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ASMR-Experience Questionnaire (AEQ): A data-driven step towards accurately classifying ASMR responders

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Autonomous sensory meridian response (ASMR) describes an atypical multisensory experience of calming, tingling sensations that originate in the crown of the head in response to a specific subset of audio-visual triggers. There is currently no tool that can accurately classify both ASMR-Responders and non-responders, while simultaneously identifying False-Positive cases that are similar sensory-emotional experiences. This study sought to fill this gap by developing a new online psychometric tool – the ASMR-Experiences Questionnaire (AEQ). Participants watched a series of short ASMR videos and answered sensory-affective questions immediately afterwards. Using a k-means clustering approach, we identified five data-driven groupings, based on tingle- and affect-related scores. ASMR-Responders differentiate based on ASMR propensity and intensity (ASMR-Strong; ASMR-Weak); non-responders differentiate based on response valence (Control+; Control−; False-Positive). Recommendations for how the AEQ and the respective output groups can be best utilized to enhance ASMR research are discussed.

Autonomous sensory meridian response (ASMR) is a spontaneous sensory experience, which is characterized by tingling sensations in response to social visual and auditory stimuli (Barratt & Davis, 2015). Typically these tingling sensations arise at the back of the head and neck; they are then thought to radiate down the spine and into the limbs in periods of greater intensity (Barratt & Davis, 2015). ASMR induction is largely thought to be involuntary and heavily dependent on environmental setting and individual mood (Barratt & Davis, 2015; Poerio, Blakey, Hostler, & Veltri, 2018).

While ASMR has wide popular appeal (e.g., over 24 million subscribers to ASMR channels on YouTube), our scientific understanding of the experience is at early stages. There are some studies that provide evidence of physiological correlates of ASMR, for instance, altered heartrate and skin conductance response when viewing ASMR videos in individuals that reported experiencing ASMR versus those who did not (Poerio et al., 2018). There is also neuroimaging work showing that ASMR experience is associated with

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neural correlates in brain regions associated with social cognition and self-awareness (Lochte, Guillory, Richard, & Kelley, 2018; Smith, Fredborg, & Kornelsen, 2019).

Autonomous sensory meridian response has also been linked to wider traits such as personality differences and empathy (Fredborg, Clark, & Smith, 2017; McErlean & Banissy, 2017). ASMR-Responders have reported increased relaxation and an elevation in mood (Barratt & Davis, 2015) following ASMR induction. There is also an interest in studying the effects of ASMR on well-being (Barratt & Davis, 2015). In this context, there is increasing focus on ASMR to help us to understand human psychological function in a wider context. For example, in the context of the social impacts of ASMR (e.g., empathy), the experience can offer a unique experimental window to help us to understand individual differences that contribute to our perception of the social world. This is important because if we are to build a complete understanding of factors that contribute to human perception, we need to understand the normative and the variation between (Happé, Cook, & Bird, 2017).

Current ASMR-responder validation limitations

While prior studies provide an important first step in objectively verifying ASMR, further work is required to develop quantitative measures to validate and measure the presence of ASMR in an individual. Indeed, before potential relationships between ASMR and broader experiences (e.g., mental health and well-being) can be fully explored, we first need to be able to better characterize and explain ASMR itself.

Most ASMR research relies upon self-described groupings for ASMR-Responders that are assigned by an individual researcher based on binary responses of whether the participants indicate that they do or do not experience ASMR. While this is a useful first step, more objective classification criteria are required. In particular, there is a crucial need for the development of tools that can help with sub-grouping participants based on how they respond to ASMR-inducing material. For example, one obstacle is understanding whether there are ASMR-specific biases in non-Responder recruitment (e.g., whether individual differences in perceived pleasantness or calmness of ASMR stimuli influences non-responders' likelihood of participation in research).

A further hindrance in ASMR research is identifying ASMR-Responders with a high reliability of ASMR induction. In particular, identifying ASMR-Responders who are able to reliably and strongly experience ASMR while under experimental conditions (i.e., in an unfamiliar environment). Unpublished and anecdotal evidence suggests environmental context can also play a role in the reliability of ASMR induction. The inconsistent and involuntary nature of ASMR has been supported by the notion of ASMR 'tolerance', that is the inability to experience ASMR from certain stimuli despite previous success (Kovacevich & Huron, 2019). A classification of ASMR trait (the capability of experiencing ASMR generally) and ASMR state (the propensity to experience ASMR at a given moment at a given intensity) has been suggested (Hostler, Poerio, & Blakey, 2019).

Another limitation in participant classification is the presence of false positives in terms of ASMR-Responders. An individual would be deemed a false positive when they report experiencing *something*, however that something does not align to the hallmark features of ASMR (e.g., pleasant, calming, head-dominant tingles; henceforth termed False-Positive). There are broad similarities between ASMR and other phenomena that result in induced somatosensory responses, for example, emotional piloerection in response to visual and/or auditory cues such as aesthetic chills (Grewe, Katzur, Kopiez, & Altenmüller, 2011; Laeng, Eidet, Sulutvedt, & Panksepp, 2016; Sumpf, Jentschke, & Koelsch, 2015);

fear-induced responses (Phillips & LeDoux, 1992); or even non-specific vicarious somatosensory responses (Gillmeister, Bowling, Rigato, & Banissy, 2017). A recent study provided evidence for expectancy effects present in non-responders (Cash, Heisick, & Papesh, 2018). In this study, the experimenters manipulated the described effectiveness of ASMR stimuli prior to participants watching the stimuli and reporting on the experience. While ASMR-Responders remained unaffected by expectancy manipulation (encouraging vs. discouraging instructions), the responses (ASMR rating) of non-responders were significantly modulated (Hostler et al., 2019). Therefore, the ability to distinguish and exclude these cases from genuine ASMR-Responder groupings will facilitate clearer analyses and interpretations.

The recent development of the ASMR-15 (Roberts, Beath, & Boag, 2019) as an individual difference score for ASMR has been extremely useful in furthering the characterization of ASMR-Responders. Here, it was shown that ASMR-Responders lie on a spectrum, and thus, there is a propensity for weaker and stronger ASMR-Responders. While useful, the ASMR-15 relies on retrospective self-reporting of various ASMR-related measures and carries some limitations: (1) There are no clear data-driven threshold scores used to differentiate groups or sub-groups; (2) the ASMR-15 appears to lack the capability to reliably identify False-Positives; (3) the measure asks participants to reflect on previous ASMR experiences with an unknown lag (i.e., they do not watch ASMR-inducing material). In light of these limitations, a useful counterpart would be the creation of a measure assessing ASMR-related items immediately after ASMR induction, thereby capturing ASMR state and minimizing inaccuracies introduced through prolonged memory recall. This study sought to achieve this. In addition, we sought to adopt a data-driven approach (a k-means cluster analysis, (Zhang et al., 1996) to identify groupings that reflect individual differences inherent in the data. This is important because it circumvents issues surrounding setting arbitrary cut-off scores and can support identification of sub-groupings of responders (e.g., see Grice-Jackson, Critchley, Banissy, & Ward, 2017; Ward, Schnakenberg, & Banissy, 2018) for use of such approaches in other domains).

With the above factors in mind, we therefore sought to develop a new web-based psychometric tool to assess ASMR that uses a data-driven approach (k-means) – ASMR-Experiences Questionnaire (AEQ). The measure sought to:

1. produce diagnostic groupings (e.g., ASMR-Responder, non-Responder), which reflect individual differences inherent in the data rather than being set by the experimenter;
2. identify sub-groupings in the population to facilitate False-Positive identification, as well as sub-groupings present in ASMR-Responder and non-Responder populations; and
3. capture ASMR state through immediate retrospective ASMR-related measures.

Methods

Participants

Participants who were familiar and unfamiliar with ASMR were recruited for participation (N = 282; see Table 1). Participants were either recruited by word of mouth, on social media websites targeted at ASMR-Responder populations (e.g., www.reddit.com/r/ASMR/), by advertisement on university premises, or via Prolific. All participants received

Table 1. Demographic characteristics of screened participants

Gender	Frequency *n*	Age *M*	Age *SD*
Female	197	24.0	8.1
Male	82	26.5	9.9
Non-binary	2	28.5	2.1
Undisclosed	1	18.0	*NA*
Total	282	24.7	8.7

Note. Age is shown in years.

remuneration for their time in the form of course credits ($n = 232$) or financial payment ($n = 50$).

Materials

The materials consisted of 5 short videos (~3 min), which depicted ASMR stimuli based on 5 different ASMR-inducing categories. These were (1) visually dominant triggers without whispering; (2) visually dominant triggers with whispering; (3) auditory dominant triggers without whispering; (4) auditory dominant triggers with whispering; and (5) personal attention simulations. In order to successfully capture as many ASMR-Responders and their respective idiosyncratic preferences in ASMR triggers, multiple different one-minute clips (respective to the category) were presented in videos 1–4. For the sake of brevity, only one three-minute personal attention simulation video was used, where it has been assumed (due to a lack of data) that a greater duration of time is needed to induce ASMR from simulation videos. This video is a simulation of a haircut and was one of the highest rated ASMR videos on YouTube at the time of creation in December 2018. Table S1 depicts the precise triggers, authors, and URLs (accessible December 2018).

Procedure

The questionnaire was hosted on an online survey platform (Qualtrics). Consent and demographics were recorded, and a description of ASMR was given.

Prior to watching any videos, respondents were asked: 'Based on your own experience and the description you've just read, would you consider yourself capable of experiencing ASMR?' [Definitely yes/Probably yes/Might or might not/Probably not/Definitely not]. Questions related to the content of general ASMR videos were then asked: 'Do you feel like certain voices or accents have a calming effect on you? (0 = completely disagree, 5 = neutral, 10 = absolutely agree)'. and 'How do you feel about watching other people draw/colour in? (0 = very unpleasant, 5 = neutral, 10 = very pleasant)'. Then, a self-report question pertaining to misophonia was asked: 'Are you made extremely uncomfortable by certain sounds, even if these sounds are quiet? e.g. polystyrene, ceramic, chalk. (0 = no discomfort, 10 = absolute discomfort)'. A question querying the capability of frisson/aesthetic chills was then asked: 'Are you capable of experiencing frisson/aesthetic chills? i.e. goosebumps down the spine and a surge of energy when listening to profoundly moving music? (0 = not capable, 10 = very capable)'. Subsequently, respondents were asked to self-report traits related to empathy and emotional sensitivity: 'Do you consider yourself an empathetic person? (0 = not at all empathetic, 10 = highly empathetic)' and "Do you consider yourself an emotionally sensitive person. i.e. are you easily upset? (0 = not emotional, 10 = highly emotional)'. The propensity of ASMR induction for that given moment was then queried: "Given the presentation of your ideal ASMR videos/sounds, how primed/ready do you feel right now to experience ASMR? (Many ASMR-Responders report a high degree of variation in their ability to experience ASMR in their day-to-day)'. Finally, a baseline state of calm question was gauged: "How calm do you feel right now? (−5 = not calm at all, 0 = neutral, 5 = extremely calm)'.

The ASMR videos were categorized into three trigger types: visual, auditory, or simulation. The videos were presented in a fixed order (see Table S1) with similar triggers together to create blocks of trials for each trigger type. This was done with a view to maximizing the likelihood of ASMR induction, by lengthening the duration of each trigger type (e.g., by presenting two visual stimuli blocks consecutively). These main trigger types appeared in a fixed order: (1) visual, (2) auditory, and (3) simulation. Immediately after each video was played, participants were asked: 'Did you experience ASMR (any tingling sensations in your head/scalp) while watching this video?' [Yes/No/No, but I did feel a precursory ASMR-conducive state (a background feeling where ASMR is more likely to occur)]. Regardless of the answer, participants were queried on a scale between −5 and 5: 'How pleasant did you find the experience of watching this video? (−5 = not pleasant, 0 = neutral, 5 = highly pleasant)' and 'How calm do you feel right now? (−5 = not calm at all, 0 = neutral, 5 = extremely calm)'. Participants who reported experiencing ASMR tingling sensations were then asked a series of questions: 'Where did you feel these tingling sensations? Please indicate as many areas as you like using the body map below'. (see Figure 2). The responses on the body map were later recoded as either head tingles or body tingles for use in the k-means clustering. Furthermore, a score out of 1 was calculated representing the per video likelihood of body part selection. Subsequently, two questions aimed to assess the intensity of the transient wave-like sensations associated with ASMR: 'On average, how intense were the tingling sensations throughout the video? (1 = very weak, 10 = very strong)' and 'How intense was your strongest period of tingling sensations during the video? (1 = very weak, 10 = very strong)'.

Clustering

A k-means approach was used to ascertain grouping membership of respondents in a data-driven method. In k-means clustering, data are partitioned into *k* number of groups (Khan & Ahmad, 2004). K-means is an unsupervised learning algorithm which can solve the clustering problem. An unsupervised learning approach has been chosen over a supervised learning approach because we wanted to avoid bias through assigning labels. This exploratory approach instead automatically identifies structure in the data, which can be subsequently labelled using qualitative data on the ASMR experience.

For an unsupervised learning approach such as k-means, it is vital that the input variables are completely reflective of the desired clustering goal. To achieve this, variables that represent the core qualities of ASMR must only be used. While the definition of ASMR is nuanced, certain qualities appear to be universal to the phenomenon. The sensation has been repeatedly reported to be (1) calming and involves (2) pleasurable (3) tingling sensations, which originate in the (4) head and often radiate down the midline to the rest of the (5) body (Barratt & Davis, 2015; Fredborg et al., 2017; Kovacevich & Huron, 2019; Poerio et al., 2018). Subsequently, labels are assigned to the outcome groups post-clustering and are deduced from patterns in the group data, unlike a supervised learning approach where labels are assigned pre-analysis.

The k-means algorithm consists of two separate steps. The first step is to calculate the centroid respective to each *k* group (where a centroid is roughly the average of a shape's vertices). Secondly, the Euclidian distance between each data point and the nearest centroid is calculated, where the minimum Euclidian distance is the goal. Once this process has occurred for all *k* number of centroids, the process repeats iteratively to recalculate the best fitting centroid positions (i.e., the position with the smallest sum of Euclidian distances to all of the member data points). Therefore, this iterative process optimizes the shape of each *k* group as defined by the data. The initial centroid position is randomly allocated multiple times to identify the optimum starting position. In this way, data points from numerous variables can be clustered to identify *k* number of groups. *k* itself can be identified using a number of methods, of which the gap statistic (Tibshirani, Walther, & Hastie, 2001) and Wards dendrogram (Ward, 1963) methods are commonly used.

Clustering was performed in R using the *stats* package version 3.6.1 with the containing *kmeans* function (iter.max = 50, nstart = 10). Standardized variables used in clustering were derived from ASMR stimuli response scores: frequency of head tingles, body tingles, pleasant scores, intensity scores, and relative calm scores (calculated as the mean relative change in calm from baseline to Video 5 calm responses). Cluster confirmation and the respective labels were then created and assigned based on group-specific scores in all of the above variables. The estimate for the number of clusters was determined using Ward's dendrogram clustering method (*stats* package, *hclust* function, method = 'ward.D2'), and by calculating the gap statistic for values of *k* from 2 to 10 (*cluster* package, *clusGap* function). Two clusters were predicted a priori: ASMR-Responders versus non-responders.

Results

Participants

Sixteen participants were omitted from the analysis ($N = 266$, range = 18–67; 76 males, age in years $M = 26.5$, $SD = 10$; 187 females, age $M = 24.1$, $SD = 8.3$; 1 undisclosed gender). The reasons for omission were incomplete responses; responses with a duration of <20 min; and responses with a duration of more than 2 h.

Clustering

The optimum number of clusters was five. The threshold linkage distance used to determine the number can vary; however, a Euclidean distance of 10 has been effective in previous studies (Grice-Jackson et al., 2017) and indicated five groups in our study. These five branches stem from two main branches, thus supporting our a priori hypothesis that there are two main types of responders to ASMR content: those who experience ASMR and those who do not experience ASMR.

The gap statistic also supports the 5-cluster approach. It therefore seems that two approaches can be taken to group the data: a simplified 2-cluster view or a more detailed 5-cluster view depending on the subsequent usage.

Cluster labelling

The 5-group cluster labelling and demographics are as follows: ASMR-StrongResponder (ASMR-S; $n = 46$, age in years $M = 28.1$, $SD = 11.4$, 35 females); ASMR-WeakResponder (ASMR-W; $n = 55$, age in years $M = 26.1$, $SD = 8.7$, 38 females); non-responders with positive affective responses to ASMR (Control+; $n = 77$, age in years $M = 25.9$, $SD = 9.7$, 54 females); non-responders with negative affective responses to ASMR (Control−; $n = 68$, age in years $M = 21.3$, $SD = 5.1$, 47 females); and Responders reporting negative tactile sensations (False-Positive; $n = 18$, age in years $M = 20.7$, $SD = 3.6$, 14 females). These labels were assigned post-clustering based on the results described below (e.g., tingle-related and affect-related scores).

When specifying two clusters into the k-means function, the group memberships were not representative of the hypothesized populations (i.e., Control+ clustering with ASMR-S). Therefore, the two-cluster group membership was determined from the five-group clusters, where groups ASMR-S and ASMR-W have been collapsed into ASMR-Responders ($N = 101$, age in years $M = 27.1$, $SD = 10$, 73 females); Control+, Control− and False-Positive have been collapsed into non-responders ($N = 166$, age in years $M = 23.4$, $SD = 7.8$, 101 females).

For all ANOVAs reported below, assumptions of equality and normality were violated, and thus, Welch's method was used, followed by Games–Howell post-hoc tests. Tables showing more detailed post-hoc comparisons for the 5-cluster analyses are provided in Tables S2–S6. Furthermore, 5-group cluster scores of each of the five individual videos are illustrated in Figure S1.

Cluster variables – Tingles

2-Cluster

As shown in Figure 1A, an independent t-test (Welch's) revealed ASMR-Responders scored significantly higher than non-responders on mean head tingle scores, $t(162) = 17.2$, $p < .001$, $d = 2.36$. ASMR-Responders also scored significantly higher than non-responders on mean body tingle scores, $t(195) = 16.0$, $p < .001$, $d = 2.07$. Finally, ASMR-Responders also scored significantly higher than non-responders on mean intensity scores, $t(172) = 17.7$, $p < .001$, $d = 2.38$.

5-Cluster

Across all tingle-related cluster variables (Figure 1B), a one-way between ANOVA (Welch's) showed a significant difference between all 5-cluster groups in mean Head tingles scores, $F(4, 82.6) = 233$, $p < .001$, *est.* $\omega^2 = 0.986$, Body tingles, $F(4, 82.4) = 250$, $p < .001$, *est.* $\omega^2 = 0.987$ and tingle intensity, $F(4, 82.5) = 320$, $p < .001$, *est.* $\omega^2 = 0.990$.

Post-hoc group comparisons on head data performed by Games–Howell tests showed no significant differences between False-Positive and Control, or False-Positive and ASMR-W. Significant differences were found between Control− and Control+ ($p < .01$), and between Control− and False-Positive ($p < .01$). All other group comparisons were also significant ($p < .001$).

Post-hoc group comparisons on body data performed by Games–Howell tests showed no significant differences between False-Positive and ASMR-W, as well as between Control+ and Control−. Significant differences were found between False-Positive and ASMR-S ($p < .05$), and all other group comparisons were also significant ($p < .001$).

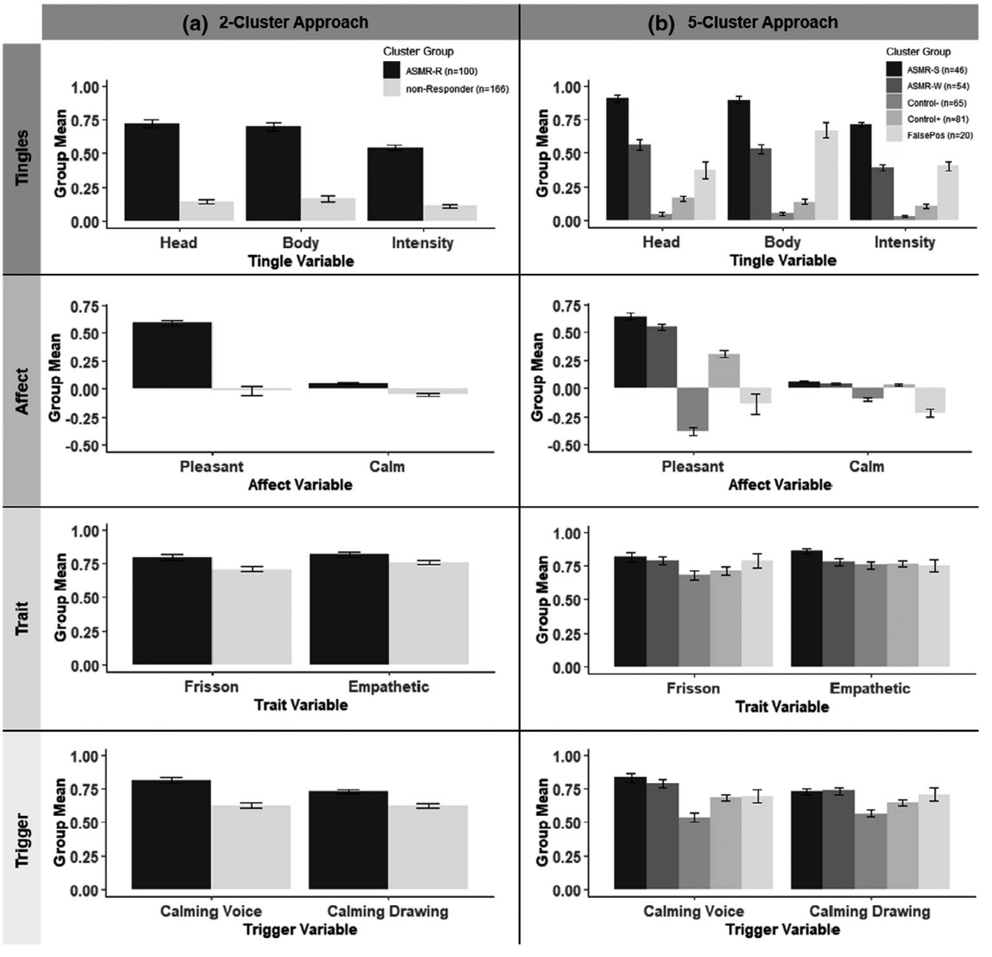

Figure 1. Mean scores of the cluster variables (tingles and affect) and general questions (trait and trigger) compared within 2-cluster (A) and 5-cluster (B) groupings. Tingles: Mean scores of the cluster variables head (presence of tingles in the head), body (presence of tingles anywhere in the body except the head) and change in calm are presented. Affect: Mean scores of the cluster variables pleasantness and intensity (mean score of peak and average intensity scores). Trait: Frisson represents the self-report capability of experiencing musical chills. Empathetic represents the degree of self-report empathic traits. Trigger: calming voices represents the self-reported effectiveness of one's voice on calming the individual. Calming drawing represents how pleasant the individual feels when watching one draw or colour. ASMR-Strong (ASMR-S) experience tingles more intensely and more frequently in the Head and Body compared to all other groups ($p < .001$). Affect scores can be used to differentiate Control subgroupings as well as False-Positives from ASMR-Responders. Error bars represent SEM. 2-cluster groupings are ASMR-Responders (ASMR-S, ASMR-W) and non-Responder (Control+, Control−, False-Positive). ASMR-R represents ASMR-Responders; ASMR-S represents ASMR-Strong; ASMR-W represents ASMR-Weak.

Post-hoc group comparisons on intensity data performed by Games–Howell tests showed no significant differences between False-Positive and ASMR-W. Significant differences were found between Control+ and Control− ($p < .01$), and all other group comparisons were also significant ($p < .001$).

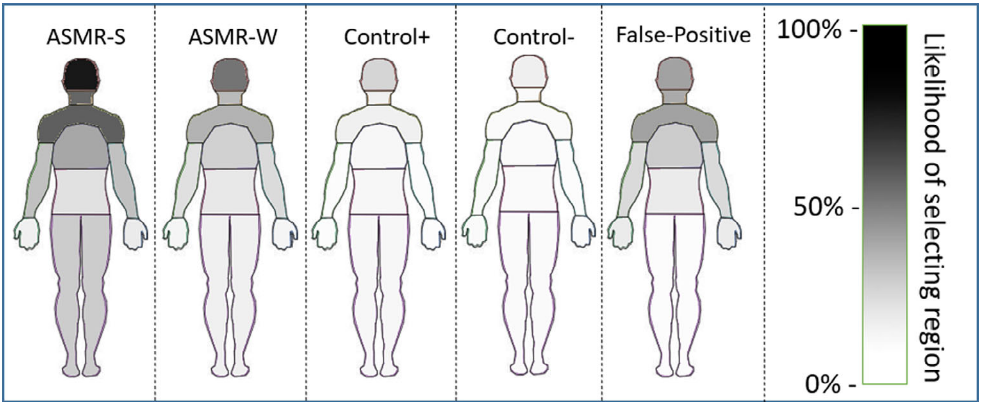

Figure 2. Heatmap of the likelihood of associating tingling sensations to a body region based on 5-cluster groupings. Scores have been calculated as likelihood of selecting a region per video where black is 100% and white is 0% likely. ASMR-S represents ASMR-Strong; ASMR-W represents ASMR-Weak.

Tingle location

As shown in Figure 2, Games–Howell post-hoc tests reveal that ASMR-S scored significantly higher compared to all other groups in the head ($p < .001$) and neck ($p < .05$) regions. Further information is provided in Tables S2 and S6.

Cluster variables – Affect

2-Cluster

As shown in Figure 1A, an independent t-test (Welch's) revealed ASMR-Responders scored significantly higher than non-responders on mean pleasant scores, $t(255) = 13.6$, $p < .001$, $d = 1.51$. ASMR-Responders also scored significantly higher than non-responders on mean calm scores, $t(264) = 7.55$, $p < .001$, $d = 0.86$.

5-Cluster

Across all tingle-related cluster variables (Figure 1B) a one-way between ANOVA (Welch's) showed a significant difference between all 5-cluster groups in mean pleasant tingle scores, $F(4, 82.6) = 144$, $p < .001$, *est.* $\omega^2 = 0.978$ and relative calm, $F(4, 83.2) = 40.2$, $p < .001$, *est.* $\omega^2 = 0.925$.

Post-hoc group comparisons on pleasant mean data performed by Games–Howell tests showed significant differences between False-Positive and Control− ($p < .05$), as well as between False-Positive and Control+ ($p < .05$) and also between ASMR-S and ASMR-W ($p < .05$). Significant differences also were found between ASMR-W and Control+ ($p < .01$) as well as between ASMR-W and False-Positive ($p < .01$). All other group comparisons were significant ($p < .001$).

Post-hoc group comparisons on relative calm mean data performed by Games–Howell tests showed no significant differences between ASMR-W and ASMR-S or between ASMR-W and Control+. Similarly, there were no significant differences between Control+ and ASMR-S. All other group comparisons were significant ($p < .001$; see Table S3).

General questions – Trait

2-Cluster

As shown in Figure 1A, an independent t-test (Welch's) revealed ASMR-Responders scored significantly higher than non-responders on frisson scores, $t(229) = 2.67, p < .01, d = 0.33$. ASMR-Responders also scored significantly higher than non-responders on empathetic scores, $t(221) = 7.55, p < .05, d = 0.29$. Finally, ASMR-Responders also scored significantly higher than non-responders on emotionally sensitive scores, $t(207) = 2.48, p < .05, d = 0.32$.

5-Cluster

Across both self-report trait variables (Figure 1B), a one-way between ANOVA (Welch's) showed a significant difference between all 5-cluster groups in mean frisson, $F(4, 88.6) = 3.35, p < .05$, *est.* $\omega^2 = 0.439$ and empathetic, $F(4, 86.6) = 2.74, p < .05$, *est.* $\omega^2 = 0.362$ scores.

Post-hoc group comparisons on frisson mean data performed by Games–Howell tests showed significantly higher scores in the ASMR-S group compared to the Control− group only ($p < .05$).

Post-hoc group comparisons on empathetic mean data performed by Games–Howell tests showed significantly higher scores in the ASMR-S group compared to Control+ ($p < .05$) and Control− ($p < .05$) groups only. However, it should be noted that emotionally sensitive self-report scores were trending to significance ($p = .083$), driven by the difference between ASMR-S and Control− ($M_{\text{diff}} = 0.121, p = .069$; see Table S4).

General questions – Trigger

2-Cluster

As shown in Figure 1A, an independent *t*-test (Welch's) revealed ASMR-Responders scored significantly higher than non-responders on mean calming voices scores, $t(229) = 6.09, p < .001, d = 0.76$. ASMR-Responders also scored significantly higher than non-responders on mean calming drawing scores, $t(251) = 4.87, p < .001, d = 0.58$.

5-Cluster

Across both self-report trigger variables (Figure 1B), a one-way between ANOVA (Welch's) showed a significant difference between all 5-cluster groups in mean calming voices, $F(4, 90.4) = 13.57, p < .001$, *est.* $\omega^2 = 0.810$ and calming drawing, $F(4, 87.5) = 8.94, p < .05$, *est.* $\omega^2 = 0.723$ scores.

Post-hoc group comparisons on calming voices mean data performed by Games–Howell tests showed significant differences between Control− and ASMR-S, Control− and ASMR-W, and Control− and False-Positive ($p < .001$). Furthermore, Control+ differed significantly from ASMR-S and from Control− ($p < .01$). Finally, Control+ differed significantly to ASMR-W ($p < .05$).

Post-hoc group comparisons on calming drawing mean data performed by Games–Howell tests showed significant differences between Control− and ASMR-S ($p < .001$), Control− and ASMR-W ($p < .001$), and Control− and False-Positive ($p < .05$). Finally, Control+ differed significantly to ASMR-W ($p < .05$; see Table S5).

Discussion

Prior research into ASMR has mainly relied on participants self-disclosing their capability of experiencing ASMR. The present work has built on this to establish a new online psychometric tool to effectively classify respondents based on their response to ASMR stimuli using a data-driven approach. The basis of this new tool relies on an unsupervised learning algorithm which clusters data derived from the core features of ASMR: pleasant tingling sensations, tingle intensity, tingle loci, and enhanced levels of calm. Respondents can be classified in either 2- (ASMR-Responder vs. non-Responder) or 5-cluster approaches (ASMR-Strong, ASMR-Weak; Control+, Control−, and False-Positive) depending on the desired aim of the research study.

There are a number of benefits that the AEQ provides over existing tools to the ASMR research community. Firstly, and most importantly, the groups derived by the AEQ are data-driven and thus are derived with less implicit bias (Abrams, Carleton, & Asmundson, 2007; Mayberry & Espelage, 2007). Taken together with the score from the ASMR-15, a fully comprehensive profile of the participant is now possible. Secondly, retrospective ratings of the ASMR experience are given immediately after watching a variety of ASMR-inducing videos and experiencing the ASMR sensations. This is an improvement over other measures where participants are able to or asked to reflect on ASMR experiences that may have happened some time ago (e.g., months, days) rather than in the immediate past. In addition, the location of tingles is considered in the clustering algorithm, which enhances False-Positive identification.

The presence of both ASMR-S and ASMR-W supports the notion that ASMR trait and state lie on a spectrum with idiosyncratic potential for ASMR induction. False-Positives appear to differ most from ASMR-Responders by reporting a more homogenous concentration of tingles in the upper body, where the tingles are generally unpleasant and reduce levels of calm. The categorization of non-responders who do not report feeling tingles show that there are two groups differing in their attitude towards ASMR content: Control+, who enjoy and feel calmer; Control− who do not enjoy and feel less calm. Self-report scores of frisson capability, being emotionally sensitive and empathetic were significantly higher in ASMR-Responders compared to non-responders. Proposals on utilizing these sub-groups effectively will be outlined below.

One key contribution of the newly developed AEQ is to provide the capacity to differentiate Control+ and Control− respondents. A major caveat in prior literature is the difficulty in identifying whether any difference between ASMR-Responders and non-responders, physiological or otherwise, is a consequence of a change in the ASMR group rather than the non-Responder group. By having a better characterization of the control group, more valid conclusions can be drawn. For example, ensuring the recruitment of an equal balance of Control− and Control+ will help to reduce individual differences inherent in the control group and thus prevent masking of effects seen between ASMR-Responder and non-Responder groups. When considering experiments involving watching ASMR stimuli, Control+ may be more likely to be recruited due to the inherent aversion and dislike to ASMR stimuli exhibited by Control−. Therefore, it is possible that effects seen in some studies may be as a result of the inherent traits of Control+ alone. Thus, the ability to stratify participants into Control+ and Control− would aid the researcher in interpreting the results and permit the ability to exclude Control− a priori if required.

Furthermore, given an appropriate paradigm, future studies can more effectively disentangle the tingling properties of ASMR from the affective modulatory properties. For instance, a comparison between Control+ only and ASMR-Responder is more likely to indicate a change in tingling alone, due to a degree of shared affective modulation between the two groups. In contrast, a comparison between Control− and ASMR-Responder is more likely to indicate a change in both affective and tingling properties between the two groups.

Another key finding of our current results is the presence of False-Positives, namely that some individuals experience tingling sensations that are unpleasant and are not calming. This finding draws into question whether there is a valence spectrum with respect to ASMR, where ASMR is at the most positive end, and other phenomena might lie on the opposite end. Furthermore, False-Positives appear to not emphasize the head as the most prominent site of induced tingling. Ideally, False-Positives would be identified in screening and thus excluded from testing. The result also demonstrates how inclusion of False-Positives may influence differences in outcome measures when comparing ASMR-Responder groups to controls. For example, if False-Positives are grouped with non-responders, then, as shown in Figure 1A, the scores for Tingles are enhanced. Conversely, if False-Positives are grouped with ASMR-Responders, then affect scores would be diminished. By being able to better characterize False-Positive responses, the AEQ offers the potential to better constrain the recruitment of ASMR participants in the future. This will help to provide more refined insights into the mechanisms and broader consequences associated with ASMR.

In terms of recruitment, the ability to differentiate ASMR-S and ASMR-W offers the potential to maximize experimental time and help to clarify observed effects in ASMR research. Specifically, prioritizing ASMR-S over ASMR-W in the recruitment stage of a study may reduce the likelihood of unsuccessful ASMR induction in an experimental environment (see Figure 1B: Tingles and Affect). This is particularly the case when ASMR-Responders can be further screened with the ASMR-15 (Roberts et al., 2019) to provide an individualized ASMR score. We are currently investigating the relationship between ASMR-15 scores and ASMR-Responder clusters identified with the AEQ. However, it should be noted that it is possible that ASMR-S and ASMR-W participants represent different ASMR sub-types and thus exhibit differing neural responses. In this scenario, experiments run on both ASMR-S and ASMR-W separately could yield interesting differences. Further research is required.

The AEQ is not without limitations. The current measure of Calm appears to exhibit a ceiling effect, where the initial calm rating of ASMR-Responders was already tending to the maximum score. Therefore, subsequent ASMR videos had little capacity to enhance calm scores. Adopting a larger scale for comparisons in future work will be an important next step. Future adaptations may also wish to consider affective descriptors derived from the circumplex affect model to hopefully further hone in on sub-groupings and enhance accuracy (Russell, 1980).

The measure, like other questionnaire measures of ASMR, suffers from a limitation implied by prior findings, namely that people can show short changes in set shifting and inhibitory control following ASMR induction (Wang, Yang, Sun, & Su, 2020). These changes may influence responses to questionnaires. There is also a limitation of scope of this tool – while a large proportion of ASMR-Responders are captured by this tool, certain cases will be overlooked due to preferences in ASMR stimuli type or inherent aversion to such stimuli. A future development of the tool could include the addition of an unintentional ASMR video, such as that of a cranial nerve examination. Another future development could be the integration of the AEQ with the ASMR checklist (Fredborg et al., 2017) and the recently compiled and validated ASMR digital video library (Liu & Zhou, 2019). The videos presented to each participant could be tailored based on trigger preferences from the ASMR checklist and then sourced from associated labels contained in the digital ASMR library. In this way, a wider range of idiosyncratic ASMR preferences can be captured with the tool, thus reducing the number of false-negative cases.

In addition to considering ASMR identification, our study also examined broader traits associated with ASMR. In line with previous investigations of the relationship between ASMR and empathy (Fredborg et al., 2017; McErlean & Banissy, 2017), ASMR-Responders showed significantly higher scores of self-report empathy compared to non-responders. Our data extend these prior findings by providing greater insights into the granularity of this relationship. When assessing the 5-cluster approach, this was driven by ASMR-S against Controls. Frisson, the multisensory experience frequently contrasted with ASMR (del Campo & Kehle, 2016; Kovacevich & Huron, 2019), was also found to be reported higher in ASMR-Responders compared to non-responders. Again this effect was driven by ASMR-S compared against Control−. This further supports the notion suggested by Smith, Fredborg, and Kornelsen (2017) that ASMR-Responders are more prone to sensory-emotional experiences, perhaps mediated by atypical thalamic connectivity (2017).

A further trait of interest was misophonia. Here, we did not replicate previous finding from our laboratory that indicated enhanced misophonia in ASMR-Responders (McErlean & Banissy, 2018). This requires further investigation. One possibility for the difference may be measurements used. Here, we used a single question; however, in our prior work, full psychometric measures were used. We are now exploring this question in ongoing projects.

The introduction of this tool will augment research on the relationship of ASMR with more general theoretical frameworks by improving characterization of participants. As noted, thus far ASMR-Responders have reported to show differences to non-responders in a range of domains including: personality traits (Fredborg et al., 2017; McErlean & Banissy, 2017; Roberts et al., 2019), brain connectivity (Smith et al., 2017), social cognition (Lochte et al., 2018), and sensory sensitivity (Poerio et al., 2021). These findings, and the inherent multisensory nature of ASMR, mean that the experience provides a unique experimental window to explore how multisensory interactions shape our perception of the world (Lochte et al., 2018). In this regard, being able to better identify ASMR-Responders can help to improve studies that seek to better understand individual differences that contribute to sensory processing, social cognition, and multisensory interaction. In doing so, this will help with endeavours, and theory, that seeks to understand not only normative mechanisms but also factors that contribute to individual variation in how we all perceive and interact with the world around us.

To summarize, here we provide a new psychometric tool that adopts a data-driven approach to aid in the identification of sub-groups of ASMR responders. In doing so, the AEQ provides promise to differentiate how participants respond to ASMR videos and categorize each respondent into one of five groups: ASMR-Strong; ASMR-Weak; Control+; Control−; and False-Positives. Both ASMR state and trait can also be captured using the tool, as well as an overview of the types of preferred triggers for each respondent. Using this data-driven approach in respondent classification allows a more comprehensive profiling of participants for ASMR response. This raises the potential to better understand mechanisms and broader traits associated with sub-groups of ASMR responders in the future.

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Conflicts of interest

All authors declare no conflict of interest.

Author contributions

Thomas R. Swart (Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Validation; Visualization; Writing – original draft) Natalie C. Bowling (Methodology; Validation; Writing – review & editing) Michael J. Banissy (Conceptualization; Funding acquisition; Project administration; Supervision; Writing – review & editing).

Data availability statement

The data that support the findings of this study are openly available at http://doi.org/10.17605/OSF.IO/PAZR5

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Supporting Information

The following supporting information may be found in the online edition of the article:

Table S1. Characteristics of ASMR stimuli present in the AEQ.
Table S2. Tingles – Games-Howell Post-Hoc Test.
Table S3. Affect – Games-Howell Post-Hoc Test.
Table S4. Trait – Games-Howell Post-Hoc Test.
Table S5. Trigger – Games-Howell Post-Hoc Test.
Table S6. Body Tingle Location – Games-Howell Post-Hoc Test.
Figure S1. 5-cluster grouping scores of individual videos labelled by stimuli type.