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Untangling the tingle: Investigating the association between the
Autonomous Sensory Meridian Response (ASMR), neuroticism, and trait
& state anxiety

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1 Abstract

2 The Autonomous Sensory Meridian Response (ASMR) is an intensely pleasant tingling
3 sensation originating in the scalp and neck and is elicited by a range of online video-induced triggers.
4 Many individuals now regularly watch ASMR videos to relax, and alleviate symptoms of stress and
5 insomnia, all which are indicative of elevated levels of anxiety. Emerging literature suggests that
6 ASMR-capable individuals are characterised by high trait neuroticism, which is associated with a
7 tendency to experience negative emotional states such as anxiety. To date however no literature has
8 empirically linked these personality constructs and watching ASMR videos on the effect of reducing
9 anxiety. In the current study, 36 ASMR-experiencers and 28 non-experiencers watched an ASMR
10 video, and completed assessments of neuroticism, trait anxiety, and pre- / post-video state anxiety.
11 MANCOVA with Group as the independent measures factor showed that ASMR-experiencers had
12 significantly greater scores for neuroticism, trait anxiety, and video engagement than non-
13 experiencers. Pre-video state anxiety was also significantly greater in the ASMR-experiencers and was
14 significantly attenuated on exposure to the ASMR video, whereas non-experiencers reported no
15 difference in state anxiety pre- and post-video. Thus, watching ASMR alleviated state anxiety but only
16 in those who experienced ASMR. Subsequent mediation analyses identified the importance of pre-
17 existing group differences in neuroticism, trait and (pre-video) state anxiety in accounting for the
18 group difference in the reduction of state anxiety. The mediation analysis further lends support for
19 watching ASMR videos as an intervention for the reduction of acute state anxiety. Future areas for
20 research are discussed.

27 Introduction

28 The Autonomous Sensory Meridian Response (ASMR) is a deeply relaxing sensory
29 phenomenon described as a pleasant tingling sensation originating from the scalp and neck which can
30 spread to the rest of the body (1-3). ASMR occurs involuntarily and is induced by focusing on auditory,
31 tactile, or visual triggers. Common examples of these triggers include receiving or watching someone
32 else receive personal attention, such as massages or hair brushing, and also from listening to soft
33 sounds such as whispers or tapping (2, 4). The mechanisms of ASMR are currently unknown, however
34 it has been likened to frisson (musical chills) since both are characterised by a tingling sensation which
35 is invoked by stimuli deemed pleasant by the perceiver (5, 6). Research incorporating fMRI
36 methodology has shown that multiple brain areas which are activated during frisson, including the
37 nucleus accumbens (NAcc) located in the basal forebrain and which is functionally associated with the
38 reward system, are also activated during ASMR (7). However, those who experience ASMR sensations
39 insist the phenomena are distinct (see 8): frisson elicits awe and involves rapidly culminating tingles
40 across the whole body, whilst ASMR elicits relaxation and involves longer-lasting dynamic tingles
41 which originate in the head and neck before spreading to other areas (9). The perceived difference
42 between the two experiences may be explained by activity in the medial prefrontal cortex (MpfC)
43 which is heightened during ASMR but reduced during frisson (7, 10).

44

45 Whilst currently only a relatively small proportion of the population are thought to be capable
46 of experiencing ASMR, it is certainly gaining popularity, with increasing numbers of aficionados in the
47 online ASMR community (11). The establishment of this community has resulted in the creation of
48 countless ASMR videos on forums such as YouTube, attracting thousands, or in some instances,
49 millions of subscribers and hits (e.g. 12; see 2, who list several of the most popular channels). Some
50 of these videos involve simple triggers such as hand movements, tapping on objects or whispering
51 into microphones, whilst others may be more elaborate, simulating situations such as doctor's
52 appointments, makeovers, or haircuts (2, 13). It is important to emphasise that, due to the subjective

53 nature of ASMR, there is substantial individual variability in which triggers induce the sensation (14).
54 That is, what causes one individual to experience ASMR might not induce the response in another (see
55 15 for differential fMRI activity in response to different ASMR triggers).

56

57 According to both creators (referred to as ASMRtists) and viewers, ASMR videos promote well-
58 being, relaxation, and sleep. This is not only evident from forums and video comment sections, but is
59 also supported by empirical research findings (e.g. 11, 16, 17). In the seminal paper by Barratt and
60 Davis (2), out of a sample of 475 participants, 70% reported watching ASMR videos in order to deal
61 with stress, 82% to aid sleep, and 98% to relax. Since stress, insomnia, and an inability to relax are all
62 typical indications of elevated levels of anxiety (18), this raises the question as to whether ASMR could
63 offer the possibility of a non-conventional intervention in the treatment of anxiety. Clinical anxiety is
64 characterised by continuous or repeating states of fear and/or panic, and with an increasing
65 prevalence of diagnosis (19). According to the most recent NHS survey (20) there has been a 20%
66 increase in clinical anxiety since 1993, now affecting 18.9% of the population in England. Whilst there
67 are a number of different treatments available for anxiety, they are not always effective for everyone
68 (18) and alternative non-clinical forms of treatment are increasing in popularity (e.g. 21). A recent
69 meta-analysis provides substantial empirical evidence for positive effects of mindfulness meditation
70 in the reduction of symptoms of anxiety (22), and emerging literature suggests that ASMR may be
71 mindfully induced (2, 9, 23). Furthermore, individuals who experience ASMR report higher scores in
72 indices of mindfulness such as the Mindful Attention and Awareness Scale (9, 23, 24). To date, no
73 known published research has investigated any direct link between experiencing ASMR and reduced
74 anxiety, however psychological and physiological symptoms of anxiety have been shown to decrease
75 after experiencing ASMR (2, 4). These studies found that experiencing ASMR resulted in increased
76 positive affect and decreased negative affect, along with physiological changes of increased skin
77 conductance and reduced heart rate, similar to those observed during mindfulness meditation (25).

78 Therefore, when taking into account the suggested link between ASMR and mindfulness, it is plausible
79 that ASMR may have the same therapeutic applications within an anxiety context.

80 Due to the recency of ASMR as a subject of empirical investigation, research attention has
81 predominantly focused on the formal descriptive parameters of the phenomenon and the effects it
82 has on those who watch ASMR videos. Consequently, there is limited research investigating traits that
83 characterise individuals who actually experience ASMR. To date there is only a small body of published
84 literature investigating any link between personality traits and the ability to experience ASMR (e.g. 26,
85 27, 28). Incorporating the Big Five Index (BFI) Fredborg et al. (26) found that ASMR-experiencers
86 scored significantly higher than non-experiencers on neuroticism and openness-to-experience (also
87 see 16, 29). Greater scores on neuroticism are of particular relevance to the present study as this is
88 often indicative of dispositional determinants of negative mental states (30). One of the emotion-
89 related sub-domains of the neuroticism scale is anxiety and can be differentiated two ways: *State*
90 *Anxiety* refers to the refers to the level of moment-to-moment anxiety an individual experiences,
91 whereas *Trait Anxiety* reflects a stable and enduring tendency to experience anxiety and which
92 predicts incidence of clinical anxiety (31, 32). Research has identified neuroticism to be a predictor of
93 various anxiety disorders including general anxiety disorder (GAD) and major depressive disorder
94 (MDD) (33; also see 34 for further discussion). Similar to individuals scoring higher in neuroticism,
95 those with a diagnosis of MDD are more likely to have a clinical anxiety diagnosis (35). Notably, a
96 significant number of those who are capable of experiencing ASMR suffer from MDD (2). It is therefore
97 plausible to suggest that if greater levels of neuroticism are found amongst ASMR experiencers, this
98 may predict negative affect and thus an increased disposition for elevated trait and state anxiety in
99 these individuals.

100

101 Whilst the impact of ASMR on short-term reduction of depression has been investigated (2),
102 there is no known research to date that has directly investigated the effect of watching ASMR videos
103 and subsequent reduction in state anxiety, and only one known published study that has associated

104 affect-related personality traits of neuroticism as a predictor in experiencing ASMR (26). Thus, the aim
105 of the present study is threefold: a) to determine whether ASMR experiencers and non-experiences
106 differ on the characteristics of neuroticism, trait, and state anxiety; b) whether exposure to ASMR
107 videos reduces state anxiety in general, or whether this is specific to those who experience ASMR, and
108 c) identify if these putative trait differences mediate any reduction in state anxiety. Due to the limited
109 research and the exploratory nature of the study, the hypotheses are generated cautiously. Firstly, it
110 was hypothesised that the group of individuals who experience ASMR would report higher scores in
111 neuroticism, trait anxiety, and pre-ASMR video state anxiety compared to those who do not
112 experience ASMR, thus providing a metric by which this group can be characterised. Secondly, due to
113 the similarities with mindfulness, those who experienced ASMR would report reduced state anxiety
114 post-exposure to ASMR videos. Finally, following the assumption that ASMR experiencers and non-
115 experiencers may differ in neuroticism, state and trait anxiety, a further exploratory question was
116 pursued, attempting to identify whether these personality factors could mediate any observed change
117 in state anxiety between the groups in response to the ASMR video.

118

119

120 **Method**

121

122 **Participants**

123 The sample consisted of 64 participants aged from 18 to 58 years ($M = 29.55$, $SD = 11.54$);
124 71.88% identified as *female*, 26.56% as *male*, and 1.56% as *other*. Participants were recruited from
125 online ASMR community forums and YouTube channels, or from social media platforms such as
126 Facebook and Instagram. Participants were categorised as either ASMR-experiencer or ASMR non-
127 experiencer based upon whether they had experienced ASMR previously, and the location of any
128 tingles if applicable, and / or on their responses on the post-video ASMR experience self-report
129 questionnaire which identified whether they had experienced any tingles during the video, and if so,

130 the location of these. ASMR is described as a tingling sensation *originating from the head and/or neck*
 131 (1-3, 36) and which we refer to as ‘true ASMR’. Therefore the categorisation of participants into the
 132 ASMR-experiencer group depended on the self-reported *origin* of the sensation including their head
 133 and / or neck. Nineteen participants consistently experienced true ASMR pre- and post-video, whilst
 134 9 participants who self-identified as ASMR-experiencers pre-video did not report tingles post-video.
 135 However, as the location of their tingles pre-video corresponded with the definition of true ASMR,
 136 they were included in the ASMR-experiencers group (9, 36; see the materials and procedure sections).
 137 Additionally, 8 participants who had never watched ASMR videos prior to the study, reported true
 138 ASMR tingles post watching the video, and were also included in the ASMR-experiencers group ($n=36$,
 139 mean age 30.42, SD 11.13; see 37). The remaining 28 participants either never experienced any ASMR
 140 sensations pre- or post-video, or reported sensations not consistent with true ASMR (i.e. False-Positive
 141 reporting of AMSR), and were assigned to the non-experiencers group (mean age, 28.43, SD 12.15).
 142 There was no significant difference in age ($t = 0.61, p = 0.498$) or gender ($\chi^2 = .064 p = 0.800$) between
 143 the two groups. See Table 1 for full demographics.

144
 145

146 **Table 1:** Demographics of the total sample, ASMR-experiencers and non-experiencers

		Total Sample	ASMR Experiencers	Non- experiencers
	n	64	36	28
Gender	M / F / other	17 / 46 / 1	9 / 26 / 1	8 / 20 / 0
Age	range	18 - 58	18 - 58	18 - 56
	mean	29.55	30.42	28.43
	SD	11.54	11.13	12.15
Previously seen ASMR Video ^a	n	38	28	10

147

148 *Note.* ^a reflects the number of participants answering “yes” to this question.

149

150

151 **Materials**

152 The online survey was created using Qualtrics (www.qualtrics.com) and consisted of the
153 following: demographic questions, the neuroticism scale from the Big Five Inventory (BFI; 38), the
154 State-Trait Anxiety Inventory (STAI; 31), a 5-minute ASMR YouTube video (39), a video engagement
155 questionnaire, and pre- and post-video ASMR-experience questionnaire.

156

157 **Neuroticism scale**

158 Scores on neuroticism were assessed using the relevant 8-items taken from the BFI (38).
159 Example items include statements such as ‘I am depressed’, ‘I am relaxed’ and ‘I can be moody’.
160 Participants were asked to respond to each item using a 5-point Likert scale from 1 = ‘strongly
161 disagree’ to 5 = ‘strongly agree’, with items 2, 5, & 7 reversed scored. The overall neuroticism score
162 was calculated from the mean score of the 8 items, with higher scores indicating greater trait
163 neuroticism.

164

165 **State-Trait Anxiety scales**

166 The STAI consists of 40 items: 20 for the State-Anxiety scale (S-Anxiety) and 20 for the Trait
167 Anxiety scale (T-Anxiety). The T-Anxiety scale was used in this study to measure characteristic-level
168 anxiety. Example items include ‘I feel like a failure’ and ‘I feel rested’. The S-Anxiety scale was used to
169 measure the level of momentary anxiety at the current time. Since it detects transitory anxiety at a
170 mental level, it was considered appropriate to detect the effect of ASMR on short-term change in

171 anxiety. Example items include 'I am tense' and 'I feel at ease'. Both tests were answered via a 4-point
172 scale with 1 = 'Very much' and 4 = 'Not at all', where higher scores indicated greater state and trait
173 anxiety. Half of the items in each test were reverse scored, and the overall score for state and trait
174 anxiety was calculated by summing the items for each scale.

175

176 **ASMR video**

177 A 5-minute ASMR video by Cynthia Henry ASMR (39; *ASMR; 5 Minutes Quick Triggers Ep. 1*)
178 was used for the study <https://www.youtube.com/watch?v=RB4wY1-Necl&t=8s>. This consisted of a
179 wide range of triggers, such as tapping, scratching, applying make-up, and microphone brushing,
180 presented in rapid succession.

181

182 **ASMR Video Engagement questionnaire**

183 Video engagement was assessed with a bespoke 3-item questionnaire (1: Did this video
184 relax/calm you? 2: Did this video make you uncomfortable? 3: Did this video make you feel sleepy?)
185 based on predominant reasons individuals watch ASMR (see 2). Participants respond to each question
186 using a 5-point Likert scale where 1 = 'Not at all' and 5 = 'Very much' (Q2 was reverse scored) and with
187 higher scores indicating a more positive experience.

188

189 **ASMR Experience questionnaire**

190 Presence of tingling sensation alone was not deemed sufficient evidence for the ability to
191 experience ASMR. Since frisson (chills) is common when focus is applied to something pleasant (9),
192 there was a possibility that participants reported experiencing tingles which were not part of ASMR.
193 Due to social distancing restrictions due to the Covid-19 pandemic at the time of data collection,
194 physiological parameters such as skin conductance and heart rate could not be measured in order to
195 ensure ASMR was not mistaken for frisson. Instead, whether the participants truly experienced ASMR

196 or not was determined using a questionnaire. These involved two ‘qualifying’ questions regarding the
197 location of any tingles. Firstly, participants were asked ‘*Did you experience a tingling sensation*’ which
198 required a Yes / No forced choice response. If they answered ‘Yes’ then they were asked ‘*Where did*
199 *these tingles start*’ to which they responded by typing their response in a text box. . Participants
200 completed the questionnaire pre- and post-watching the ASMR video. The inclusion of pre- and post-
201 video assessments was necessary in order to account for individuals who are able to experience ASMR
202 but did not during the video provided, as well as those who had never come across or experienced the
203 phenomenon before the study, but experienced ASMR during the video for the first time.

204

205 **Procedure**

206 Participants were directed to the Qualtrics link where the purpose and the procedure of the
207 study was explained and participants could give informed online consent. Participants were asked to
208 find somewhere quiet and wear headphones for the duration of the study to maximise the chance
209 that ASMR was experienced (see 6). They were presented with the demographic questions and pre-
210 video ASMR experience questionnaire. Next, they completed the trait anxiety and neuroticism
211 measures, and the pre-video state anxiety questionnaire. They were then asked to follow the on-
212 screen link and watch the 5-minute ASMR video. Following the video, participants completed the post-
213 test measure of state anxiety, followed by the post-video engagement and post-video ASMR
214 experience questionnaires. Participants were debriefed following completion of the survey and
215 directed to online ASMR communities if interested in learning more about the phenomenon. The
216 study took approximately 10-15 minutes to complete, which received ethical approval from the
217 Department of Psychology, Northumbria University Ethics Committee.

218

219

220 **Data Treatment**

221 Descriptive statistics were initially carried out to identify Group scores in trait anxiety,
222 neuroticism, state anxiety pre-ASMR video exposure (pre-video), state anxiety post-ASMR video
223 exposure (post-video), and scores on the ASMR video engagement. Following this, correlation and
224 partial correlation analyses controlling for age and gender were carried out on the key variables.

225 The MANCOVA looked at the differences between the ASMR-experiencer and non-experiencer
226 groups, in terms of neuroticism, trait anxiety, and pre-video exposure state anxiety, controlling for age
227 and gender. The mixed ANCOVA analysis (age and gender as covariates) with Group as the
228 independent measures factor, and pre- versus post-video state anxiety scores as the repeated
229 measures factor examined whether there was a general reduction in state anxiety or whether this was
230 more specific to the ASMR-experiencer group. Following point biserial analyses of the primary
231 relationship between the Group variable and the outcome measure, Change in State Anxiety, a series
232 of mediation analyses were then carried out. Group was the main predictor, change in state anxiety
233 (pre- vs. post-video values) as the outcome variable, and age and gender as covariates. Neuroticism,
234 trait anxiety, pre-video state anxiety measures were initially employed as the single mediators. In
235 addition, the participants' engagement with the ASMR video acted as a mediator in the final analysis
236 in order to identify the importance of the video engagement in accounting for any group differences
237 in state anxiety change. All analyses were conducted using SPSS v26. The dataset for the current study
238 can be accessed via <https://doi.org/10.25398/rd.northumbria.16654846>

239

240

241

242

243 **Results**

244 Participants were categorized into ASMR-experiencers or non-experiencers according to their
 245 answers in response to the *ASMR Experience* questionnaire. Means and standard deviations were
 246 calculated for the key variables and are shown in Table 2 below. Table 2 indicates that the ASMR-
 247 experiencer group demonstrate higher mean scores in all of these key measures.

248
 249

250

251 **Table 2: Summary of descriptive statistics of ASMR-experiencers and non-experiencers**

Group		Trait Anxiety	Neuroticism	Pre-video State Anxiety	Post-video State Anxiety	Change in State Anxiety	Video Engagement
ASMR Experiencer <i>n</i> =36	Mean	49.17	3.41	41.75	36.58	5.17	3.46
	<i>SD</i>	13.29	0.63	12.82	11.87	10.83	1.12
ASMR Non-Experiencer <i>n</i> =28	Mean	41.00	2.86	35.04	35.14	-0.11	2.71
	<i>SD</i>	12.81	0.85	9.05	10.39	7.39	0.99
Overall	Mean	45.59	3.17	38.81	35.95	2.86	3.14
	<i>SD</i>	13.61	0.78	11.73	11.18	9.77	1.12

252

253

254 In order to explore the relationships between the key variables, correlations and partial
 255 correlation analyses were carried out. The findings are shown in Table 3 below and indicates significant
 256 positive relationships between trait anxiety, neuroticism, and pre-video state anxiety ($p < 0.001$). In
 257 addition, controlling for age and gender continued to reveal significant positive correlations between
 258 trait anxiety, neuroticism, and ASMR video engagement ($p < 0.001$).

259

260

261 **Table 3:** Correlations between the key predictor variables, trait anxiety, neuroticism, pre-video state

262 anxiety and video engagement.

	Trait anxiety	Neuroticism	Pre- video state anxiety	ASMR video engagement
Trait Anxiety	—	0.85***	0.75***	0.19
Neuroticism	0.848***	—	0.65***	0.20
Pre-video State Anxiety	0.777***	0.70***	—	0.19
ASMR video engagement	0.26*	0.27*	0.22	—

263 * $p < 0.05$, *** $p < 0.001$

264

265 Note: The values above the diagonal are zero-order correlations and below the diagonal, partial

266 correlations controlling for age and gender.

267

268 Comparing traits between the groups

269 In order to test the first hypothesis, trait anxiety, neuroticism, pre-video state anxiety and

270 ASMR video engagement scores were compared between ASMR-experiencers and non-experiencers.

271 A one-way multivariate analysis of variance controlling for age and gender (MANCOVA) determined

272 that there was a statistically significant difference in overall character trait scores between the groups.

273 Using Wilk's lambda, the MANCOVA revealed a significant effect associated with Group, $\lambda =$

274 0.79, $F(4,56) = 3.72$, $p = 0.009$, partial $\eta^2 = .210$, Box's $M = 19.64$, $p = 0.052$. Subsequent ANOVA

275 analyses showed a significant Group effect with trait Anxiety, $F(1,59) = 5.51, p = 0.022, \text{partial } \eta^2 =$
276 $.085$; neuroticism, $F(1,59) = 9.62, p = 0.003, \text{partial } \eta^2 = .140$; and pre-video state anxiety, $F(1,59) =$
277 $4.88, p = 0.032, \text{partial } \eta^2 = .076$; ASMR video engagement, $F(1, 59) = 7.80, p = 0.006, \text{partial } \eta^2 = .119$.
278 With all of the measures there was significantly greater trait anxiety, neuroticism, pre-video state
279 anxiety and ASMR video engagement scores observed in the ASMR-experiencer group compared to
280 the non-experiencer group.

281

282 In order to explore the second hypothesis, a mixed 2-way ANCOVA was carried out, with
283 Group as the independent measures factor and pre- and post-video state anxiety scores as the
284 repeated measures factor. Age and gender were employed as co-variates. The ANCOVA revealed that
285 there was a main effect of the repeated measures factor, pre-video vs post-video, $F(1,62) = 4.48, p =$
286 $0.038, \text{partial } \eta^2 = .067$ with significantly greater state anxiety prior to exposure to the video. There
287 was no significant Group difference, $F(1,62) = 2.49, p = 0.119, \text{partial } \eta^2 = .039$. However, the
288 interaction was significant, $F(1,62) = 4.87, p = 0.031, \text{partial } \eta^2 = .073$.

289

290 In order to clarify the significant interaction between the independent variables, a series of
291 paired and independent sample t-tests were conducted. Firstly, paired samples t-tests were
292 conducted to compare the pre-video state anxiety scores to the post-video state anxiety scores for
293 each group. The tests found that the ASMR-experiencer group had a significantly lower state anxiety
294 scores post-video ($M = 36.58, SD = 11.87$) than pre-video ($M = 41.75, SD = 12.82$), $t(35) = 2.86, p =$
295 $0.007, d = 0.48$. In contrast, there was no difference between the pre- ($M = 35.04, SD = 9.05$) and post-
296 video scores for the non-experiencer group ($M = 35.14, SD = 10.39$), $t(27) = -0.08, p = 0.939, d = -0.02$.
297 Secondly, independent sample t-tests were run to determine whether there was a statistically
298 significant effect of Group on the pre-video and post-video state anxiety scores. The test found
299 significantly higher pre-video state anxiety scores in the ASMR-experiencer group ($M = 41.75, SD =$
300 12.82) than the non-experiencer group ($M = 35.04, SD = 9.04$), $t(61.49) = 2.45, p = 0.017, d = 0.58$.

301 However, there was no significant difference between the ASMR-experiencer group ($M = 36.58$, $SD =$
302 11.87) and the non-experiencer group ($M = 35.14$, $SD = 10.39$) when comparing post-video state
303 anxiety scores, $t(62) = 0.51$, $p = 0.613$, $d = 0.13$ (see Fig 1).

304

305

306 **Fig 1.tif** *Mean state anxiety scores of ASMR-experiencer and non-experiencer groups, pre- versus*
307 *post-video exposure. Note: bars are standard errors.*

308

309

310 In order to investigate the final hypothesis, a series of mediation analyses (40) were carried out. The
311 initial correlation analysis between Group and Change in State Anxiety revealed $r_{pb} = -.270$, $p = .037$.

312 The outcomes are shown in Fig 2.

313

314

315

316 **Fig 2.tif** *The contribution of trait anxiety, neuroticism, pre-video state anxiety and ASMR video*
317 *engagement as mediators of the Group-change in state anxiety relationship.*

318

319

320 Fig 2 shows that the insertion of each of the mediators into the Process model makes the direct
321 relationship between Group and change in state anxiety non-significant, with neuroticism, pre-video
322 state anxiety, and ASMR video engagement rating each acting as significant mediators.

323

324 **Analysis Summary**

325 The findings suggest that significant differences in personality characteristics were present
326 between the two groups in trait anxiety, neuroticism, and in pre-video state anxiety. In addition, there
327 was a significant group difference in ASMR video engagement. The correlations and partial
328 correlations revealed significant relationships between trait anxiety, neuroticism, and pre-video state
329 anxiety and some significant relations of these variables with ASMR video engagement. The mixed
330 ANOVA with pre- versus post-video exposure (state anxiety scores) and Group revealed a significant
331 interaction, with only the ASMR-experiencer group evidencing a significant reduction in state anxiety.
332 Finally, mediation analyses revealed that neuroticism, pre-video state anxiety, and the ASMR video
333 engagement scores all acted as significant mediators, with the direct relationship between Group and
334 change in state anxiety no longer being significant.

335

336

337 **Discussion**

338 The primary aim of the study was to investigate whether the ability to experience ASMR is
339 associated with higher levels of neuroticism, trait anxiety, and state anxiety. The second aim was to
340 identify whether watching ASMR videos helps reduce state anxiety in general, or whether any benefit
341 was subject to actually experiencing the phenomenon. We also investigated whether any difference
342 in personality characteristics between the groups could be mediating the difference in the impact of
343 the video on state anxiety.

344

345 The results upheld our first hypothesis, that individuals who are able to experience ASMR have
346 significantly greater neuroticism, state anxiety, and trait anxiety scores compared to non-
347 experiencers. The significantly greater neuroticism scores observed in the ASMR-experiencers is
348 consistent with the limited prior studies which have investigated personality traits in ASMR-

349 experiencers (e.g. 16 - though their group differences were rendered non-significant with multiple
350 comparisons, 26, 28). Neuroticism and trait anxiety are known to be strongly linked since neuroticism
351 describes a predisposition to negative emotional states such as anxiety (30). Thus, the results here
352 suggests that those with the ability to experience ASMR are more likely to experience negative
353 emotional states and have a propensity for trait anxiety. This relationship was confirmed by the strong
354 positive correlation between the scores of neuroticism and trait anxiety. The results also supported
355 the second hypothesis, as only the ASMR-experiencers reported a decrease in state anxiety as a result
356 of watching the ASMR video. This result was driven by significantly greater pre-video state anxiety in
357 the ASMR-experiencer group compared to the non-experiencers. In contrast, there was no difference
358 in pre- and post-video state anxiety in the non-experiencers group. This suggests that ASMR-
359 experiencers also have greater predisposition for baseline state anxiety, which can be alleviated by
360 watching ASMR videos. This concurs with the prior observation of a relationship between trait and
361 state anxiety where high trait anxiety is indicative of greater baseline level of state anxiety (31).

362

363 When considering the ASMR video engagement ratings, correlational analyses found both
364 trait anxiety *and* neuroticism scores were significantly positively correlated with video engagement
365 scores, when age and gender were controlled for, suggesting that the severity of disposition for
366 negative affect and anxiety are related to enjoyment of ASMR videos. Analyses of group differences
367 found ASMR-experiencers gave significantly higher video engagement scores than the non-
368 experiencers. This supports several studies which suggest ASMR is only enjoyable for individuals who
369 experience the phenomenon and may even be unenjoyable for non-experiencers (2, 4, 9, 11).
370 Furthermore, video engagement scores were strongly correlated with change in state anxiety,
371 suggesting that the more positive the ASMR engagement, the greater the reduction in short term
372 anxiety. Similar results have been reported previously (2), where ASMR experiencers who had been
373 diagnosed with depression experienced the greatest decrease in depressive symptoms as a result of
374 watching an ASMR video, though caution needs to taken with this comparison as depression and

375 anxiety are discrete types of psychopathology. However, when considering the comparisons made
376 between mindfulness and ASMR, in order to experience ASMR, mindful focusing is required (9, 23, 24,
377 41). As mindfulness has been shown to reduce anxiety (e.g. 22, 42; but also see 43 for alternative
378 findings), it is unsurprising that ASMR has similar positive effects. Combined, this lends further support
379 for watching ASMR videos as an intervention for the reduction of acute state anxiety, but only in those
380 with a propensity to experience ASMR.

381

382 However, the results from the mediation analysis suggest alternative interpretations need to
383 be considered. This analysis found that neuroticism, pre-video state anxiety, and video engagement
384 each acted as significant mediators resulting in the relationship between Group and change in state
385 anxiety being rendered non-significant. Therefore, this leads us to question whether ASMR *could* be
386 considered as an intervention even for those who do not actively watch ASMR videos and / or have
387 experienced ASMR tingles but do have elevated levels of neuroticism and anxiety. This was implied by
388 the findings of a recent study employing electroencephalography (EEG) methodology with a non-
389 clinical sample (44). Participants completed a difficult mental task while either listening to an ASMR
390 audio of choice or in silence. The authors found that, when completing the mentally demanding task
391 was accompanied with an ASMR audio, the alpha and beta frequency band levels increased to levels
392 commensurate of resting states (also see 45). Greater alpha and beta power values are also observed
393 during mindfulness mediation (46-48), thus the study by Ohta and Inagaki (44) provides a seminal
394 indicator of the functional significance of ASMR, as a means to aid relaxation and mental stress, even
395 during demanding cognitive processing. There are two notable implications from this study. Firstly, it
396 re-emphasises the importance of using the participants' choice of trigger, which was lacking in the
397 current study (see 15). Secondly, the comparable high levels of alpha whilst completing the mentally
398 demanding task suggest that ASMR may have a clinical application even under conditions of high
399 cognitive load. When considering that individuals typically watch ASMR under quiet, relaxing
400 conditions with focused attention (similar to those when practicing mindfulness mediation), the

401 findings of Ohta and Inagaki (44) suggest that the benefits of ASMR may be evident under alternative
402 conditions. This work clearly requires replication and should be supplemented with biomarkers such
403 as galvanic skin response (GSR) and heart rate, as changes in these are indicative of reduce anxiety
404 and have been observed in response to ASMR exposure (4, 11, 49).

405

406 The present study is not without limitations. We cannot discount that there was strong
407 selection bias amongst the sample group. Most of the ASMR-experiencer group consisted of
408 participants who were recruited online from ASMR forums or social media comment sections. Thus,
409 the recruitment method resulted in 28 out of 36 ASMR-experiencer participants having prior
410 knowledge and experience of ASMR. That is, since the ASMR-experiencer group consisted mainly of
411 ASMR viewers, we cannot be certain of whether the effects seen are representative of all ASMR-
412 capable individuals or whether they just belong to individuals who are actively seeking out ASMR
413 videos. However, 8 participants allocated to the ASMR-experiencer group, based on the location of
414 their tingles post-video, had never been exposed to ASMR previously (37). This emphasises the
415 importance of recruiting ‘ASMR-naïve’ participants in future studies. The benefit of recruiting an
416 ‘ASMR-naïve’ sample would enable researchers to clarify whether the proposed character traits were
417 indeed reflective of *all* ASMR-experiencers, or just the experiencers who view ASMR regularly.
418 Certainly, inclusion of ASMR-naive individuals prone to high anxiety warrants further investigation.

419

420 Nine participants who identified as experiencing ASMR prior to the study and were allocated
421 to the ASMR-experiencers group, did not experience ASMR tingles during the study. This likely reflects
422 the individual differences in which ASMR triggers that precipitate a response (2, 15, 26). To try and
423 counter this, a video with as many triggers as possible was selected for the study; however, the brief
424 duration of the video meant each trigger was also relatively short. Therefore, it is plausible that some
425 ASMR-capable individuals simply did not experience ASMR tingles during the video used in the current
426 study. This might be overcome by including a video with a large range of longer-lasting triggers.

427 Alternatively, future studies would benefit from including an option for participants to choose which
428 type of ASMR videos they want to watch (e.g. 15, 44), especially as stimulus familiarity may also be
429 implicit in greater experience of ASMR as is observed with musically induced frisson (50). We also
430 need to consider that nine participants allocated to the non-experiencer group *did* report tingles
431 either pre-and / or post-video, however the location of these was not consistent with 'true' ASMR
432 which originates in the head and / or neck. This emphasises the importance of more fully identifying
433 participants' usual ASMR experiences as well as those during experimental investigation in order to
434 rule out false-positive reporting of the experience (see 36 for a discussion).

435

436 The measures used in the current study are also not without question. Whilst use of the STAI
437 is widespread, its ability to discriminate anxiety from depression has been questioned (e.g. 51). Thus,
438 future research might consider an alternative measure such as the State-Trait Inventory for Cognitive
439 and Somatic Anxiety (STICSA; 52; for a discussion see 53). Another issue was the brevity of the video
440 engagement questionnaire, therefore future studies should aim to use more psychometrically
441 validated measures such as the ASMR-15 inventory (54) or the ASMR-Experience Questionnaire (AEQ;
442 36), though of note the video engagement questionnaire used here *did* contribute significantly to the
443 mediation model in Fig 2.

444

445 In summary, the primary results support the hypothesis that ASMR-capable individuals score
446 higher in neuroticism and trait anxiety than non-experiencers. This suggests that ASMR-experiencers
447 are particularly prone to experiencing negative emotional states as well as anxiety disorders. The main
448 findings also provide evidence in support of the second hypothesis which proposed exposure to ASMR
449 videos would reduce state anxiety in ASMR-experiencers but not non-experiencers, indicative that
450 ASMR has positive effects in those who are capable of experiencing the phenomenon. Furthermore,
451 investigation of the interaction between timing and group revealed that ASMR-experiencers have
452 higher baseline levels of state anxiety than average, where scores are reduced to a typical level as a

453 result of watching ASMR. Though there were certain limitations in the methodology of the study, these
454 primary outcomes provide strong support of the prospect that ASMR has the potential to be both
455 effective and suitable as a clinically relevant anxiety treatment. Non-clinical future studies should
456 direct investigations towards EEG and fMRI studies, particularly in order to verify the potential
457 mechanism behind ASMR's anxiety reducing capabilities. Another important avenue would be to
458 investigate the possibility that ASMR *viewers* are characteristically different to ASMR-capable
459 individuals with no prior experience of online ASMR. Whilst it seems logical that those who experience
460 ASMR report greater video engagement ratings, the results here suggest that ASMR has the potential
461 to have anxiety-reducing effects in general; in particular as our data imply that individuals with high
462 trait anxiety levels are more likely to be able to experience ASMR than those lower in trait anxiety. We
463 need to consider that the targeted group in the current study may have a particular predisposition to
464 seek out and experience ASMR. However, the pattern of reduced state anxiety, along with the results
465 of the mediation analyses, suggest that ASMR could be employed as a clinical intervention in general,
466 targeting any group of individuals who have elevated levels of neuroticism or anxiety.

467

468 References

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- 470 1: Ahuja NK. " It feels good to be measured": clinical role-play, Walker Percy, and the tingles.
471 *Perspect Biol Med.* 2013;56(3):442-51. doi:10.1353/pbm.2013.0022
- 472 2: Barratt EL, Davis NJ. Autonomous Sensory Meridian Response (ASMR): a flow-like mental
473 state. *PeerJ.* 2015;3:e851. doi:10.7717/peerj.851
- 474 3: Tihanyi BT, Ferentzi E, Beissner F, Köteles F. The neuropsychophysiology of tingling.
475 *Conscious Cogn.* 2018;58:97-110. doi: 10.1016/j.concog.2017.10.015
- 476 4: Poerio GL, Blakey E, Hostler TJ, Veltri T. More than a feeling: Autonomous sensory meridian
477 response (ASMR) is characterized by reliable changes in affect and physiology. *PLoS One.*
478 2018;13(6): e0196645. doi: 10.1371/journal.pone.0196645
- 479 5: Grewe B, Katzur B, Kopiez R, Altenmüller E. Chills in different sensory domains: Frisson
480 elicited by acoustical, visual, tactile and gustatory stimuli. *Psychol Music.* 2010;39(2):220–
481 239.
- 482
- 483
- 484
- 485
- 486

- 487 6: Kovacevich A, Huron D. Two studies of Autonomous Sensory Meridian Response
488 (ASMR): The relationship between ASMR and music-induced frisson. *Empir Musicol*
489 *Rev.* 2018;13(1-2):39-63.
490
- 491 7: Lochte BC, Guillory SA, Richard CA, Kelley WM. An fMRI investigation of the neural correlates
492 underlying the autonomous sensory meridian response (ASMR). *BioImpacts.* 2018;8(4):295.
493 doi:10.15171/bi.2018.32
494
- 495 8: Roberts N, Beath A, Boag S. A mixed-methods examination of autonomous sensory meridian
496 response: Comparison to frisson. *Conscious Cogn.* 2020;86:103046.
497
- 498 9: del Campo MA, Kehle TJ. Autonomous sensory meridian response (ASMR) and frisson:
499 Mindfully induced sensory phenomena that promote happiness. *Int J Sch Educ Psychol.*
500 2016;4(2):99-105. doi:10.1080/21683603.2016.1130582
501
- 502 10: Blood AJ, Zatorre RJ. Intensely pleasurable responses to music correlate with activity in brain
503 regions implicated in reward and emotion. *Proc Natl Acad Sci.* 2001;98(20):11818-23. doi:
504 10.1073/pnas.191355898
505
- 506 11: Poerio G. Could insomnia be relieved with a YouTube video? The relaxation and calm of
507 ASMR. In: Callard F, Staines K, Wilkes J, editors. *The Restless Compendium [E-book].* 2016.
508 pp.119-126. Available from:
509 https://library.oapen.org/bitstream/handle/20.500.12657/28427/Bookshelf_NBK453230.pdf?sequence=1#page=123
510
511
- 512 12: Gentle Whispering ASMR. <https://www.youtube.com/user/GentleWhispering>
513
- 514 13: r/asmr. (2011, February 18). ASMR: Sounds that feel good. Reddit.
515 <https://www.reddit.com/r/asmr/>
516
- 517 14: Barratt EL, Spence C, Davis NJ. Sensory determinants of the Autonomous Sensory Meridian
518 Response (ASMR): understanding the triggers. *PeerJ.* 2017;5:e3846. doi:10.7717/peerj.3846.
519
- 520 15: Smith SD, Fredborg BK, Kornelsen J. Functional connectivity associated with five different
521 categories of Autonomous Sensory Meridian Response (ASMR) triggers. *Conscious Cogn.*
522 2020;85: 103021.
523
- 524 16: Janik McErlean AB, Banissy MJ. Assessing individual variation in personality and
525 empathy traits in self-reported Autonomous Sensory Meridian Response. *Multisens*
526 *Res.* 2017;30(6):601-13.
527
- 528 17: Paszkiel S, Dobrakowski P, Lysiak A. The impact of different sounds on stress level in the
529 context of EEG, cardiac measures and subjective stress level: A pilot study. *Brain Sci.*
530 2020;10:728. doi:10.3390/brainsci10100728
531
- 532 18: Mind. Anxiety and Panic Attacks. 2021. Available from
533 [https://www.mind.org.uk/information-support/types-of-mental-health-problems/anxiety-](https://www.mind.org.uk/information-support/types-of-mental-health-problems/anxiety-and-panic-attacks/about-anxiety/)
534 [and-panic-attacks/about-anxiety/](https://www.mind.org.uk/information-support/types-of-mental-health-problems/anxiety-and-panic-attacks/about-anxiety/)
535
- 536 19: Lader M, Marks I. *Clinical Anxiety.* London: Heinemann Medical; 1971
537

- 538 20: NHS Digital. Adult Psychiatric Morbidity Survey: Survey of Mental Health and
539 Wellbeing, England. 2014. Available from:
540 [https://digital.nhs.uk/data-and-information/publications/statistical/adult-psychiatric-](https://digital.nhs.uk/data-and-information/publications/statistical/adult-psychiatric-morbidity-survey/adult-psychiatric-morbidity-survey-survey-of-mental-health-and-wellbeing-england-2014)
541 [morbidity-survey/adult-psychiatric-morbidity-survey-survey-of-mental-health-and-](https://digital.nhs.uk/data-and-information/publications/statistical/adult-psychiatric-morbidity-survey/adult-psychiatric-morbidity-survey-survey-of-mental-health-and-wellbeing-england-2014)
542 [wellbeing-england-2014](https://digital.nhs.uk/data-and-information/publications/statistical/adult-psychiatric-morbidity-survey/adult-psychiatric-morbidity-survey-survey-of-mental-health-and-wellbeing-england-2014)
543
- 544 21: Lin-Stephens S. Visual stimuli in narrative-based interventions for adult anxiety: A systematic
545 review. *Anxiety Stress Coping*. 2020;33:281-98.
546
- 547 22: Blanck P, Perleth S, Heidenreich T, Kröger P, Ditzen B, Bents H, et al. Effects of mindfulness
548 exercises as stand-alone intervention on symptoms of anxiety and depression: Systematic
549 review and meta-analysis. *Behav Res Ther*. 2018;102:25-35. doi:10.1016/j.brat.2017.12.002
550
- 551 23: Fredborg BK, Clark JM, Smith SD. Mindfulness and autonomous sensory meridian response
552 (ASMR). *PeerJ*. 2018;6:e5414. doi:10.7717/peerj.5414
553
- 554 24: Scofield E. A quantitative study investigating the relationship between Autonomous Sensory
555 Meridian Response (ASMR), misophonia and mindfulness. Psychology Department.
556 Manchester Metropolitan University. 2019. Available from:
557 https://e-space.mmu.ac.uk/623904/1/Emma_Scofield%5B1%5D.pdf
558
- 559 25: Lutz A, Slagter HA, Dunne JD, Davidson RJ. Attention regulation and monitoring in
560 meditation. *Trends Cogn Sci*. 2008;12(4):163-69. doi:10.1016/j.tics.2008.01.005
561
- 562 26: Fredborg B, Clark J, Smith SD. An examination of personality traits associated with
563 autonomous sensory meridian response (ASMR). *Front Psychol*. 2017;8:247.
564 doi:10.3389/fpsyg.2017.00247
565
- 566 27: Keizer A, Chang TH, O'Mahony CJ, Schaap NS, Stone KD. Individuals who experience
567 Autonomous Sensory Meridian Response have higher levels of sensory
568 suggestibility. *Perception*. 2020;49(1):113-16. doi:10.1177/0301006619891913
569
- 570 28: Koumura T, Nakatani M, Liao S-I, Kondo HM. Dark, loud, and compact sounds induce frisson.
571 *Q J Exp Psychol*. 2021; 74(6):1140-1152. doi:10.1177/1747021820977174
572
- 573 29: Roberts N, Beath A, Boag S. Autonomous Sensory Meridian Response: Sensitivity
574 and personality correlates. *J Individ Differ*. 2020: Advance online publication.
575 <http://dx.doi.org/10.1027/1614-0001/a000337>
576
- 577 30: Kroencke L, Geukes K, Uteshch T, Kuper N, Back MD. Neuroticism and emotional risk
578 during the COVID-19 pandemic. *J Res Pers*. 2020;89:10438.
579
- 580 31: Spielberger CD, Gorsuch RL, Lushene R, Vagg PR, Jacobs GA. Manual for the State-Trait
581 Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press; 1970. Available from:
582 <https://twynhamschoolalevelpe.weebly.com/uploads/2/2/6/6/22662982/stai.pdf>
583
- 584 32: Widiger TA, Oltmanns JR. Neuroticism is a fundamental domain of personality with
585 enormous public health implications. *World Psychiatry*. 2017;16(2):144-45.
586
- 587 33: Merino H, Senra C, Ferreiro F. Are worry and rumination specific pathways linking
588 neuroticism and symptoms of anxiety and depression in patients with Generalized Anxiety

- 589 Disorder, Major Depressive Disorder and Mixed Anxiety-Depressive Disorder? PLoS One.
590 2016;11(5):e0156169. doi:10.1371/journal.pone.0156169
- 591
- 592 34: Ormel J, Rosmalen J, Farmer A. Neuroticism: a non-informative marker of vulnerability to
593 psychopathology. *Soc Psychiatry Psychiatr Epidemiol.* 2004;39(11):906-12.
594 doi:10.1007/s00127-004-0873-y.
- 595
- 596 35: Zhou Y, Cao Z, Yang M, Xi X, Guo Y, Fang M, et al. Comorbid generalized anxiety disorder and
597 its association with quality of life in patients with major depressive disorder. *Sci Rep.*
598 2017;7:40511. doi:10.1038/srep40511
- 599
- 600 36: Swart TR, Bowling NC, Bannisy MJ. ASMR-Experience Questionnaire (AEQ): A data-driven
601 step towards accurately classifying ASMR responders. *Br J Psychol.* 2021:
602 doi:10.1111/bjop.12516
- 603
- 604 37: Wang X, Yang X, Sun Y, Su Y. The influence of autonomous sensory meridian response
605 on individual's executive function. *Q J Exp Psychol.* 2020;73: 1587–95.
- 606
- 607 38: Costa Jr PT, McCrae RR. The Revised NEO Personality Inventory (NEO-PI-R). In: Boyle
608 GJ, Matthews G, Saklofske DH, editors. *The SAGE Handbook of Personality Theory
609 and Assessment, Vol. 2. Personality measurement and testing.* London: Sage
610 Publications Ltd; 2008; pp. 179-198. doi: 10.4135/9781849200479.n9
- 611
- 612 39: Henry, C. ASMR| 5 Minutes Quick Triggers. [Cynthia Henry ASMR]. YouTube.
613 Retrieved July 5 2020, from <https://www.youtube.com/watch?v=RB4wY1-NecI>
- 614
- 615 40: Hayes AF, Slater MD, Snyder LB. *The Sage sourcebook of advanced data analysis
616 methods for communication research.* London: Sage Publishing; 2008
- 617
- 618 41: Brown KW, Ryan RM. The benefits of being present: mindfulness and its role in psychological
619 well-being. *J Pers Soc Psychol.* 2003;84(4):822-48. doi:10.1037/0022-3514.84.4.822
- 620
- 621 42: Vøllestad J, Sivertsen B, Nielsen GH. Mindfulness-based stress reduction for patients with
622 anxiety disorders: Evaluation in a randomized controlled trial. *Behav Res Ther.* 2011;49:281-
623 88.
- 624
- 625 43: Strauss C, Cavanagh K, Oliver A, Pettman D. Mindfulness-based interventions for people
626 diagnosed with a current episode of an anxiety or depressive disorder: A meta-analysis of
627 randomised controlled trials. *PLoS One.* 2014;9(4):e96110.
628 doi:10.1371/journal.pone.0096110
- 629
- 630 44: Ohta Y, Inagaki K. Evaluation of the effect of ASMR on reduction of mental stress EEG study.
631 *IEEE 3rd Global Conference on Life Sciences and Technologies (Life Tech); 2021 Mar 9-11.*
632 Nara, Japan. doi:10.1109/LifeTech52111.2021.9391945.
- 633
- 634 45: Fredborg BK, Champagne-Jorgensen K, Desroches AS, Smith SD. An electroencephalographic
635 examination of the autonomous sensory meridian response (ASMR). *Conscious Cogn.*
636 2021;87:103053
- 637

- 638 46: Ahani A, Wahbeh H, Nezamfar H, Miller M, Erdogmus D, Oken B. Quantitative change of EEG
639 and respiration signals during mindfulness meditation. *J Neuroeng Rehabil.* 2014;11:87.
640 doi:10.1186/1743-0003-11-87
641
- 642 47: Bing-Canar H, Pizzuto J, & Compton RJ. Mindfulness-of-breathing exercise modulates EEG
643 alpha activity during cognitive performance. *Psychophysiology.* 2016;53:1366–76.
644
- 645 48: Gao J, Fan J, Wu BWY, Zhang Z, Chang C, Hung YS, et al. Entrainment of chaotic activities in
646 brain and heart during MBSR mindfulness training. *Neurosci Lett.* 2016;616:218-23.
647 doi:10.1016/j.neulet.2016.01.001
648
- 649 49: Harrison RJ. An investigation of subjective mood improvements when using audiovisual
650 media as supplementary therapy for generalised anxiety disorder and depression. MA thesis,
651 University of Huddersfield. 2017. Available from: <http://eprints.hud.ac.uk/id/eprint/34180/>
652
- 653 50: Panksepp J. The emotional sources of “chills” induced by music. *Music Percept.* 1995;13:
654 71–207. doi:10.2307/40285693
655
- 656 51: Gros DF, Antony MM, Simms LJ, McCabe RE. Psychometric properties of the State-Trait
657 Inventory for Cognitive and Somatic Anxiety (STICSA): Comparison to the State-Trait Anxiety
658 Inventory (STAI). *Psychol Assess.* 2007;19:369-81.
659
- 660 52: Ree MJ, French D, MacLeod C, Locke V. Distinguishing cognitive and somatic dimensions of
661 state and trait anxiety: Development and validation of the State-Trait Inventory for Cognitive
662 and Somatic Anxiety (STICSA). *Behav Cogn Psychother.* 2008;36:313-32.
663
- 664 53: Van Dam NT, Gros DF, Earleywine M, Antony MM. Establishing a trait anxiety threshold that
665 signals likelihood of anxiety disorders. *Anxiety Stress Coping.* 2013;26(1):70-86.
666 doi:10.1080/10615806.2011.631525
667
- 668 54: Roberts N, Beath A, Boag S. Autonomous Sensory Meridian Response: Scale development
669 and personality correlates. *Psychol Conscious.* 2019;6(1):22-39.
670

671

672 **Fig 1.tif** *Mean state anxiety scores of ASMR-experiencer and non-experiencer groups, pre- versus*
673 *post-video exposure. Note: bars are standard errors.*

674

675 **Fig 2.tif** *The contribution of Trait Anxiety, Neuroticism, Pre-Video State Anxiety and ASMR Video*
676 *engagement as mediators of the Group-Change in State Anxiety relationship.*