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Running Title: How adults with ID perform on the VAT

**An exploratory study investigating how adults with intellectual disabilities
perform on the Visual Association Test (VAT)**

McPaul, Ann, Walker, Brigid, Law, Jim and McKenzie, Karen

ABSTRACT

Background: Neuropsychological tests of memory are believed to offer the greatest sensitivity at identifying people at risk of developing dementia. There is a paucity of standardised and appropriate neuropsychological assessments of memory for adults with an intellectual disability (ID). This study examines how adults with an ID perform on the Visual Association Test (VAT).

Methods: Forty participants (18-45 years) with ID, without a diagnosis of dementia, completed the VAT and subtests of the CAMCOG-DS. Correlational analysis of the test variables was carried out.

Results: All participants performed well on the VAT irrespective of age, gender or IQ. No significant correlations were found between the VAT and the subtests of the CAMCOG-DS.

Conclusions: The VAT was found to be an easy and quick test to use with people with ID and all participants scored above 'floor' level.

Keywords: intellectual disabilities, memory, neuropsychological test, Visual Association Test, dementia.

Introduction

Alzheimer's disease (AD) is the most common cause of dementia in people with an intellectual disability (ID) (e.g. Strydom *et al.* 2007). People with ID also have an increased risk of acquiring AD as they age, compared to the general population (British Psychological Society & Royal College of Psychiatrists 2015). People with Down syndrome (DS), in particular, have an increased risk of acquiring AD early in life (e.g. Tyrell *et al.* 2001); some 30-40 years earlier than the general adult population (e.g. Holland *et al.* 1998).

Neuropsychological assessment is increasingly being recognised as having a crucial role, especially in the early identification of cognitive decline associated with AD (National Institute for Clinical Excellence 2006; Scottish Intercollegiate Guidelines Network 2006). There are a wide range of tests available for use in the general population (see Lezak *et al.* 2004). There is, however, a paucity of neuropsychological assessments which are validated, standardised and appropriate for application with people with ID (Masson *et al.* 2010).

Neuropsychological assessments developed for use in the general population may be too complex for people with ID which can result in 'floor effects' (Crayton *et al.* 1998). This means it can be difficult to differentiate between changes in cognitive ability associated with the onset of AD from those attributable to the ID. In addition, co-morbid health conditions, such as depression, epilepsy, and hyperthyroidism, are

common in people with ID and can mimic the presence of AD or confound the test results (e.g. Burt *et al.* 1992; Das *et al.* 1995a; Devenny *et al.* 1996; Hanney *et al.* 2009).

To overcome these difficulties, working groups have suggested that a standardised battery of tests should be employed longitudinally to assess dementia (Burt & Aylward 2000). In recent years, there has been increasing interest in exploring which tests can be reliably used to assess changes in functioning over time (see Prasher 2009 for a review). Neuropsychological assessments used with the general adult population have been modified for use with people with ID, for example, the Cambridge Cognitive Examination (CAMCOG-DS; Ball *et al.* 2006) and the Test for Severe Impairment (Albert & Cohen 1992). However, more research is needed to validate a range of assessments that assess different areas of cognitive functioning (e.g. executive functioning or different areas of memory functioning such as episodic memory).

In AD, one of the early signs is a deterioration in episodic memory (Buschke *et al.* 1997; Fuchs *et al.* 2012). This is typically assessed using a cued recall task, which provides a cue at the time of encoding to aid retrieval of the target information (Lezak 2004). One such assessment is the Visual Association Test (VAT) (Lindeboom *et al.* 2002). It has shown to be a useful assessment for detecting early stage AD in the older adult population and it has also shown sensitivity and specificity over other tests of recognition (Fuchs *et al.* 2012). It can discriminate those with AD from depressed and healthy individuals (Dierckx *et al.* 2007). Furthermore, studies have shown relationships with the VAT and hippocampal functioning (e.g. Henneman *et al.* 2009)

which is the location of the initial onset of AD pathology. The VAT is easy to administer, simple, quick to complete and ‘it is not confounded by age, education or depression’ (Lindeboom *et al.* 2002, pp. 132) and does not rely heavily on language ability. Thus, it may be appropriate for use with adults with ID.

Within the general population the VAT has shown to correlate with the Cambridge Cognitive Examination (CAMCOG) (Lindeboom *et al.* 2002), which is a neuropsychological test battery used to aid the assessment of dementia (e.g. Huppert *et al.* 1996). Specifically, the VAT corresponded with memory items (e.g. recognition) in the CAMCOG and thus, demonstrated convergent validity.

The aim of this exploratory study was to examine whether the VAT may be a suitable measure for use with adults with ID. That is, if adults are able to score above the ‘floor’ of the test and perform similarly to the general population, who typically perform near the ceiling of the test. A secondary aim was to examine whether performance was influenced by IQ. A third aim was to examine whether the VAT correlated with other measures of memory.

Method

Participants

The participants were 40 adults (21 Males; 19 Females) aged between 18 to 44 years (mean age = 31.08 years; SD = 8.075) with mild-moderate ID (mean Full Scale IQ (FSIQ) = 59.10, SD = 7.57; range = 46-73). The participants had mixed aetiology.

Recruitment

In order to be eligible for inclusion, all potential participants had to be between 18 and 45 years of age, fluent in English and able to provide consent. Potential participants were excluded if they had significant visual or hearing impairments, a diagnosis of dementia or significant personality and behavioural problems.

Participants were recruited via health professionals from Community Learning Disability Teams based in the north of Scotland. Those who were interested in participating were subsequently contacted by the researcher, who provided further accessible information about the study. Consent was gathered by means of a written consent form which was witnessed by their clinician or relative to ensure consent was acquired appropriately. The study was granted approval from the south east of Scotland Research Ethics Committee.

Measures

The following measures were completed:-

1. Visual Association Test

The VAT (Lindeboom et al. 2002) is a test of visual associative memory. For the first part of the test, six cards with two interacting objects are shown and the person is asked to name both objects. Immediately following this, six cards with only one of the interacting objects is shown and the person is asked to say which object is missing. The pictures were shown in the same order for both trials. This version of the test, Form A, is considered suitable for adults aged 65 years and over.

The VAT is a valid and reliable test used within the general population with an internal consistency of 0.84 on the first trial and 0.86 for those who completed two trials on Form A, according to Cronbach's alpha (Lindeboom & Schmand 2003). Its validity has been replicated by others (e.g. Diercks *et al.* 2007; Henneman *et al.* 2009; Kulansky *et al.* 2002).

2. Cambridge Cognitive Examination adapted for people with Down Syndrome and Intellectual Disabilities

The CAMCOG-DS is the neuropsychological section of the CAMDEX-DS (Ball *et al.*, 2006) which has been adapted for use with people with DS and ID. Only the picture recall and picture recognition subtests were administered. These provide a measure of visual incidental learning and have been shown to correlate with the VAT

in the general population (Lindeboom *et al.* 2002). Although validity for the CAMCOG-DS has not yet been established, the CAMCOG has been shown to be reliable and has excellent internal reliability. Cronbach's alpha was 0.82 and 0.89 in different samples (Holland & Ball 2009).

3. Intellectual Functioning

The Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV; Wechsler 2008) was used to assess whether VAT performance was dependent on the level of intellectual ability.

Twenty-two individuals completed the WAIS-IV during the study. The WAIS-IV data of the other 18 participants was taken from their clinical files with their consent. Where participants had been assessed using the WAIS-IV in the previous three years, these scores were used.

Procedure

All participants were administered the neuropsychological tests in the same order: (1) VAT; (2) WAIS-IV (if not previously completed) and (3) Sub-tests from CAMCOG-DS. If the WAIS-IV was not completed a break of 20 minutes between the administration of the VAT and the CAMCOG-DS was provided to reduce the likelihood of participants confusing the test items. Testing lasted between 30 minutes and two hours and breaks were also provided. A second appointment was provided for individuals completing the WAIS-IV.

Data Analysis

Data was screened to assess for normality, homogeneity of variance, skew and kurtosis to ensure agreement with statistical assumptions. Violations of normality were found for the VAT, CAMCOG-DS and WAIS-IV and, as a result, non-parametric analyses were used. The raw scores of tests were used and a conservative p-value of .01 was applied to control for multiple analyses (Field 2009).

Results

Descriptive Data

Table 1 presents the participants' scores on all the neuropsychological tests and the mean and median score and standard deviation.

Table 1. Means and Standard Deviations of Test Scores (n=40).

As can be seen from Table 1, all participants scored above the 'floor' of the VAT.

In the current study, Cronbach's alpha was 0.27 for the first trial and 0.59 for the two trials of the VAT. An acceptable value of alpha is above .7 (see, Pallant 2010). In terms of the CAMCOG, the recall subtest suggested an acceptable internal consistence, with a Cronbach alpha coefficient of .723. The recognition subtest showed poorer internal consistency of .515.

Table 2. Distribution (in %) in Memory Test scores (n=40)

As can be seen from Table 2, 25 per cent of participants scored at the 'floor' of the recall subtest of the CAMCOG-DS. Furthermore, 22.5 per cent of participants scored 1 on this test.

No significant relationship was found between performance on the VAT Trial 1 and picture recall ($T=0.109$, $p=.431$) or between VAT Trial 1 and picture recognition

($T=0.157$, $p=.305$). No significant correlations were found between the VAT Trial 1 and FSIQ ($T=0.180$, $p=.168$), VAT Trial 1 and age ($T= -0.30$, $p=.816$); and there were no significant difference between males and females on the VAT Trial 1 ($U=173.5$, $z= -.931$, $p=0.352$).

The performance of the nine participants who scored less than full marks on Trial 1 and Trial 2 of the VAT were examined descriptively.

Table 3. Incorrect Responses on Object Pairs on Trial 1 and Trial 2 of the VAT.

As is shown in the Table 3, participants who incorrectly responded to the cue on Trial 1 appeared to have most difficulty with the object pair four and object-pair six, although, these scores improved at Trial 2.

Discussion

The study examined how 40 adults with mild to moderate intellectual disabilities performed on the VAT. The results showed that all participants were able to score above the 'floor' of the test. There were no significant correlations between the VAT and the CAMCOG-DS recall or recognition subtests. Additionally, performance on the VAT was not affected by age, FSIQ or gender.

According to Lindeboom and Schmand (2008), the VAT has good internal consistency, with a Cronbach alpha coefficient reported of 0.84 on the first trial and 0.86 for the two trials. However, in the current study, the Cronbach's alpha coefficient was 0.27 for the first trial and 0.59 for the two trials of the VAT, which indicates poor internal consistency. In terms of the CAMCOG-DS, the recall subtest suggested an acceptable internal consistency, with a Cronbach alpha coefficient of .723. The recognition subtest showed poorer internal consistency of .515. The results may have been due to the small sample size, the sensitivity of Cronbach's alpha to the number of items in the scale (Pallant 2010) or that the test is not reliable for this particular ID sample. Further research is needed to clarify this, before the test is used within clinical practice.

The CAMCOG-DS is listed as a suggested tool according to the new dementia guidelines for adults with intellectual disabilities (BPS & RCP, 2015). However, many participants performed at the 'floor' or near the floor of the recall subtest which questions how useful this measure is as a prospective measure of memory in this group. Nevertheless, the participants scored better on the recognition subtest. As

mentioned previously, it is well established that people with ID find recall tests more difficult than recognition tests (e.g. Jarrold *et al.* 2007). Additionally, recall tasks require more cognitive demand than recognition tasks. Descriptively participants performed similarly on the VAT and recognition subtest, with 75 per cent of participants obtaining a score of six on recognition and obtaining a score of six on the VAT. This is consistent with evidence from the general adult population and lends weight to the VAT being at the level of recognition, as it involves a cue at the time of encoding (Lindeboom *et al.* 2002). In other samples in the general population, the VAT has shown more sensitivity and specificity to other tests of recognition, including the CAMCOG (Fuchs *et al.* 2012). However, further research is needed to examine whether this is the case in people with ID.

Another area for examination is the potential “ceiling” effect of the VAT and the CAMCOG-DS recognition subtests which may not allow for any early change in cognitive decline to be identified. The VAT has been shown to be sensitive to the early changes of AD in the general population whilst people with intact memory functioning performing at or near the ceiling of the VAT (Lindeboom *et al.* 2002). However, further research is needed to examine whether both the VAT and the CAMCOG-DS are sensitive to the early changes in memory associated with AD in people with ID.

As indicated in the results section, nine out of the 40 participants did not achieve full marks on the VAT. Further examination of data revealed that the participants appeared to have the most difficulty with object-pair four and six. However, given the small numbers, little can be deduced from this. Further research will be needed to examine whether this is the case in a larger sample of people with ID as this may indicate further adaptation of the VAT assessment may be required for use in this population.

The results of the study must be viewed in the context of its limitations, in particular the relatively small sample size which potentially impacted on statistical power. In addition, the variety of genetic conditions in the participant sample meant that the group was not homogenous and thus, the study is unable to provide performance norms for a specific group. While no relationship was found between performance on the VAT and age, gender and FSIQ, the study did not control for other factors that have previously been found to confound test results, such as health conditions (e.g. Burt *et al.* 1992; Das *et al.* 1995; Devenny *et al.* 1996; Hanney *et al.* 2009). It would have been helpful to collect re-test data using the VAT, however, this was out with the scope of this study. The test therefore should be used with caution until further research has been carried out.

It would be helpful if future research could examine VAT performance in a sample of older adults to see whether VAT performance is affected by age and IQ. Future research could then examine VAT performance prospectively in line with RCP and

BPS guidelines (2015) whilst exploring how it correlates with other recommended measures for assessing dementia.

Conclusion

The study found that the majority of participants with ID scored highly on the VAT and that performance was not affected by FSIQ, age or gender. Further research is needed to determine if the VAT represents a useful assessment tool with this population by investigating its reliability and validity in a larger sample.

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Appendix

Table 1. Means and Standard Deviations of Test Scores (n=40).

Test		<i>Mean</i>	<i>SD</i>	<i>Range</i>	<i>Median</i>	<i>Max Score</i>
VAT	Trial 1	5.7	0.62	(4-6)	6	6
	Trial 2	5.9	0.38	(4-6)	6	6
	Total 2 trials	11.6	0.90	(8-12)	12	12
CAMCOG-DS	Picture recall	2.12	1.81	(0-6)	2	6
	Picture recognition	5.65	0.74	(4-6)	6	6
WAIS-IV	FSIQ	59.45	7.66	(46-73)	59	160

Table 2. Distribution (in %) in Memory Test scores (n=40)

Test score	0	1	2	3	4	5	6
CAMCOG-DS picture recall	25.0	22.5	10.0	15.0	12.5	15.0	0.0
CAMCOG-DS picture recognition	0.0	0.0	0.0	5.0	0.0	20.0	75.0
VAT (1 trial)	0.0	0.0	0.0	0.0	7.5	17.5	75.0

Table 3. Incorrect Responses on Object Pairs on Trial 1 and Trial 2 of the VAT.

<u><i>Object Pair</i></u>	<u><i>Trial 1</i></u>	<u><i>Trial 2</i></u>
<u>1</u>	<u>0</u>	<u>0</u>
<u>2</u>	<u>2</u>	<u>1</u>
<u>3</u>	<u>0</u>	<u>0</u>
<u>4</u>	<u>4</u>	<u>0</u>

<u>5</u>	<u>2</u>	<u>1</u>
<u>6</u>	<u>5</u>	<u>2</u>