

## Introduction

- Many Autistic people have specific difficulties recalling personally experienced past events (episodic memory; EM).
- Memory difficulties also include thinking about oneself in the future (episodic future thinking; EFT) and remembering to perform an intended action, at an appropriate future occasion (prospective memory; PM).
- A core component of PM, EM and EFT is the ability to mentally visualise oneself in relation to past or future potential events.
- Mental visual imagery occurs on a spectrum from 'minimal to no mental visual content' (Aphantasia) to 'high clarity of vivid imagery' (Hyperphantasia).
- Aphantasia occurs in approximately 2% of the general population and is thought to be a key factor in EM and EFT difficulties in the general population.<sup>1</sup>
- We investigated whether autistic people experience more general difficulties in creating vivid mental imagery (Aphantasia) and if this was related to EM and EFT difficulties. A study by Crane et al. (2012) found no differences between autistic and non-autistic adults overall, but reported that autistic adults generated more Specific Episodic Memories (compared to Future Thinking) events, and more Semantic Associates for Future Thinking (compared to Episodic Memories).<sup>2</sup>
- To our knowledge, this is the first study of Aphantasia in autism.

## Methods

### Participants

- 98 Autistic diagnosed and self-identifying (AS) adults and 93 non-autistic (NT) adults (total n=193) completed the online study. (Table 1)
- Participant gender at birth and gender identity preferences were recorded.

Table 1. Participant characteristics

Measure	AS (n=98) Mean (SD)	NT (n=93) Mean (SD)	Statistics	Sig. (p)
Gender identity (F:M:NB) <sup>a</sup>	49:46:2	50:44:1	$\chi^2(3) 1.34$	n.s.
Age (years)	36.34 (12.78)	41.69 (15.71)	$t(191) 2.60$	.01
Autistic traits RAADS <sup>b</sup>				
Total	28.66 (7.29)	11.75 (8.95)	$t(191) -14.42$	<.001
Mentalizing	14.97 (4.04)	5.04 (5.62)	$t(191) -14.12$	<.001
Social Anxiety	7.89 (2.32)	4.73 (2.23)	$t(191) -9.64$	<.001
Sensory Reactivity	5.81 (2.32)	1.98 (2.48)	$t(191) -11.07$	<.001

Notes: a. Gender identity preferences reported by autistic and non-autistic participants were either Female (F), Male (M), or Non-Binary. One autistic participant did not disclose their gender identity.

b. RAADS scores are calculated for: Total (0-42), Mentalizing (0-21), Social anxiety (0-12), Sensory reactivity (0-9). Higher scores indicated greater autism-related difficulties.

### Materials and Procedures

Participants completed a series of online questionnaires for self-rated assessments of:

- **Autistic Traits:** Ritvo Autism and Asperger's Diagnostic Scale-14 items (RAADS-14).<sup>3</sup>
- **Aphantasia:** Vividness and Visual Imagery Questionnaire (VVIQ).<sup>4</sup>
- **Episodic Memory:** Sentence Completion of Events from the Past Test (SCEPT).<sup>5</sup>
- **Episodic Future Thinking:** Sentence Completion of Events from the Future Test (SCEFT).<sup>6</sup>
- A pre-defined coding scheme was used to code EM and EFT content. <sup>2,5,6</sup>. (Table 2)

Table 2. Coding scheme for Episodic Memory (SCEPT) and Episodic Future Thinking (SCEFT)

Abbreviation	Category	Description
S	Specific	A single event (past or future) that happened (or will happen) on one particular day, e.g., "I went to my first ever concert, to see the band The Limehouse Magnets".
GE	General Extended	A single event that lasts for longer than one day, e.g., "going on holiday"; or a period of their life, e.g., "weekends at grandma's house".
GC	General Categorical	Repeated events or merging of similar events. Something that required effort on more than one occasion, e.g., "studying for exams" or "playing football in high school".
SA	Semantic Associates	A memory or future thought that is not a particular event, but is a non-specific statement of information about something, e.g., "I remember my first car" (past), e.g., "I can picture my house" (future).
C	Continuous	A memory or future thought that is a continued from a previous word stem.
O	Omission	Failed to generate an event.

## Results

Since autism diagnoses could not be verified online, Multivariate Analyses of Variance were carried out first with, then without self-identifying autistic adults in the AS group. Results held true in all analyses. Thus, results presented below include all participants.

### Autistic traits

- As would be expected, RAADS-14 scores for autistic traits were higher in autistic compared to non-autistic adults (all  $p < .001$ ). (Table 1)

### Visualisation

- In both groups, the majority of participants were in the average phantasia range (score 24-79; AS 93.88%; NT 95.78%). (Table 3)
- For the factors of interest, the autistic group generated fewer vivid mental images on the VVIQ, compared to non-autistic adults ( $p < .02$ ). (Table 3)
- 5.1% of autistic adults showed Aphantasia profiles (score 0-80), ranging from moderate (score 17-23; 3.06%) to extreme aphantasia (0-16; 2.04%), suggesting somewhat elevated levels of Aphantasia, compared to non-autistic adults ( $p < .02$ ).<sup>5</sup>

### Episodic Memory and Episodic Future Thinking

- Both autistic and non-autistic adults generated fewer **Specific** events for Episodic Memory and Future Thinking compared to other types of memories. (Figure 1)
- Autistic adults generated fewer **Specific** and **Categorical** events for both Episodic Memory and Future Thinking compared to non-autistic adults (all  $p < .05$ ). (Figure 1)

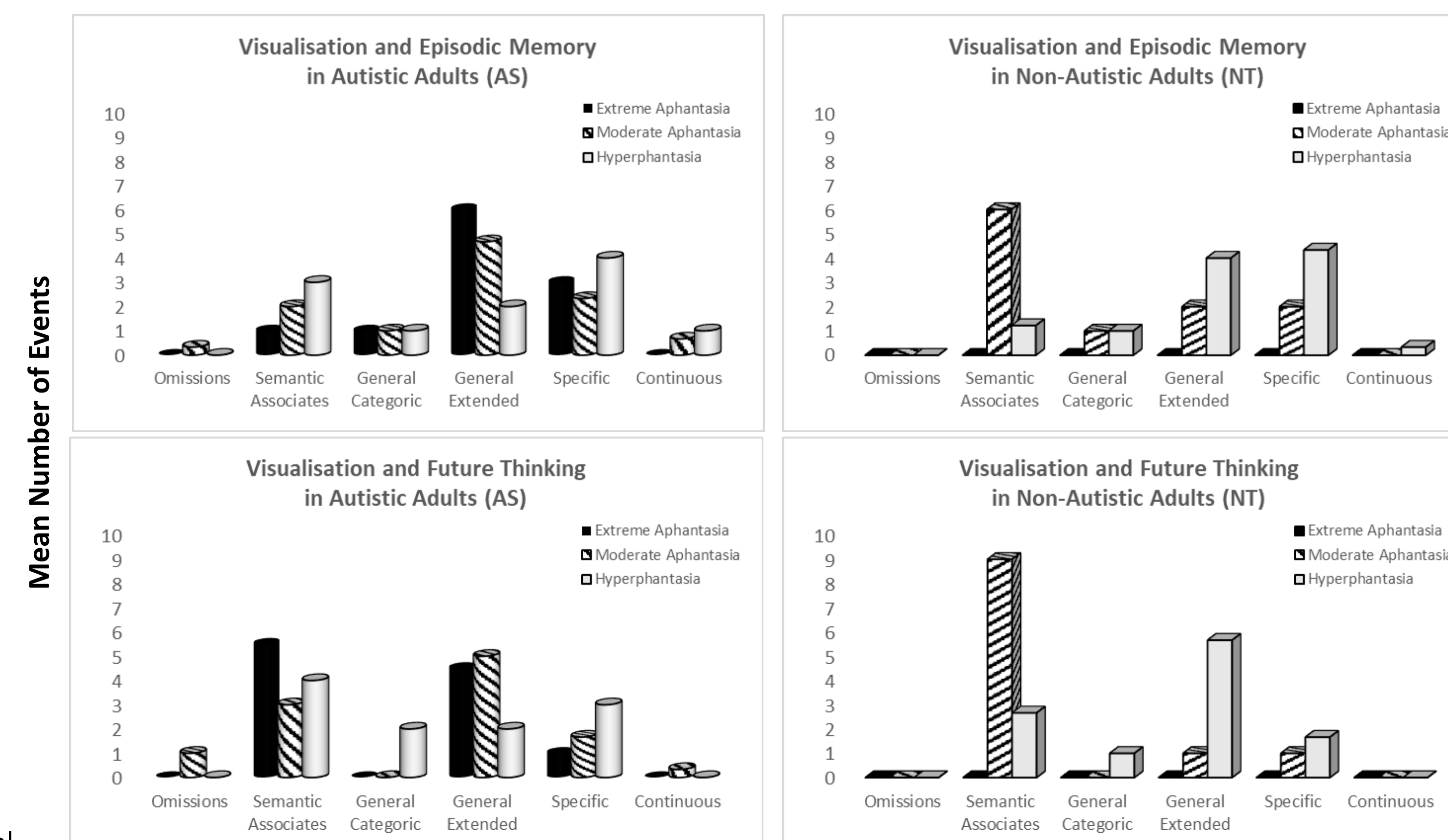


Figure 1. Diagnostic Group Visualisation related to Episodic Memory and Future Thinking

- Overall, AS adults had greater difficulties generating Future Thinking events compared to Episodic Memories. They also made significantly more **Omissions** and **Continuous** examples (instead of unique events) than NT adults.
- Correlation analyses of Autistic traits and Aphantasia sub-groups showed that **Mentalizing** difficulties were related to greater **Visualisation** difficulties ( $r = -.30, p < .001$ ), and fewer **Specific** Episodic Memories ( $r = -.17, p < .03$ ), but not Future Thinking ( $r = -.12, p > .05$ ).
- Visualisation ability for NT adults predicted more **Specific** and **General Extended Episodic Memories**; for AS adults it predicted more **General Extended Episodic Memories** and **General Categorical Future Thinking** events. (Figure 2)

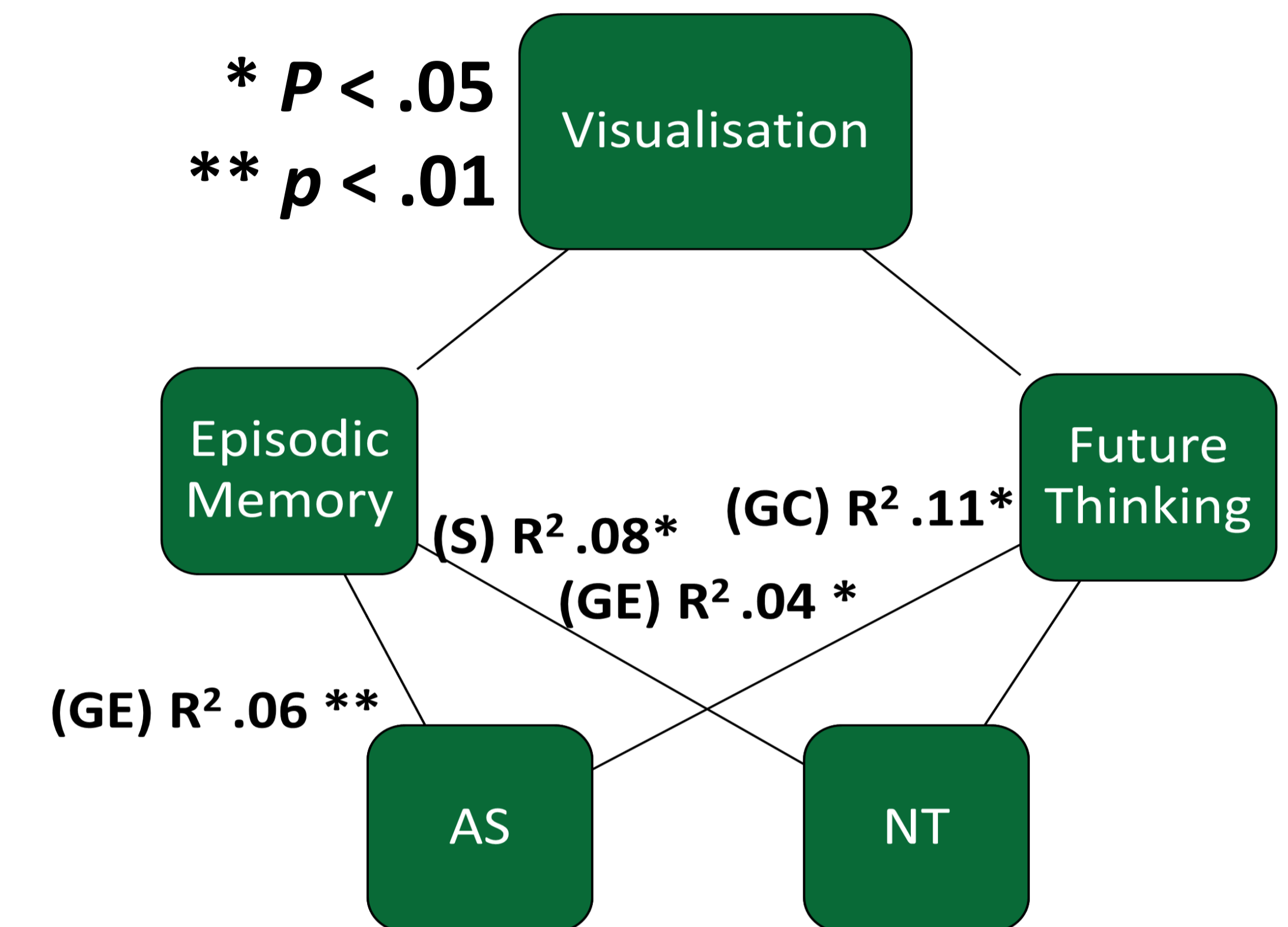


Figure 2. Diagnostic Group Visualisation as predictors of Episodic Memory and Future Thinking

## Conclusions

- This is the first study of Aphantasia and its association with Episodic Memory and Future Thinking in autistic adults.
- The findings show that autistic adults have a slightly elevated level of Aphantasia compared to non-autistic study participants and compared to the general population.<sup>7</sup>
- Lower level Visualisation of mental images (Aphantasia) was related to greater autistic Mentalizing difficulties.
- Our study partially replicated the findings of Crane et al. (2012)<sup>2</sup>. Similarly, we observed that autistic adults generated more Specific Episodic Memories (compared to Future Thinking) events, and more Semantic Associates for Future Thinking (compared to Episodic Memories). However, autistic adults in our study made more Omissions and fewer Episodic Memories and Future Thinking events compared to non-autistic adults.
- Visualisation (Aphantasia) but not Mentalizing difficulties for autistic adults were related to fewer Future Thinking events than Episodic Memories.
- The medium to large effect sizes support the strength of these findings in a community-based sample of autistic adults who experience specific memory difficulties.
- These findings offer promising insights to the pattern of cognitive variability in autistic adults to inform future targeted interventions to support everyday remembering.

## References

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