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Awareness of memory task impairment versus everyday memory difficulties in dementia

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The study investigated different types of awareness of memory dysfunction in dementia, specifically judgements concerning memory task performance or appraisal of everyday memory functioning and also exploring the neuropsychological correlates of such awareness. This was investigated in 76 people with dementia, comprising 46 patients with Alzheimer's disease (AD) and 30 patients with vascular dementia (VaD). The Memory Awareness Rating Scale (Clare *et al.*, 2002, *Neuropsychol Rehabil*, 12, 341–362) was used, which includes an Objective-Judgement Discrepancy (OJD) technique involving comparison of subjective evaluation of performance on specific memory tasks with actual performance, and a Subjective Rating Discrepancy (SRD) technique, which compares self versus informant judgement of everyday memory function. The AD and VaD groups showed lower awareness than a normal control group for both types of measures, the AD group showing less awareness than the VaD group on the OJD measure. Regression analyses supported associations for both groups between memory impairment and the OJD measure and between naming impairment and the SRD measure. The findings are discussed in terms of neurocognitive theories accounting for loss of awareness in dementia.

Loss of 'awareness' of neuropsychological impairment is common in the two most frequently occurring forms of dementia, Alzheimer's disease (AD; Morris & Hannesdottir, 2004) and vascular dementia (VaD; Chan, Lim, & Sahadevan, 2008). An understanding of the neurocognitive mechanisms that result in this loss of awareness in dementia is incomplete, but it has been shown to be linked with deficits in neuropsychological functions (Morris & Hannesdottir, 2004), behavioural disturbance (Tamietto, Corazzini, Castelli, & Geminiani, 2004), loss of social cognitive function (Nelis *et al.*, 2011), and reduction in activities of daily living (Martyr *et al.*, 2012).

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The specificity of awareness deficit found in people with particular types of neuropsychological impairments indicates that loss of awareness has a strong neurobiological component (Prigatano, 2010; see also Clare, Marková, Roth, & Morris, 2011; and Clare *et al.*, 2012 for psychosocial aspects), and investigations have been conducted to ascertain specific neuropsychological correlates. In AD, there is evidence for associations with memory loss (Feher, Mahurin, Inbody, Crook, & Pirozzolo, 1991; Hannesdottir & Morris, 2007; Reed, Jagust, & Coulter, 1993; but see for example, DeBettignies, Mahurin, & Pirozzolo, 1990; McGlynn & Kaszniak, 1991), and impairments in language (Migliorelli *et al.*, 1995; Sevush & Leve, 1993; Starkstein, Fedoroff, Price, Leiguarda, & Robinson, 1993) and executive functioning (Auchus, Goldstein, Green, & Green, 1994; Hannesdottir & Morris, 2007; Lopez, Becker, Somsak, Dew, & DeKosky, 1994; Mangone *et al.*, 1991; Michon, Deweer, Pillon, Agid, & Dubois, 1994; Starkstein *et al.*, 1993). These associations, however, have not been consistently found, and a number of possible explanations have been put forward. One possibility is that awareness of neuropsychological impairment is not a unitary construct and the different measures of measurement might tap into different supporting processes (Agnew & Morris, 1998; Hannesdottir & Morris, 2007; Nelson & Narens, 1990). This includes, for example, whether a performance-based measure or a questionnaire about aspects of everyday functioning is used to ascertain awareness, and what modality of awareness is assessed. A second explanation is that the neurocognitive basis for loss of awareness of deficit may vary between different types of dementia, depending on which cognitive systems are predominantly affected.

To address these issues, the present study measured awareness of memory impairment comparing two main types of measurement techniques, namely Objective-Judgement Discrepancy (OJD) and Subjective Rating Discrepancy (SRD), investigating both AD and VaD. The OJD technique measures the difference between performance on neuropsychological tests and the person's subsequent immediate rating of the performance, with the extent to which performance is overestimated indicating loss of awareness. The SRD technique involves self-rating of everyday memory functioning, contrasting this with a similar rating by an informant, the difference again providing an awareness measure. These types of measures can be contrasted in terms of the cognitive processes they invoke (Hannesdottir & Morris, 2007). Specifically, the OJD tests ability to monitor task performance to detect and appraise impairment, but also to remember the level of performance just long enough to allow a judgement to be made after the task is completed, producing a transient response to task failure. An OJD judgement might be more closely related to monitoring of memory performance, associated with 'online' cognitive processes such as immediate memory function. In contrast, the SRD technique measures knowledge of everyday failure that must be consolidated and later recalled, revising the appraisal of self-efficacy. This then determines the more general answers that a person with dementia gives to questions about his/her everyday memory ability. Hence, such measurement may reflect the development of awareness over an extended period in which the acquisition of personal semantic information plays a more important role, including incorporation into self-knowledge (Hannesdottir & Morris, 2007; Mograbi, Brown, & Morris, 2009; Morris & Hannesdottir, 2004; Morris & Mograbi, 2013; Souchay, 2007). It may, for instance, rely on the integrity of long-term mnemonic processes (over weeks, months, or years) to form a more stable/more enduring appraisal of memory ability, but it also may depend on the ability to process semantic material, including relying more on language processing (Morris & Mograbi, 2013). This type of dissociation provides a rationale for exploring the two types of measures of awareness in a parallel fashion.

Furthermore, in this study, we compared loss of awareness in two main dementia types, namely AD and VaD. Previous studies have shown, variously, that loss of awareness is either more severe or more common in AD (Danielczyk, 1983; DeBettignies *et al.*, 1990; Moretti, Torre, Antonello, & Cazzato, 2006) or less severe (Chan *et al.*, 2008; Starkstein *et al.*, 1996), while some studies suggest equal levels of impairment in the two forms of dementia (Verhey, Rozendaal, Ponds, & Jolles, 1993; Zanetti *et al.*, 1999). Nevertheless, most previous studies have either used a single questionnaire method or based their assessment of awareness on clinician ratings following a brief interview. This study extends investigation in this area by comparing these two main categories of dementia and utilizing two principal methods for exploring awareness.

Method

Participants

The participants were 76 individuals with dementia, comprising two groups: (1) Forty-six participants with probable or possible AD; and (2) Thirty participants with a diagnosis of either multi-infarct or subcortical VaD, both groups diagnosed according to ICD-10 criteria (World Health Organisation, 1992). Participants with dementia were recruited from National Health Service Memory Clinics in North Wales, United Kingdom, and following Ethical Committee approval. For the purposes of this study, those with a diagnosis of combined probable AD and VaD were excluded. The participants had Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) scores of 18 and above (approximately 18 and above is considered the mild range). In this sample, they were all over the age of 65 years, fluent in English, and with adequate eyesight and hearing. They had no history of other neurological disorder or brain injury and no current major psychiatric disorder. They also had to have an available carer, spouse, partner, friend, or other family member who could rate their functioning as part of the measurement of awareness.

The participants were recruited through memory clinics specializing in the diagnosis of dementia, and the study formed part of the Memory Impairment and Dementia Awareness Study (Clare *et al.*, 2012, 2013). The demographic characteristics of the two groups are provided in Table 1. The groups were matched on age ($t(75) = -1.41$, $p = .14$), social class (stratified from 1 to 5 using employment or partner employment categorization/Office for National Statistics (ONS), 2005; $\text{Chi-Square} = 1.45$ ($df = 75$), $p = .29$), and premorbid intelligence ($t(75) = -1.71$, $p = .091$), the latter assessed using the National Adult Reading Test-Revised (NART-R; Nelson & Willison, 1991).

Table 1. Age, socio-economic grouping, NART-R predicted Full Scale IQ, gender, and MMSE scores of participants with Alzheimer's disease or vascular dementia

	Alzheimer's disease ($n = 46$)	Vascular dementia ($n = 30$)
Age (years)	79.2 \pm 6.00 (66,89)	79.83 \pm 6.49 (66,91)
Social grouping	3.00 \pm 1.31 (1,5)	3.20 \pm 1.45 (1,6)
NART-R	106.50 \pm 10.98 (82,123)	109.96 \pm 9.80 (91,129)
Gender (m/f)	16/30	13/17
MMSE	24.00 \pm 2.74 (18,30)	24.43 \pm 2.43 (18,29)

Note. Mean \pm SD (minimum, maximum) unless otherwise stated.

The carers of the people with dementia ($n = 76$; *mean age* 68.54, *SD* 13.90, range 34–89) included 50 spouses/partners, 22 adult children, 2 siblings, one niece, and one friend, with 75% co-resident. They had, in the judgement of the assessor on interview, no significant evidence of cognitive impairment, and adequate eyesight and hearing.

Awareness assessment

Two methods were used for measuring awareness, taken from the Memory Awareness Rating Scale (MARS; Clare, Wilson, Carter, Roth, & Hodges, 2002; Clare, Whitaker, & Nelis, 2010; Clare *et al.*, 2012). This is a standardized procedure, which measures OJD and SRD based around the Rivermead Behavioural Memory Test-II (RBMT; Wilson, Cockburn, & Baddeley, 2003), a memory battery designed to have ecological validity in that the memory tests simulate a range of everyday memory activities. Both the OJD and SRD techniques are mapped onto this procedure, providing semi-isomorphic measurements pertaining to the same memory activities.

Objective-Judgement Discrepancy

A measure of awareness of immediate performance was created by combining the Rivermead Behavioural Memory Test II (RBMT-II; Wilson *et al.*, 2003) with a memory performance scale (MPS). The RBMT-II includes the following 13 memory subtests: remembering an appointment, remembering a short route: immediate and delayed, remembering a belonging, remembering to deliver a message, picture recognition, orientation, story recall: immediate and delayed, remembering a name, and face recognition. For each of these subtests, the participant then immediately rates his/her performance using a 5-point rating scale. For example, on the RBMT-II, in the 'remembering a name subtest' a photograph of a person and name are presented and the participant has to recall the name after a delay. The participant is then given the following MPS item: 'I asked you for the name of the person whose picture I showed you earlier' and has to judge his/her performance as either 'very good', 'good', 'alright', 'poor', or 'very poor'. Total RBMT and MPS scores are obtained by summing across the subtests in each case. A ratio between the two measures is calculated (MPS/RBMT), termed the Memory Performance Ratio (MPR), adjusted by adding 0.5 to each score to avoid dividing a value by zero (Clare *et al.*, 2010). This MPR provides a value that is higher with less awareness, with ratio scores close to 1 indicating close agreement between performance and rating. In the subsequent statistical analysis, the ratio was log transformed to ensure normalized data distribution within groups.

Subjective Rating Discrepancy

This is measured using the Memory Function Scale (MFS), a rating scale from the MARS concerning everyday memory performance based on the RBMT-II subtest material. It includes a self-rating scale (MFS-S) used by the person with dementia, and a parallel informant scale (MFS-I) used by the carer. The items on this scale parallel the memory requirements of the RBMT-II subtests and use a similar five-point rating format to the MPS. For example, the matching item for the face memory test on the RBMT on the MFS-S is 'You meet someone and are told their name. Later on you meet them again and need to remember their name' and this is rated as either 'always, often, sometimes, rarely or never'. The MFS-I uses the same items, but is adapted for informant rating. The MFS-S and

MFS-I scores are separately summed across the items. To compute the measure of awareness, the Memory Functioning Difference (MFD), the difference between the measures is normalized for overall rating level using the following formula: $(MFS-S - MFS-I) / ((MFS-S + MFS-I) / 2)$; Clare *et al.*, 2010), whereby more positive scores suggest lower awareness (overestimation of ability) and negative scores suggest underestimation of ability relative to the carer.

The MARS awareness measures have normative data for 236 healthy participants (*mean age* = 69.01 years, *SD* 7.96, range 55–91; 110 male/126 female; NART-R error score *mean* 11.00; *SD* 7.42; range 0–37). Analysis of the normative data has shown that neither the MFD nor MPR measures correlate with age or NART-R performance.

Neuropsychological correlates

Memory

The Word List subtest from the Wechsler Memory Scale III (WMS-III; Wechsler, 1997) was used to measure verbal memory function. The test requires the participant to recall the same list of 12 words (A) four times, followed by a distractor list of 12 different words (B), an attempt to recall list A and then a final delayed recall of list A after approximately 25 min. The measures used were immediate recall (total recall for the first four attempts), learning (the score for the fourth minus the first attempt) and delayed recall of list A.

Language and semantic memory

Object naming was measured using the Graded Naming Test (McKenna & Warrington, 1983; Warrington, 1997) in which thirty different line drawings are presented and the participant must identify the object depicted in each drawing. To measure semantic memory, the picture–picture matching subtest from the Pyramids and Palm Trees test (Howard & Patterson, 1992) was used, in which three pictures are shown. One is an exemplar and the participant has to select from the remaining two the one which is connected with the exemplar. For both tests, a higher score indicates better performance. This task has been validated on people with AD and been shown to be sensitive to impairment in the early stages (Hodges & Patterson, 1995).

Executive functioning

This was assessed using the Verbal Fluency subtests from the Delis–Kaplan Executive Function System (D-KEFS) test battery (Delis, Kaplan, & Kramer, 2001). The Letter Fluency (FS) and Category Fluency (animals and boys' names) tests were used to measure verbal generativity, with mental flexibility measured using the Category Switching (fruit and furniture) test, using the Total Switching Accuracy measure. The raw scores for these tests were converted into age scaled scores (*mean* 10; *SD* = 3).

Results

Statistical analysis

Two-tailed independent *t*-tests were used to explore differences between the groups. A Pearson correlational analysis was carried out to determine the level of agreement between the two methods of measuring awareness and the association between

awareness and neuropsychological performance. Stepwise regression analyses were conducted to explore further these latter associations.

Measures of awareness

The awareness data are shown in Table 2. For both measures, Z scores have been calculated using the normative data from 236 older controls published by Clare *et al.* (2010).

For the MPR, measuring OJD, both groups showed significantly lower levels of awareness in comparison to normative control data. Independent *t*-tests between the two groups and the normative sample assuming unequal variances showed highly significant differences for both groups (AD: $t(78) = 8.43, p < 0.001$; VaD: $t(78) = 4.67, p < 0.001$). The AD group also showed significantly lower awareness than the VaD group as indicated by a *t*-test assuming equal variance ($t(74) = 2.23, p = .029$). These tests were significant after using a Holm–Bonferroni adjustment for multiple *t*-tests, used because of the unequal variances.

The MFD, measuring SRD, revealed overall reduced awareness, again highly significant in both groups (AD: $t(78) = 6.60, p < 0.001$; VaD: $t(78) = 6.95, p < 0.001$), with the difference between the two groups not significant ($t(74) = 0.14, p = .88$), using Holm–Bonferroni adjustment.

Table 2 also provides Z score effect sizes based on the normative data indicating substantial loss of awareness relating to all measures.

Neuropsychological performance

The neuropsychological performance is provided in Table 3. The two groups did not show any significant differences in performance.

Awareness measures and neuropsychological performance

Correlations between the measures of awareness and the MMSE and neuropsychological results are shown in Table 4.

The MMSE score correlated with awareness measures in both groups, with the exception of the MFD measure in the VaD group, where a trend was found ($p = .07$). Negative correlations indicated that awareness was lower with greater severity.

For the AD group, significant correlations were found for both the MPR and MFD and the Word List and Graded Naming measures; for MPR only there was a significant

Table 2. OJD and SRD measured, respectively, using the MPR and the MFD in participants with Alzheimer's disease or vascular dementia

	Alzheimer's disease ($n = 46$)	Vascular dementia ($n = 30$)	Normal controls ($n = 236$)
MPR	0.93 ± 0.66 (–3.77)	0.60 ± 0.58 (–2.27)	0.10 ± 0.22
MFD	0.60 ± 0.59 (–3.44)	0.62 ± 0.58 (–3.56)	–0.02 ± 0.18

Note. Mean ± *sd*.

Also in brackets there are Z scores calculated using normative data provided by Clare *et al.* (2010).

OJD, Objective Judgement; SRD, Subjective Rating Discrepancy; MPR, Memory Performance Ratio; MFD, Memory Functioning Difference.

Table 3. Neuropsychological performance of participants with Alzheimer's disease or vascular dementia

	Alzheimer's disease (<i>n</i> = 46)	Vascular dementia (<i>n</i> = 30)	<i>t</i> (<i>p</i>)
Memory			
WMS-III total	15.78 ± 6.60	14.25 ± 5.01	1.08 (0.29)
WMS-III delayed	0.90 ± 1.95	0.89 ± 1.84	0.03 (0.98)
Language/semantic			
Graded naming	11.84 ± 6.25	14.43 ± 6.44	-1.74 (0.09)
Pyramid and Palm	47.84 ± 4.52	46.69 ± 5.15	1.03 (0.31)
Executive fluency			
Letter fluency*	9.07 ± 4.38	7.57 ± 3.34	1.60 (0.12)
Category fluency*	6.02 ± 3.19	5.00 ± 2.69	1.49 (0.15)
Executive control			
Switching*	5.70 ± 3.93	4.87 ± 3.21	0.97 (0.33)

Note. Mean ± SD.

t-test *t*-value and probabilities.

*Scaled Scores.

Table 4. Correlations between measures of awareness and neuropsychological performance

	Alzheimer's disease		Vascular dementia	
	MPR	MFD	MPR	MFD
Global				
MMSE	-0.46**	-0.39**	-0.36*	-0.38
Memory				
WMS-III total	0.45**	0.37*	0.23	0.75**
WMS-III delayed	0.49**	0.41**	0.44**	0.38*
Language/semantic				
Graded naming	0.46**	0.40**	0.37*	0.59**
Pyramids and Palm Trees	0.12	0.19	-0.03	0.24
Executive/fluency				
Letter fluency	-0.05	-0.10	0.04	0.11
Category fluency	0.29	0.17	0.21	0.35
Executive/control				
Switching	0.42**	0.21	0.19	0.17

Note. Positive correlations indicate a positive association between loss of awareness and neuropsychological deficit; **p* < .05; ***p* < 0.01.

correlation with D-KEFS Switching. For the VaD group, significant correlations were found for both MPR and MFD and the delayed memory measure, but only between MFD and the immediate memory measure. Both MPR and MFD correlated with Graded Naming.

Additionally, in an exploratory fashion, stepwise regression analyses, done separately for the AD and VaD groups, were computed with the MPR and MFD awareness measures as the dependent variables. The variables as given in Table 4 were selected as the neuropsychological variables, but with only the delayed measure from the Word List task used, as this was most sensitive to memory disorder and a purer measure of long-term memory.

For the MPR and for both the AD and VaD groups, only the delayed Word List remained in the models (AD: $\beta = 0.55$; VaD: $\beta = 0.45$), the model explaining 26.1% of the variance for AD ($F(1, 44) = 18.2, p < .001$) and 19.4% of the variance for VaD ($F(1, 28) = 6.75, p = .015$). For MFD, only Graded Naming remained in the models (AD: $\beta = 0.44$; VaD: $\beta = 0.59$), explaining, respectively, 19.3% and 34.2% of the variance (AD: $F(1, 45) = 10.1, p = .003$; VaD: $F(1, 29) = 14.58, p < .001$).

Discussion

This study compared levels of awareness of memory impairment in AD and VaD using the standardized MARS procedure, showing that both groups had substantially lower levels than predicted from normative control data. For OJD, measured using the MPR, the AD group were significantly worse than the VaD group, whilst for SRD, measured using the MFD, the groups were at the same level. In terms of associations between neuropsychological deficits, the regression analyses indicated that for both groups OJD was significantly related to memory function whilst SRD was significantly related to language function as measured using the Graded Naming Test.

The study also found specific associations between awareness of memory deficit and other aspects of neuropsychological functioning. Specifically, for both groups, OJD awareness is associated with memory function as indicated by regression analysis; this is consistent with the notion of memory dysfunction being a significant factor in reducing levels of awareness. Previous studies, for example, by Hannesdottir and Morris (2007), have demonstrated task-specific associations between OJD performance judgement and memory ability in AD and this study replicates this finding in AD and VaD. The type of memory measured in the neuropsychological assessment, namely episodic memory with a relatively short delay interval, is that used for maintaining information about task performance required for making subsequent judgements about ability or failure. It is known, however, from previous research that AD patients are able to improve their prediction of task performance following experience on tasks, to the extent that they can show judgements similar to controls (Ansell & Bucks, 2006; Moulin, Perfect, & Jones, 2000). The current finding suggests that both groups are impaired when monitoring memory performance, but this does not rule out the difference disappearing with practice on a particular task, as indicated by the previous studies. It should be noted that procedures also exist in which an estimate of likely performance efficacy is compared with post-performance appraisal of efficacy, and this provides a method of assessing how well people can reflect on their memory performance and adjust their expectations (Souchay, 2007). Such procedures could be used with the MARS to investigate this aspect in more detail.

In contrast, for the SRD measurement, awareness was associated with naming ability, again in both dementia groups. This replicates a previous finding by Sevush and Leve (1993) for AD patients in which loss of awareness was associated with impaired object naming. This association potentially could be related to loss of semantic memory or visuoperception, but no associations with the Pyramids and Palm Trees picture–picture matching task performances, which measure both these aspects, were found. Additionally, it has been shown that in early AD, naming impairment is not necessarily due to loss of semantic knowledge (Masterson *et al.*, 2007). Nevertheless, it should be noted that semantic memory performance on the Pyramids and Palm Trees task tended towards ceiling effects in the three groups, so this may not be an adequate test of such impairment

in this case. Other studies have shown that awareness is related to language function, including Verbal IQ (Starkstein *et al.*, 1993) and verbal comprehension (Migliorelli *et al.*, 1995; Starkstein *et al.*, 1993). In this case, the Graded Naming Test might be a proxy for language function more generally, as naming impairment is a sensitive early indicator of language dysfunction. One explanation for the finding of reduced awareness associated with language impairment is that explicit awareness, as measured in this study, is reliant on verbal comprehension and expression. Impairment of these capacities would make verbal judgement less accurate and in some situations provide the impression of less awareness. An issue to be considered is why there was no association with memory functioning, given that a failure to consolidate information concerning task performance might lead to eventual inaccuracy in terms of global appraisal of ability (see also Morris & Mograbi, 2013). A possible explanation is that, unlike judgement of immediate performance, longer term consolidation of information needed for the SRD judgement is influenced by a range of factors that might reduce the association, but with language playing a more potent role in this respect. Conversely, the lack of association between the OJD measure and language performance might be because language processing is not so important for immediate expressed judgement of task efficacy. In this case, doing the task provides non-verbal information concerning task activity without the need to process a verbal description, as in the SRD measurement technique.

It should also be acknowledged that the SRD relies on the carer to make a judgement concerning the memory abilities of the person with dementia. This can be considered as a benchmark, but there are a number of demonstrated factors that can bias this judgement. Specifically, using the MARS technique, Clare *et al.* (2012) have shown that carer stress is a prominent factor predicting lower ratings of ability on the SRD informant measure. If such factors predominate and are equal between groups, AD and VaD, they might potentially make the levels of awareness appear similar. Conversely, for OJD measurement, personal factors such as self-concept and mood state can influence judgements of ability (Clare *et al.*, 2012) and such factors might be differentiated between groups.

There have been relatively few previous studies comparing loss of awareness in AD and VaD. Clinician ratings of awareness following interview have either shown similar levels of reduced awareness in AD and VaD (Verhey *et al.*, 1993; Zanetti *et al.*, 1999) or more severe awareness loss in AD (Danielczyk, 1983; Mahendra, 1984). Studies using the SRD method have found more severe reduction in AD. This includes the study by DeBettignies *et al.* (1990), who reported that people with AD show a greater loss of awareness of their capacity for independent living skills when compared with ratings made by their carers. Tamietto *et al.* (2004) compared awareness in three domains. They measured awareness for memory function using the Self-Rating Scale of Memory Functions (Dalla Barba, Parlato, Iavarone, & Boller, 1995), functional deficit using adaptations and amalgamations of the Blessed Dementia Rating Scale (Blessed, Tomlinson, & Roth, 1968) and the Geriatric Rating Scale (Plutchik *et al.*, 1970), and also neuropsychiatric disorder using the Neuropsychiatric Inventory (Cummings *et al.*, 1994). AD patients showed significantly less awareness in the first two domains, memory and functional ability. Converse findings are reported in two studies, firstly by Chan *et al.* (2008), who used a semi-structured interview and reported a greater percentage of patients demonstrating loss of awareness of dementia symptoms in VaD compared with AD; this difference was found for patients with mild dementia, but disappeared in more severe dementia. A study by Starkstein *et al.* (1996) reported more severe loss of awareness in VaD, using an SRD method and the Anosognosia Questionnaire-Dementia (AQ-D; Migliorelli *et al.*, 1995), which includes questions concerning intellectual function, interests, and personality. The sample of VaD

patients studied by Starkstein *et al.* (1996) were also significantly more impaired on tests of executive functioning and showed corresponding lower frontal lobe and basal ganglia perfusion, perhaps suggesting that their more severe loss of awareness stemmed from greater frontal lobe pathology. The participant groups in the current study did not show significant differences in verbal executive functioning. It is acknowledged that the mixed pathologies of the VaD group, not differentiated in this study, may obscure potential AD versus VaD differences. Nevertheless, there is a growing literature relating to the overlap of grey matter and vascular pathology, which may account for the less reliable differentiation between these types of dementia (e.g., Jelinger, 2007; Weiderkehr, Simard, Fortin, & van Reekum, 2008) as well as the suggestion that where cognitive differences between the two conditions exist, the differences may not be sufficiently great to suggest clinical significance (Matthias & Burke, 2009).

This study has shown that OJD measurement of awareness of memory function can yield different results when comparing AD with VaD. However, certain limitations in the study should be considered. Firstly, despite the relatively large total sample size, an expansion of this study could take into account subgroups of VaD, for example, distinguishing dementia primarily associated with small vessel disease, a patient population for which there are little data concerning awareness to date (Brookes, Hannesdottir, Markus, & Morris, 2013). A larger sample with subgroups relating to different severities of dementia and types of VaD similarly comparing measurement approaches would help address such issues. Additionally, a larger sample would enable the regression technique to be used to explore the data beyond a preliminary exploratory mode. Longitudinal studies, in which multiple types of measurement of memory awareness are used, would also help understanding of differential evolution of awareness difficulties. Additionally, the specific measures of neuropsychological functioning could be revised to ensure good sensitivity and range. For example, in our study, the Pyramid and Palm Trees measure tended towards a ceiling effect; although previously this measure has been shown to be sensitive to semantic memory deficit in people with AD designated as having minimal dementia, considerable heterogeneity has been demonstrated, with not all participants showing impairment (Hodges & Patterson, 1995).

In conclusion, this study used the MARS battery to investigate awareness of memory disorder comparing AD with VaD and has shown substantial loss of awareness of memory functioning in both groups. These results derive from patients with early dementia, with MMSE scores of about 24 on average, indicating mild levels of severity. This suggests that loss of awareness can occur in the two most common forms of dementia without substantial neuropsychological impairment. However, the two groups showed different degrees of awareness loss depending on the method used to ascertain awareness. This demonstrates the importance of testing multiple aspects of memory awareness to derive as full a picture as possible when exploring patient differences and the neurobiological correlates of awareness.

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