This is the accepted version of the manuscript:

Bedwell, S. A., & Butcher, I. (2020). The Co-occurrence of Alice in Wonderland Syndrome and Autonomous Sensory Meridian Response. PsyPAG

Research-in-brief

The Co-occurrence of Alice in Wonderland Syndrome and Autonomous Sensory Meridian Response

*Alice in Wonderland Syndrome (AIWS) is a perceptual disorder reported to affect 1-3% of the population, usually in childhood. Autonomous sensory meridian response (ASMR) is associated with similar symptoms to AIWS, reported into adulthood. ASMR is also thought to stem from a heightened sensitivity to external stimuli. Despite similarities, there has been limited research investigating the link between these two phenomena. We sought to establish a link between AIWS and ASMR. Our findings show an increased presence of AIWS symptoms amongst a population who are aware of experiencing ASMR. We described a predictive relationship between the visual symptoms of AIWS and the age of onset of ASMR. ASMR has an increasing presence and is suggested as an intervention for a range of disorders. Despite this, there remains little understanding of its causation. These findings provide an important basis for establishing the causation of ASMR as well as furthering understanding of AIWS.*

# Introduction

## Disorders of Perception

Human perception is a complex entity that encompasses multiple processes and complex networks. The nature of perception has been researched for centuries and continues to be a topic of investigation across psychology and neuroscience. Abnormalities or alterations to the complex connectivity and action of perceptual networks can result in a range of outcomes, including disorders of perception. Perceptual disorders are often grouped into sensory distortions, whereby real external stimuli are perceived in a distorted way (Casey & Kelly, 2007), and sensory deceptions whereby stimuli are perceived that do not exist in the external environment (Casey & Kelly, 2007). Sensory delusions have been widely studied, specifically in association with symptoms of psychosis, with delusion being a hallmark positive symptom of schizophrenia (Patru & Reser, 2015). Sensory distortions however, remain more poorly understood, despite their relatively high prevalence in the population (Bell, Halligan & Ellis, 2005). In recent years, neuroscience and psychology research has begun to explore sensory disorders in more depth, highlighting previously undescribed biological basis for childhood perceptual disorders such as sensory perception disorder (SPD) and little investigated phenomena such as autonomous sensory meridian response (ASMR).

## Autonomous Sensory Meridian Response

ASMR refers to a neurophysiological response to external stimuli; it is thought to be a result of a heightened sensitivity to specific sounds, images or sensations. ASMR is often described as a pleasurable tingling sensation brought on in response to specific external auditory, tactile, visual or olfactory triggers (Andersen, 2014; Fredborg, Clark & Smith, 2017). ASMR is believed to begin in the scalp and, depending on the strength of the response elicited, can radiate down the spine and throughout the rest of the body (Barratt & Davis, 2015). As a relatively new area of study in neuroscience and psychology, the underlying mechanisms and effects of ASMR are little understood (Poerio et al, 2018). However, recent evidence shows a possible therapeutic effect on depression and anxiety (Barratt & Davis, 2015; Ditchburn & Bedwell, 2019).

## Alice in Wonderland Syndrome

Similar to the experience of ASMR, Alice in Wonderland Syndrome (AIWS) is a perceptual disorder characterised by distortions of visual perception (Blom, 2016). Research suggests that AIWS could result from oversensitivity to external stimuli. AIWS is a term used to describe the occurrence of unusual, mainly visual, sensory experiences (Blom, 2016). Whereas ASMR usually manifests in childhood and continues into adulthood, most reports indicate that AIWS is resolved, without treatment, by adulthood (Blom, 2016).

Both AIWS and ASMR are thought to be elements of, or to be related to, temporal lobe epilepsy, as a response to a heightened sensitivity to external stimuli (visual or auditory). Temporal lobe epilepsy is usually diagnosed in childhood or adolescence. It can be caused by injury, lesion or infection. Findings show that, like AIWS, approximately 1 in 3 children diagnosed with temporal lobe epilepsy grow out of the disorder by adulthood, that is without intervention, they cease to experience seizures (Spooner, 2006). Perhaps it is through maturity of complex network structures and synaptic pruning that the brain can overcome the deficit and develop a protective mechanism to deal with oversensitivity to stimuli.

Accounts of childhood sensory processing disorder (SPD) may be linked with symptoms described as AIWS. Specifically, SPD is described as a struggle in processing sensory information. Symptoms of SPD include hypersensitivity to sound, sight and touch, and an unusual interest in sensory aspects of the environment (Chang et al., 2016). Despite similarities, there is a marked difference between the way in which symptoms of SPD and AIWS are described. SPD is often reported with an emphasis on stimuli as an irritant, which does not appear to be the case with AIWS. Although AIWS can involve unpleasant sensations, there are no known accounts of the symptoms of AIWS being described as irritant or unbearable, as in SPD. Similarly, ASMR is more often described as a pleasurable experience (Barratt & Davis, 2015).

Based on current knowledge, there are commonalities in the individual reported experiences of AIWS and ASMR, with some cross over with descriptions of SPD. There are also many overlaps in reports of possible underlying physiological mechanisms of ASMR and AIWS, including mild seizure activity in the temporal lobe and a relationship with migraine (Mastria et al., 2016) and abnormalities in the default mode network (Smith, Fredborg & Komelsen, 2016). However, it is unclear whether these two phenomena are related, part of a common overarching condition, if AIWS is a precursor of ASMR, or if ASMR is a protective mechanism that is, developed in response to AIWS.

Developing a clearer understanding regarding the overlapping symptoms and experiences of AIWS and ASMR will allow for further developments in treatment for AIWS as well as the proposed therapeutic effects of ASMR (Barratt & Davis, 2015). In the present study, we aimed to form a basis on which to establish the presence and nature of the relationship between these two poorly understood phenomena. The findings of this study will form the basis for future research investigating the underlying causes and mechanisms of these understudied neurophysiological phenomena, as well as the relationship between the two experiences. This research also aims to provide a basis on which to identify whether childhood experiences of AIWS are overcome by the development of ASMR and if, in the absence of ASMR further psychological disorder develops. For this study, we define childhood as before the age of 18.

## Aims and Hypotheses

### Research Questions

1. Is there a significant relationship present between the known similar experiences and symptoms (hypersensitivity and heightened response to external stimuli) associated with AIWS and ASMR?

2. Are symptoms of AIWS predictive of ASMR triggers?

3. Are symptoms of the predominantly childhood-occurring AIWS ceased or reduced with the onset of experiences of ASMR?

### Hypotheses

Based on similarities in symptom reports and age of onset/resolution of AIWS and ASMR, we expect to observe a significant predictive relationship between AIWS and ASMR. Specifically, it was hypothesised that specific symptoms reported in AIWS during childhood would be predictive of experiencing specific ASMR triggers later in childhood and during adulthood. If as predicted, AIWS is a precursor of ASMR, we would expect to see reports of a reduction in AIWS symptoms around the time of ASMR onset.

# Methodology

## Participants

292 volunteer adult participants were recruited through social media (Facebook, Twitter, Reddit) to participate in the online study. Participants were required to have no history of brain injury. Participants were recruited based on having known previous experience of ASMR and current knowledge of ASMR as a phenomenon, participants were required to be over the age of 18 to participate. Of the 292 participants who completed the study 100 were female, 114 were male, 8 reported as non-binary/other and the remainder reported no gender. The mean age of participants was 26.9. Participants were informed that their participation would aid in the understanding of a little-understood neurophysiological phenomenon, ultimately leading to advances in our understanding of the underlying processes, development and potential protective and therapeutic properties.

## Materials

Participants were asked to complete two questionnaires presented via eSurvey Creator® that addressed their ASMR experiences and AIWS symptoms by self-report. The ASMR questionnaire was consistently presented first. It took approximately 20 minutes to complete the study but no time restrictions were imposed. Participants could take an optional break after completing the first questionnaire but they were not allowed to exit the study and return later.

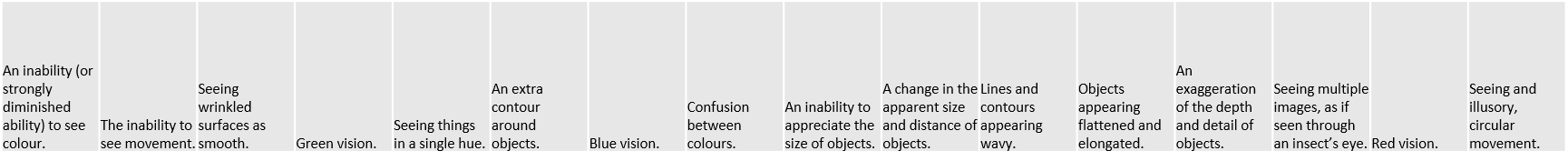
### Questionnaire 1

The ASMR checklist (Barratt & Davis, 2015) was used to identify participants’ experiences of ASMR. This is a 72-item questionnaire that asks the participants to report details of their individual ASMR trigger stimuli, physiological sensations, attentional, emotional and mood effects. The questionnaire also asks participants to indicate co-occurrence of synaesthesia and chronic pain.

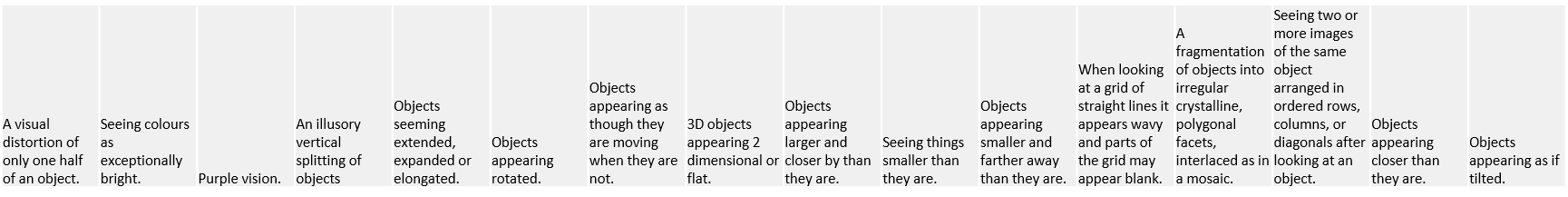
### Questionnaire 2

The second questionnaire investigated symptoms of AIWS as defined by Blom (2016). Participants were asked to report past experiences and symptoms associated with AIWS. This is a 57 Item questionnaire that asks participants to identify symptoms they recollect having experienced and whether the AIWS symptom continued after the onset of ASMR experiences. AIWS symptoms include visual distortions, somesthetic and other non-visual distortions. All included symptoms can be seen in Table 1.

a



b



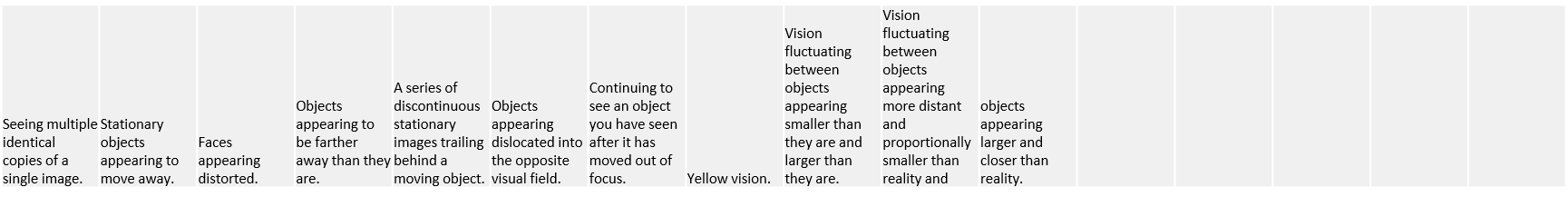


Table 1. List of (a) visual symptoms of Alice in Wonderland Syndrome and (b) non-visual symptoms of Alice in Wonderland Syndrome, as depicted in figures 2 and 3

**Procedure**

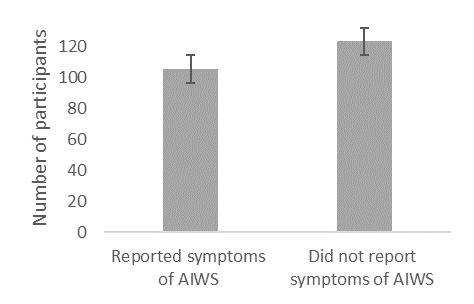
All participants completed the ASMR checklist (Barratt & Davis, 2015) and AIWS questionnaire via the eSurvey Creator® platform after reading a study information sheet informing them of what would be required of them, their rights to withdrawal and contact information for the investigators. All participants were required to confirm their suitability to participate according to the inclusion criteria and to provide informed consent prior to continuing to the questionnaire elements. The study was approved by the University Ethics Committee and complied with the ethical guidelines of the British Psychological Society.

## Statistical Analysis

Data were analysed in IBM SPSS 24 by way of a Pearson correlation coefficient analysis (Pearson’s r) and a linear regression model, to determine the presence of a predictive relationship between experiences associated with AIWS and those identifiable with ASMR. All statistical tests were applied with 95% confidence.

# Results

Two hundred and ninety-two adults who reported known experience of ASMR completed the study. 46.4% of participants reported symptoms of AIWS. 53.2% of participants reported no symptoms of AIWS (Figure. 1.a.). There were more reports of AIWS in female participants (m = 48.2%, f = 57%). Our findings show that, typically, reported symptoms of AIWS were lower after onset of ASMR than before (Figure. 1.b).



a

b

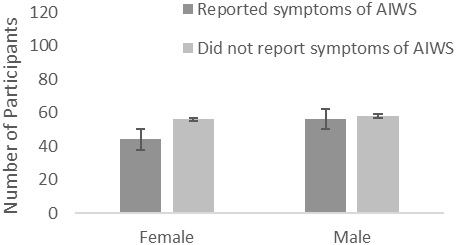


Figure 1: Number of participants who reported having experienced symptoms associated with Alice in Wonderland Syndrome in their childhood compared to number of participants who reported experiencing no symptoms associated with Alice in Wonderland syndrome in their childhood. Shown (a) as the whole sample and (b) between male and female participants. Error bars = standard error.

This difference is most prominent for specific visual symptoms including; inability to appreciate the size of objects, exaggeration of depth and detail of objects, objects appearing rotated, seeing things larger than they are, seeing things smaller than they are and objects appearing smaller and farther away than they are (Figure. 2.a). Such clear observable differences are not when comparing simply between childhood and adulthood (Figure. 2.b).

a

a

b

b

Figure 2. Visual symptoms of Alice in Wonderland Syndrome reported (a) before onset of ASMR and after onset of ASMR, and (b) reported in childhood and adulthood. Error bars = standard error.

When comparing prevalence of non-visual AIWS symptoms, there is an observable increase in prevalence of symptoms from before onset to after onset of ASMR, these include the sensation of floating in the air, time seeming to move slowly, time seeming to move faster and experience of time passing in a way different to reality. (Figure 3.a). Many non-visual symptoms appeared to be more present in adulthood than childhood (Figure. 3.b.).

a

b

Figure 3. Non-visual symptoms of Alice in Wonderland Syndrome reported (a) before onset of ASMR and after onset of ASMR, and (b) reported in childhood and adulthood. Error bars = standard error.

**Number of symptoms of AIWS in childhood is a significant predictor of the age of ASMR onset**

### Visual symptoms of AIWS during childhood

To further establish if there was a significant predictive effect specifically of visual experiences of AIWS on experiences of ASMR, we sought to determine if a correlation was present. A Pearson’s r analysis revealed a significant negative correlation between the number of visual symptoms of AIWS in childhood and the age of onset of ASMR (r=-.143 p=.036).

To determine if experiences of visual symptoms of AIWS in childhood are a predictor of experiences of ASMR, a linear regression analysis was applied. Here the criterion variable was number of reported visual symptoms of AIWS and the predictor variable was reported age of onset of ASMR. All variables entered the regression analysis at the same time. Visual symptoms of AIWS were revealed to be a significant predictor of ASMR age of onset.

The full model significantly predicted ASMR age of onset (F(1,215) = 4.453 p=.036). Specifically, number of visual AIWS symptoms experienced in childhood was revealed to be a significant predictor of ASMR age of onset (β = -.335, t = -2.110 , p =.036). This finding indicates that as the number of visual symptoms of AIWS during childhood increased, the age of ASMR onset decreased i.e. the more visual AIWS symptoms, the earlier the onset of ASMR.

### Non-visual symptoms of AIWS during childhood

To further establish if there was a significant predictive effect specifically of non-visual experiences of AIWS on experiences of ASMR, we sought to determine if a correlation was present. A Pearson’s r analysis revealed no significant correlation between the number of non-visual symptoms of AIWS in childhood and the age of onset of ASMR (r=.011 p=.876).

To determine if experiences of non-visual symptoms of AIWS were a predictor of experiences of ASMR, a linear regression analysis was applied. Here the criterion variable was the number of reported non-visual symptoms of AIWS and the predictor variable was the reported age of onset of ASMR. All variables entered the regression analysis at the same time.

The full model did not significantly predict ASMR age of onset (F(1,216)=.024 p=.876). Specifically, the number of non-visual AIWS symptoms experienced in childhood was revealed not to be a significant predictor of ASMR age of onset (β = .031, t =.156, p =.876). This finding indicates that non-visual symptoms of AIWS experienced in childhood do not significantly predict the age of onset of ASMR.

Taken together, these linear regression analyses show that visual symptoms associated with AIWS in childhood have a significant relationship with ASMR onset, whereas non-visual symptoms associated with AIWS do not.

# Discussion

The present study aimed to establish if there is an observable link between neurophysiological experiences associated with AIWS and those associated with ASMR. We sought to establish if there is a possibility that AIWS and ASMR are elements of the same entity, or if one is a product of the other. Our findings support our hypothesis in that there does appear to be an observable correlation between experiences of AIWS in childhood and experiencing ASMR in adulthood.

One of the most striking observations arising from the present study is the very high prevalence of AIWS symptoms reported by participants (43%), who all experienced ASMR, in comparison to the much lower prevalence of AWIS (1.3 – 6.2%) thought to exist in the general population (Abe et al, 1989; Lipsanen et al, 1999) and in the population who experience migraine (15%) (Restak, 2006). We revealed a strikingly high number of individually reported AIWS symptoms in this study’s population. This is in comparison to the commonly observed 1 – 4 symptoms described by Blom (2016) in the general population, as well as those with migraine. Blom (2016) proposed a possible stochastic process, whereby the presence of one symptom of AIWS lowers the threshold for an additional symptom to be experienced. Our findings support this theory, perhaps also indicating that ASMR symptoms follow the same trend. Based on Blom’s theory, commonality in the presence of AIWS and ASMR might indicate that AIWS symptom presence also lowers the threshold for the manifestation of ASMR symptoms.

Previous studies into the symptoms described in AIWS and ASMR (Andersen, 2014; Fredborg, Clark & Smith, 2017; Blom, 2016) suggested a level of comorbidity. The present study is the first to explicitly investigate the presence of both phenomena in the same study group, thus identifying previously undescribed relationships between the two phenomena.

Until now, the potential causality and developmental outcomes of AIWS and ASMR have remained unknown. The findings presented here provide important evidence to indicate a possible relationship between two entities that were previously thought to be independent. Based on the predictive relationship between AIWS and ASMR that we have outlined here, it is reasonable to suggest that the experiences we describe as part of AIWS typically in early childhood and as ASMR later in childhood and adulthood, are part of the same protective neurophysiological process. Perhaps they are different stages in the development of the same response.

The findings of the present study identified a predictive relationship between visual symptoms of AIWS in childhood and the age of ASMR onset. Specifically, we established that participants who reported more visual symptoms of AIWS in childhood had an earlier onset of ASMR. Interestingly, this was not the case for non-visual symptoms of AIWS, where no significant predictive relationship was found. This finding offers evidence to support suggestions that ASMR is a neuroprotective mechanism, perhaps in this case to overcome or cope with debilitating visual symptoms. The findings of the present study provide an important basis on which to expand our currently limited understanding of AIWS and ASMR, two little investigated neurophysiological phenomena.

**Author Information**

Stacey A. Bedwell, Department of Psychology, Curzon Building, Birmingham City University, Cardigan St, Birmingham, B4 7BD. stacey.bedwell@bcu.ac.uk

Isabelle Butcher, Division of Psychology and Mental Health, Zochonis Building University of Manchester, Brunswick St, Manchester, M13 9PL. isabelle.butcher-2@postgrad.manchester.ac.uk

# References

Abe, K., Oda, N., Araki, R., & Igata, M. (1989). Macropsia, micropsia, and episodic illusions in Japanese adolescents. J Am Acad Child Adolesc Psychiatry, 28, 493–496.

Andersen, J. (2014). Now you’ve Got the Shiveries: Affect, Intimacy, and the ASMR Whisper Community. Television & New Media, 16(8), 683-700.

Barratt, E. L., & Davis, N. J. (2015). Autonomous Sensory Meridian Response (ASMR): a flow-like mental state. PeerJ, 3, e851.

Bell, V., Halligan, P.W., & Ellis, H.D. (2006). The Cardiff Anomalous Perceptions Scale (Caps): A New Validated Measure Of Anomalous Perceptual Experience. Schizophrenia Bulletin, 32(2), 366-377.

Blom, J. (2016). Alice in Wonderland Syndrome. A systematic review. Neurology Clinical Practice. 6 (3).

Ditchburn, T.A., & Bedwell, S.A. (2019). Autonomous sensory meridian response: An ineffective long-term therapeutic intervention. PsyPAG Quarterly, 110, 19 – 24.

Chang, Y., Gratiot, M., Owen J. P., Brandes-Aitken, A., Desai, S., Hill, S.S., Arnett, A.B., Harris, J., Marco, E.J., Mukherjee, P. (2016). White Matter Microstructure is Associated with Auditory and Tactile Processing in Children with and without Sensory Processing Disorder. Frontiers in Neuroanatomy, 9, 169.Fredborg, B., Clark, J. & Smith, S. D. (2017). An examination of Personality Traits Associated with Autonomous Sensory Meridian Response (ASMR). Frontiers in Psychology, 8, 247.

Lipsanen, T., Lauerma, H., Peltola, P., & Kallio, S. (1999). Visual distortions and dissociation. J Nerv Ment Dis, 187, 109–112.

Mastria, G., Mancini, V., Vigano, A. & Di Piero, V. (2016). Alice in Wonderland Syndrome: A Clinical and Pathophysiological Review. BioMed Research International. Article ID 8243145.

Poerio, G. L., Blakey, E., Hostler, T. J., & Veltri, T. (2018). More than a feeling: Autonomous sensory meridian response (ASMR) is characterized by reliable changes in affect and physiology. PloS one, 13(6).

Restak, R. (2006). Alice in Migraineland. Headache, The Journal of Head and Face Pain, 46, 306–311.

Spooner, C. G. (2006). New-onset temporal lobe epilepsy in children: lesion on MRI predicts poor seizure outcome. Neurology, 67(12), 2147-2153.

Smith, S. D., Fredborg, B. K., & Komelsen, J. (2016). An examination of the default mode network in individuals with autonomous sensory meridian response (ASMR). Social Neuroscience, 12(4); 361-365.