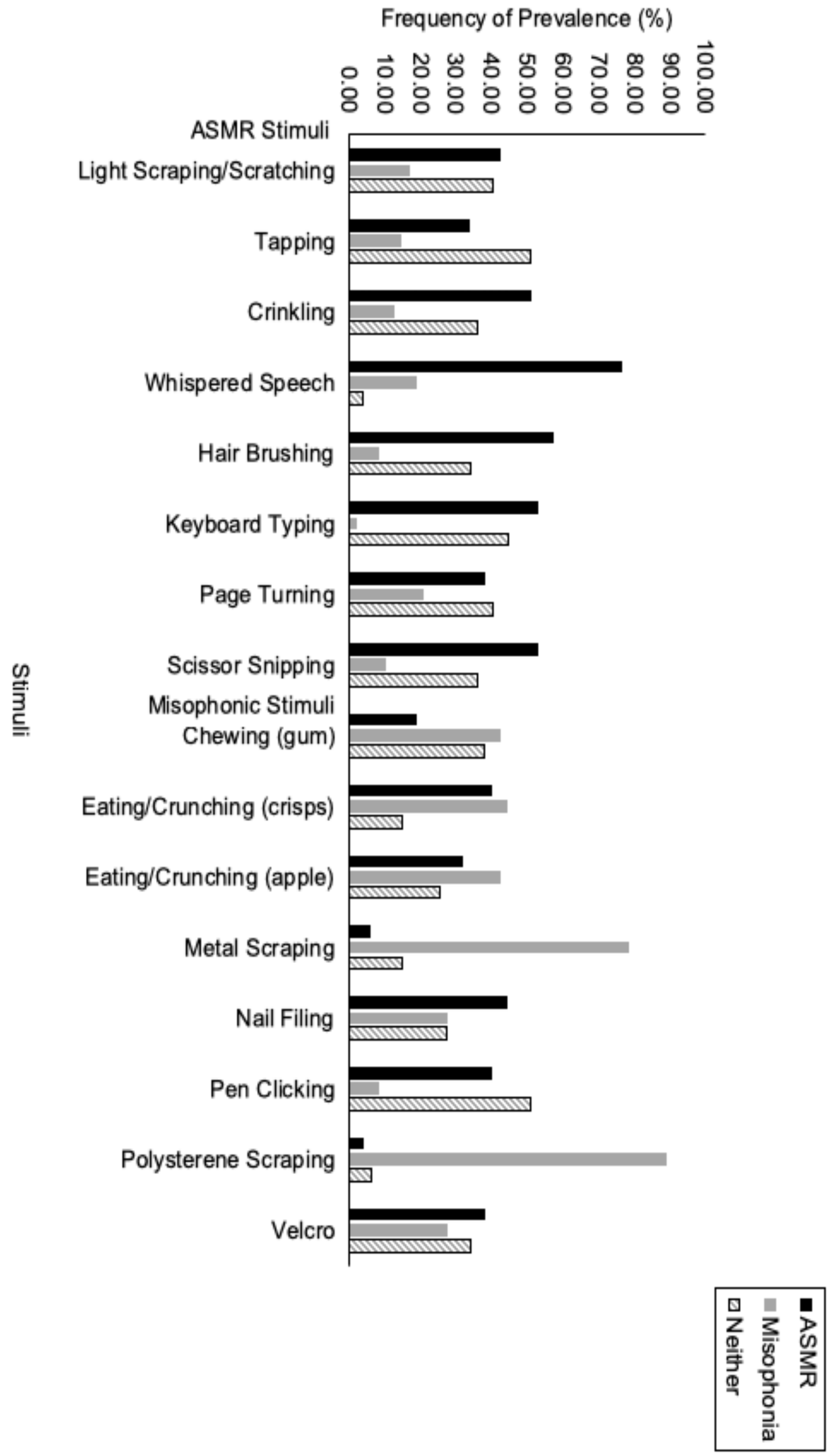
		sounds as the misophonic inducer) did not elicit as strong a misophonic response as it may in the real world.	*they're part of an experiment makes them less annoying."*

Note. For themes that have multiple codes, evidence is presented in order of the code such that each individual piece of evidence (quote from participant) corresponds with a particular code.

Appendix C.3. Chapter 5 Study-1 Illustration of the Preliminary Prevalence Rates of Each Response for Each Stimulus



Appendix C.4. Chapter 5 Study-2 Illustration of the Preliminary Prevalence Rates of Each Response for Each Stimulus



Appendix C.5. Chapter 5 Study-1 Paired-Samples t-tests – Somatic Distribution

For the head, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.73, SD=.446). The difference in means (difference = .267) was statistically significant, t(74) = 5.187, p=.001.

For the scalp, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.27, SD=.447). The difference in means (difference = .730) was statistically significant, t(62) = 12.952, p=.001.

For the face, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.67, SD=.492). The difference in means (difference = -.333) was statistically significant, t(11) = -2.345, p=.039.

For the eyes, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.17, SD=.389). The difference in means (difference = -.833) was statistically significant, t(11) = -7.416, p=.001.

For the ears, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.56, SD=.499). The difference in means (difference = .444) was statistically significant, t(125) = 10.001, p=.001.

For the mouth (general), the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.36, SD=.505). The difference in means (difference = -.636) was statistically significant, t(10) = -4.183, p=.002.

For the teeth, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.04, SD=.209). The difference in means (difference = -.957) was statistically significant, t(22) = -22.001, p=.001.

For the jaws, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.42, SD=.515). The difference in means (difference = -.583) was statistically significant, t(11) = -3.924, p=.002.

For the neck, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.47, SD=.501). The difference in means (difference = .525) was statistically significant, t(157) = 13.181, p=.001.

For the shoulders, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.69, SD=.471). The difference in means (difference = .730) was statistically significant, t(62) = 12.952, p=.001.

For the back, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.51, SD=.504). The difference in means (difference = .313) was statistically significant, t(31) = 3.754, p=.001.

For the spine, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.48, SD=.512). The difference in means (difference = .524) was statistically significant, t(20) = 4.690, p=.001.

For the chest, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.75, SD=.444). The difference in means (difference = -.250) was statistically significant, t(19) = -2.517, p=.021.

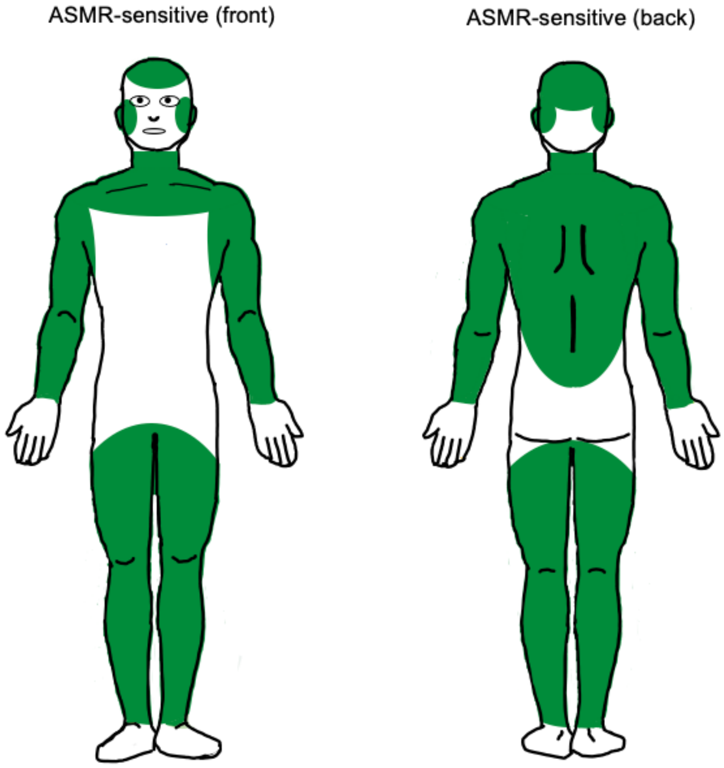
For the stomach, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.14, SD=.363). The difference in means (difference = -.857) was statistically significant, t(13) = -8.832, p=.001.

For the arms, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.62, SD=.493). The difference in means (difference = .385) was statistically significant, t(38) = 4.873, p=.001.

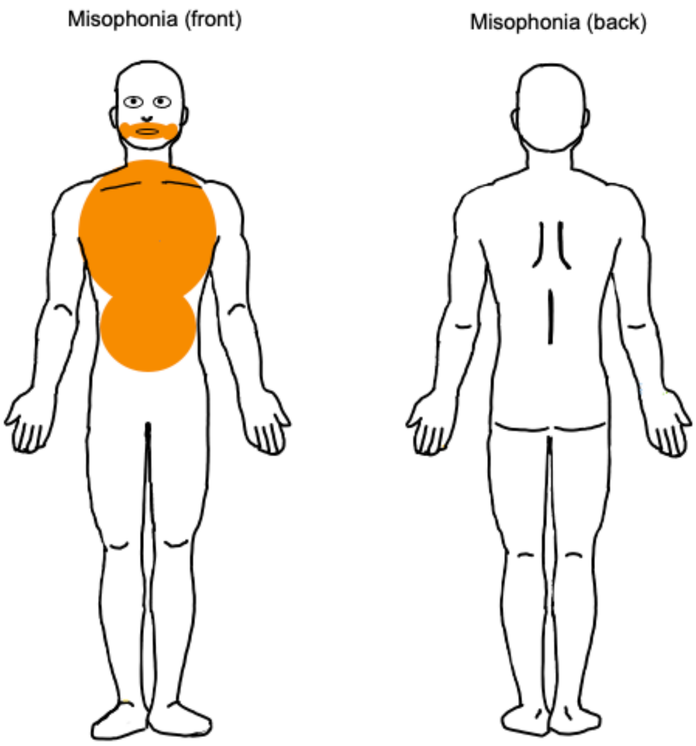
For the legs, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.18, SD=.405). The difference in means (difference = .818) was statistically significant, t(10) = 6.708, p=.001.

Appendix C.6. Chapter 5 Study-1 Paired-Samples t-tests – Heatmaps

ASMR (significant areas)



Misophonia (significant areas)



Appendix C.7. Chapter 5 Study-2 Paired-Samples t-tests – Somatic Distribution

For the head, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.86, SD=.354). The difference in means (difference = -.143) was statistically significant, t(48) = -2.828, p=.007.

For the scalp, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.21, SD=.426). The difference in means (difference = .786) was statistically significant, t(13) = 6.904, p=.001.

For the ears, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.75, SD=.434). The difference in means (difference = .247) was statistically significant, t(72) = 4.854, p=.001.

For the teeth, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.22, SD=.428). The difference in means (difference = -.778) was statistically significant, t(17) = -7.714, p=.001.

For the neck, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.49, SD=.504). The difference in means (difference = .507) was statistically significant, t(68) = 8.367, p=.001.

For the back, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.60, SD=.498). The difference in means (difference = .401) was statistically significant, t(29) = 4.397, p=.001.

For the spine, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.50, SD=.519). The difference in means (difference = .501) was statistically significant, t(13) = 3.606, p=.003.

For the chest, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.21, SD=.426). The difference in means (difference = -.333) was not statistically significant, t(8) = -2.001, p=.081.

For the stomach, the mean was higher for misophonia (M=1.0, SD=.001) than ASMR (M=.29, SD=.488). The difference in means (difference = -.714) was statistically significant, t(6) = -3.873, p=.008.

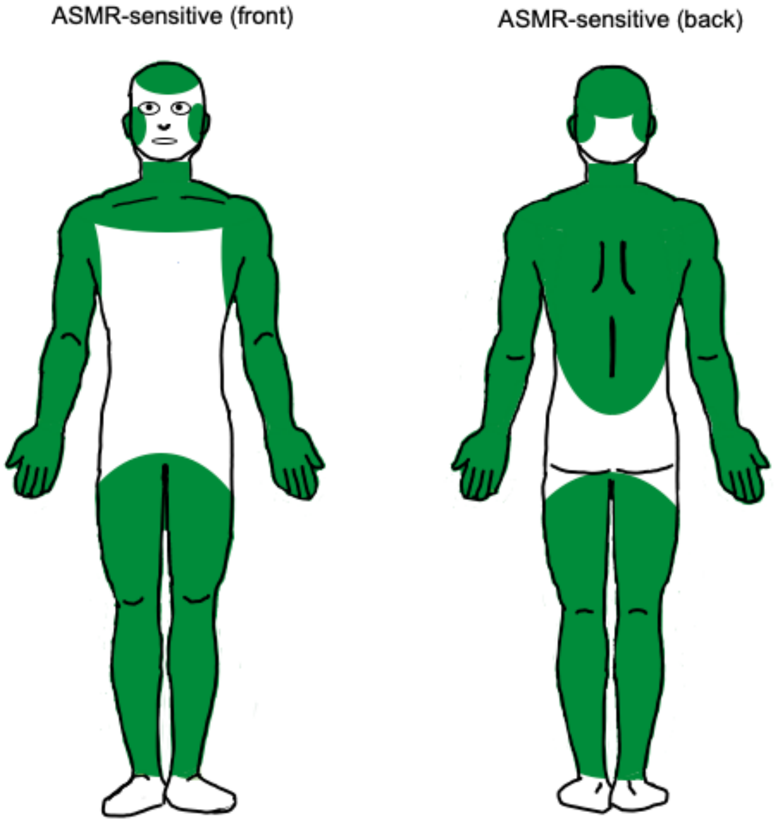
For the arms, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.38, SD=.495). The difference in means (difference = .625) was statistically significant, t(23) = 6.191, p=.001.

For the hands, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.18, SD=.405). The difference in means (difference = .818) was statistically significant, t(10) = 6.708, p=.001.

For the legs, the mean was higher for ASMR (M=1.0, SD=.001) than misophonia (M=.39, SD=.502). The difference in means (difference = .611) was statistically significant, t(17) = 5.169, p=.001.

Appendix C.8. Chapter 5 Study-2 Paired-Samples t-tests – Heatmaps

ASMR (significant areas)



Misophonia (significant areas)