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Can verbal instruction enhance the recall of an everyday task and promote error-monitoring
in people with dementia of the Alzheimer-type?

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Abstract

People with dementia of the Alzheimer-type (DAT) have difficulties with performing everyday tasks and error awareness is poor. Here we investigated whether recall of actions and error monitoring in everyday task performance improved when they instructed another person on how to make tea. In this situation, both visual and motor cues are present, and attention sustained by the requirement to keep instructing. The data were drawn from a longitudinal study recording performance in four participants with DAT, filmed regularly for five years in their own homes, completing three tea-making conditions: performed-recall (they made tea themselves); instructed-recall (they instructed the experimenter on how to make tea); and verbal-recall (they described how to make tea). Accomplishment scores (percentage of task they correctly recalled), errors and error-monitoring were coded. Task accomplishment was comparable in the performed-recall and instructed-recall conditions, but both were significantly better than task accomplishment in the verbal-recall condition. Third person instruction did not improve error-monitoring. This study has implications for everyday task rehabilitation for people with DAT.

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Introduction

A deterioration of everyday task performance is one of the diagnostic criteria for dementia/major neurocognitive disorder (American Psychiatric Association, 2013), with dementia of the Alzheimer-type (DAT) being the most common, followed by vascular dementia (VaD) and mixed dementia, respectively (Brunnström, Gustafson, Passant, & Englund, 2009). People with dementia make significantly more errors than age-matched controls when carrying out everyday tasks, their errors increase with greater dementia severity and they tend to produce mostly errors of omission (a task step/action is completely omitted; Giovannetti et al., 2008; Giovannetti, Libon, Buxbaum, & Schwartz, 2002; Ramsden, Kinsella, Ong, & Storey, 2008; Rusted & Sheppard, 2002).

Bettcher and Giovannetti (2009), suggested that errors may not be prevented in this population, and therefore the management of such errors, or error-monitoring, may be a more viable target for research. Error-monitoring is typically referred to as the detection and correction of errors (see Bettcher & Giovannetti, 2009, for a review). Studies which have explored error-monitoring in people with dementia have found that they error-monitor far less than age-matched controls during everyday task performance, whether performance is assessed in a cross-sectional (Bettcher, Giovannetti, Macmullen, & Libon, 2008; Giovannetti et al., 2002) or in a longitudinal (Balouch & Rusted, 2014) design.

One study employed verbal description, picture presentation and video presentation of the task, in order to strengthen recall of the task schema (Bettcher et al., 2011), reporting that errors were reduced and error detection increased. These results are promising for rehabilitation, but despite detecting errors, error correction did not increase with this training method. Another study in a patient with action disorganisation syndrome (Bickerton, Humphreys, & Riddoch, 2006) showed that verbal strategies can reduce errors and enhance

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error-monitoring – in this case, the verbal strategy was to learn a mnemonic.

In the present study, we ask whether error monitoring and error correction would improve if task performance was made a more overt and ‘conscious’ process by requiring the person to observe and instruct another person on the task script and hence take on an outsider’s perspective? In this situation, in addition to the participants engaging with the schema through instructing a third person, they also have the visual cues of the third person carrying out the task actions in front of them. This requirement should both maintain activation of the task schema and increase awareness of the task. According to Schwartz (2006), high error producers (e.g. people with dementia) find it increasingly difficult to select the target schema due to severe cognitive resource limitations. Thus, the schema or task representation may still be intact, but the schema and its associated actions may not be sufficiently active. In this situation, other distractions/schemas may capture attention, leading to attention failures that allow the target schema to become *deactivated*. From this, we can infer that errors could be detected (and consequently corrected) if the target schema is *maintained in an activated state* by encouraging strategies that sustain the task schema, such as verbalising the script of the task.

Third person instruction is an interesting proposition for a cognitively impaired person to undertake for a number of reasons. First, it requires the instructor to take on the role of the performer and anticipate/reflect on the performer’s actions as they are carried out. As a result, they would need to coordinate their own schema with the actions of the person being instructed in reference to a common goal, making them more mindful of their own schema script. Second, this strategy would encourage joint attention (a shared focus of two individuals on an object or task). Joint attention is widely studied in developmental psychology (see Striano & Reid, 2006, for a review), but recently dementia care research has

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shown an interest in it too (Astell et al., 2010; Sävenstedt, Zingmark, Hydén, & Brulin, 2005). The two latter studies show that people with dementia are capable of engaging in joint attention and can benefit from dementia care interventions that utilise joint attention. Third, the mere act of verbalising the task script may make participants more aware and mindful of the task schema. However, this is yet to be tested in people with dementia. In the present study we examine whether people with dementia error-monitor more when they increase their engagement (through instructing another person) with the task schema, and more effectively complete the task.

Observing another's actions activates the 'mirror neuron system' (MRN), which has been demonstrated in non-human primates (di Pellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992; Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; Rizzolatti, Fadiga, Gallese, & Fogassi, 1996; Rizzolatti & Craighero, 2004). Human studies provide evidence for an 'action observation network' (AON; Cross, Kraemer, de C. Hamilton, Kelley, & Grafton, 2009; Grèzes, Armony, Rowe, & Passingham, 2003; Jenkins, Brooks, Nixon, Frackowiak, & Passingham, 1994; Sakai, Ramnani, & Passingham, 2002): a discrete set of neural regions that are active when observing and when performing actions. However, *doing* the task normally provides optimal encoding of action phrases. First, a wide body of research has shown that a list of unrelated action phrases are recalled better when the participant performs the actions (subject-performed tasks, SPTs), rather than when they verbally process them (verbal task, VTs) - this is known as the enactment effect (Earles, 1996; Johannes Engelkamp, 1998; Johannes Engelkamp & Zimmer, 1994; Knopf, Mack, Lenel, & Ferrante, 2005). Second, when participants are asked to watch the researcher perform the actions with imaginary objects and later recall them (experimenter-performed tasks, EPTs), they recall more action phrases than the VT condition, but fewer action phrases than the SPT condition

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(Engelkamp & Dehn, 2000; Mulligan & Hornstein, 2003). However, studies of the enactment effect normally focus on the encoding of action *phrases*, rather than the retrieval of action *sequences*, which is where our interest lies. To this effect, Steffens (2007) found that in a goal-directed sequence of actions, observing those actions was just as effective as performing those actions, in terms of free recall of the objects used in the task and the participants' performance of that task. In addition, organisation of the actions was better recalled after observation, rather than enactment. Steffens (2007) explained that during the enactment of a sequence of actions, the bigger picture can often be missed; whereas during the observation of a sequence of actions, by taking an outsider's perspective, it is easier to see the missing pieces. In support of the notion that sequential action is recalled better than unrelated actions, Hutton, Sheppard, Rusted, and Ratner (1996) showed that in people with mild-moderate DAT, sequential goal-directed actions were recalled better than unstructured actions. Therefore, one would assume that watching and instructing a third person carry out a goal-directed task (such as tea-making), could particularly target sequence errors.

The data reported here is derived from archive data (Rusted & Sheppard, 2002) from participants with DAT carrying out various tea-making tasks in their own homes at regular intervals for up to 6 years. In the original study, the participants took part in three tea-making tasks: a) participants made tea according to their own routines in their own kitchens (performed-recall condition); b) the participants instructed the experimenter on how to make tea in their own kitchen according to their own routine (instructed-recall condition); and c) the participants verbally recalled how to make a cup of tea (according to their own routine), without actually making the tea or having the visual cues present (verbal-recall condition). The instructed-recall condition constitutes unpublished data from this archive and provides the data for the current study. In the original study (Rusted & Sheppard, 2002), participants

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with DAT showed preserved memory for tea-making in the performed-recall condition, compared to the verbal-recall condition, even into the severe stage of dementia, but errors of omission increased significantly with dementia severity. In a more refined analysis of that data, Balouch and Rusted (2014) reported that error monitoring in the performed-recall condition remained poor. Here we consider whether similar failures in error-monitoring occur when they are verbally instructing a third party to execute the routine. By maintaining the schema through instruction, activation of the AON through observing another's actions during instruction, and using a goal-directed task (optimising recall of the organisation/sequence of actions), we anticipated that: 1) instructed-recall and performed-recall conditions will be comparable in terms of task accomplishment and the number of errors made, but both would be superior to verbal-recall in task-accomplishment; 2) the instructed-recall condition will promote more efficient error-monitoring, compared to the performed-recall condition; 3) sequence/anticipation errors will be reduced in the instructed-recall condition, in relation to the performed-recall condition. Furthermore, although everyday task performance declines with increasing dementia severity (Rusted & Sheppard, 2002; Balouch & Rusted, 2014), we hypothesised that the instructed-recall condition would be protective against this decline and thus predicted that 4) as dementia becomes more severe, task accomplishment will decline in all conditions, but mostly in the verbal-recall condition, whilst task accomplishment in the instructed recall will remain equivalent to task accomplishment in the performed-recall condition.

The opportunistic data used in this study not only provides a step towards exploring the effects of externalising the task schema in participants with DAT but it also documents this effect longitudinally up to 5 years in a developing dementia, allowing us to study the changes that occur with dementia progression.

Method

Design

Longitudinal, observational, case-study data previously collected by Rusted and Sheppard (2002) was utilised for this study. The two experimental conditions were performed-recall and instructed-recall conditions, where task accomplishment, errors and error-monitoring behaviours were compared. The verbal-recall condition was used as a baseline for the accomplishment score when visual and motor cues were not present.¹

Ethical approval

Ethical approval for the original study was obtained from the local Health Authority Ethics Committee and by the University of Sussex Ethics Committee. It included the consent of the participants to store and reanalyse the video footage beyond the original study. For the present study, ethical approval was sought from the Schools of Psychology and Life Sciences Ethics Committee, University of Sussex to reanalyse the archived data.

Participants

Only the data from participants with a substantial number of sessions available in both experimental conditions were included in the present study. This comprised 4 participants with full datasets from Rusted and Sheppard (2002). Rusted and Sheppard (2002) recruited

¹ Data from the performed condition published elsewhere (Balouch & Rusted, 2014).

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participants from the community on the basis that they already had a clinical diagnosis of probable Alzheimer's disease as classified by the Cambridge Examination for Mental Disorders of the Elderly (CAMDEX) test battery (Roth, Huppert, Tym, & Mountjoy, 1988). The clinical diagnosis was made by the consultant psychogeriatrician from the local medical centers at the time and was based on clinical interviews, Mini Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) scores below 26 and CT scans showing significant cerebral atrophy. Exclusions included vascular and mixed dementia (vascular and AD), cognitive decline associated with systemic illness, and a history of psychiatric problems. All participants lived at home with a spouse or carer. All participants were either in the mild or mild-moderate stage of dementia at the outset (see Appendix A).

Procedure and measures used in Rusted and Sheppard (2002)

Participants were visited in their own homes by the original researchers (Rusted & Sheppard, 2002) and all data collection took place in the participants' homes with their spouses present. Tea-making was the everyday task used in each condition, which comprised several independent actions needed to achieve the goal (i.e. to make a cup of tea). At recruitment, participants' individual tea-making routines were still intact; participants made tea in their own homes as part of their daily activities and had been doing so for many years prior to the study commencing. Therefore, each person's tea-making routine was well established at the beginning of the study. Initially participants carried out preliminary tea-making sessions that determined their individual protocol for their tea-making routine. Any deviations from each individual's unique protocol was used as a basis to measure errors.

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At recruitment and all subsequent sessions, the MMSE was used to measure cognitive status over time. After the preliminary sessions, all participants completed sessions at intervals that varied between 12 weeks (initially) and 4 weeks (towards the end of the study) for up to five years. At each session the participant made tea under three different conditions: performed-recall (participant made tea in his/her own kitchen following his/her own normal routine), instructed-recall (participant, seated in his/her own kitchen, verbally instructed the experimenter on how to make a cup of tea in his/her own kitchen according to his/her own routine), and verbal-recall (participant, seated in the living room, described “in as much detail as possible” how he/she made a cup of tea in his/her own kitchen). In the instructed-recall condition the instructions to the participant were: "Give me instructions to tell me exactly how to make a cup of tea, so that I can make a cup for you, exactly the way you would do it yourself. Don't go too fast, because I have to keep up. I'm going to do everything as and when you tell me to do it."

The order of the conditions was counterbalanced at each session. All sessions were filmed and it is with this video footage that further analysis has been made possible for the purposes of the current study.

Data Coding

The Noldus Observer Version 5.0 was used to code all errors and error/monitoring behaviours. Errors and error-monitoring (in the performed-recall and instructed-recall conditions only) were coded according to the error and error-monitoring taxonomy developed by Balouch and Rusted (2013, 2014). Errors were coded when a task step was recalled incorrectly (perseveration, anticipation/sequence, quantity, substitution, location and tool errors), when an off-task step was recalled (i.e. action addition), and when a task step was completely omitted (i.e.

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omission). All errors, apart from omissions, were summed as a single score of commission errors. Corrections, microslips (initiation and termination of an error before the error is completed) and checking behaviour (verbal and non-verbal) during tea-making were also coded, indicating error-monitoring. For the instructed-recall condition, a further category was added to the taxonomy to capture all the instances when the participant intervened, i.e. when the participant did not verbalise the instructions and instead carried out the actions himself/herself (see Appendix B for the error-monitoring taxonomy and the coding of interventions).

All data were coded by the first author and a trained research assistant. A Kappa analysis of the coded data revealed a high inter-rater reliability for two coders (Kappa = .90, $p < .0001$).

The percentage of actions recalled correctly from individual protocols was calculated for each session in each condition, to form an *accomplishment score*. The equation for calculating the accomplishment score (modelled on Schwartz, Segal, Veramonti, Ferraro, & Buxbaum, 2002; Balouch & Rusted, 2014) was (Number of actions in protocol) – (number of omissions) – (number of uncorrected substitutions) – (number of uncorrected tool errors). Accomplishment score was coded in performed-recall, instructed-recall and verbal-recall conditions.

Grouping of sessions

Sessions were grouped into stages of dementia severity (DAT-stage from hereon) based on NICE guidelines (NICE, 2011), using the MMSE scores: mild = 26-21, mild-moderate = 20-15, moderate = 10-14, severe ≤ 9 . This resulted in data across three DAT-stages (mild-moderate, moderate and severe) for one participant (AH), and across two stages of dementia

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(mild-moderate and moderate) for two participants (TL and DB). Sessions were grouped by DAT-stage; multiple sessions at each stage (entered as independent replications – effectively, sessions as items) provide a more robust measure of performance competence, allowing for sessional variation in cognitive functioning observed with volunteers with dementia. Participant FM, whose MMSE scores remained in the mild category over the five year period of the study, was included as a control for time (no change in dementia severity) with sessions instead grouped by year (see Appendix A for grouping of sessions).

Data analysis

Each participant's data was analyzed separately using SPSS; sessions were entered as independent replications, with dementia stage as a time factor. The three conditions (performed-recall, instructed-recall and verbal-recall) were repeated measures at each replication. In this format, mixed ANOVAs and MANOVAs were performed to compare outcomes across conditions separately for each volunteer.

To test the first prediction, accomplishment was analysed using 2-way ANOVAs, with DAT-stage (2 or 3 levels: mild-moderate, moderate, and for AH severe; or year for FM: 5 levels for each year) and condition (3 levels: performed-recall, instructed-recall and verbal-recall) as the independent variable. Key error variables (commissions and omissions) were analysed using 2-way MANOVAs. The predictor variables were DAT-stage and condition (2 levels: performed-recall and instructed-recall). All significant MANOVAs were followed up with 2-way ANOVAs, followed by contrasts as appropriate. Bonferroni corrections were applied accordingly. For the second prediction, error-monitoring variables (proportion of errors-corrected, microslips, non-verbal checks and verbal checks) were analysed using the

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same procedure. For the third prediction, 2-way ANOVAs (condition x DAT-stage/year) were conducted on anticipation errors, followed by appropriate contrasts, with Bonferroni corrections. The fourth prediction, the effect of dementia severity, was tested in the same ANOVAs used for prediction 1 (significant main effects of DAT-stage were followed by polynomial contrasts to determine linear trends across DAT-stage/year). P was significant at the .05 level and all p values are reported as 1-tailed, unless otherwise stated. The effect sizes are reported for all significant main effects (where two groups are compared) and all significant contrasts, using Pearson's Correlation Coefficient (r); whereby .10 is a small effect, .30 is medium, and .50 is large (Cohen, 1988).

Results

Prediction 1: Instructed-recall and performed-recall conditions will be comparable in terms of task accomplishment and the number of errors made, but superior to verbal-recall in task-accomplishment

Task accomplishment. See Figures 1-4 for accomplishment scores across DAT-stages for each participant.

Case AH. There was a significant main effect of condition on accomplishment, $F(2, 36) = 406.13$, $p < .0001$, with no significant difference between performed-recall and instructed-recall conditions, $p > .05$, but both these conditions were significantly higher than the verbal-recall condition, $F(1, 18) = 412.97$, $p < .0001$, $r = .98$; $F(1, 18) = 1007.09$, $p < .0001$, $r = .99$, respectively. A significant main effect of DAT-stage on accomplishment, $F(2, 18) = 6.03$, $p = .01$ and a significant linear contrast, $p < .01$, revealed that accomplishment

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declined as dementia became more severe, but this did not interact with condition, $p > .05$. When interventions were excluded from the instructed-recall condition and the ANOVA was conducted again: the significant main effect of condition remained, $F(1.38, 24.89) = 89.26$, $p < .0001$, but instructed-recall was significantly lower than performed-recall, $F(1, 18) = 13.16$, $p = .002$, $r = .65$, but significantly higher than verbal-recall, $F(1, 18) = 73.61$, $p < .0001$, $r = .90$.

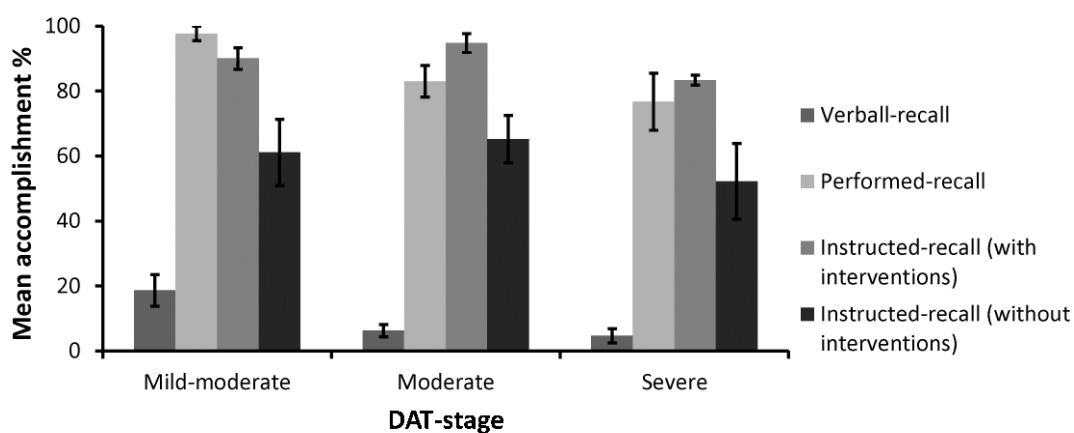


Figure 1. AH's mean accomplishment % (+/-1 SEM bars) across DAT-stages, as a function of condition.

Case TL. There was a significant main effect of condition on accomplishment, $F(2, 10) = 387.02$, $p < .0001$, but in contrast to AH, TL's accomplishment score was significantly higher in the performed-recall condition, than the instructed-recall and verbal-recall conditions: $F(1, 5) = 12.62$, $p = .02$, $r = .85$; $F(1, 5) = 2004.38$, $p < .0001$, $r = 1.00$, respectively. However, similar to AH, the instructed-recall outperformed the verbal-recall, $F(1, 5) = 490.49$, $p < .0001$, $r = .99$. There were no significant main effects of DAT-stage and no condition x DAT-stage interaction (all $ps > .05$). Although TL made interventions in

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the instructed-recall condition, these were not sufficient to increase accomplishment and bring it in line with the performed-recall condition.

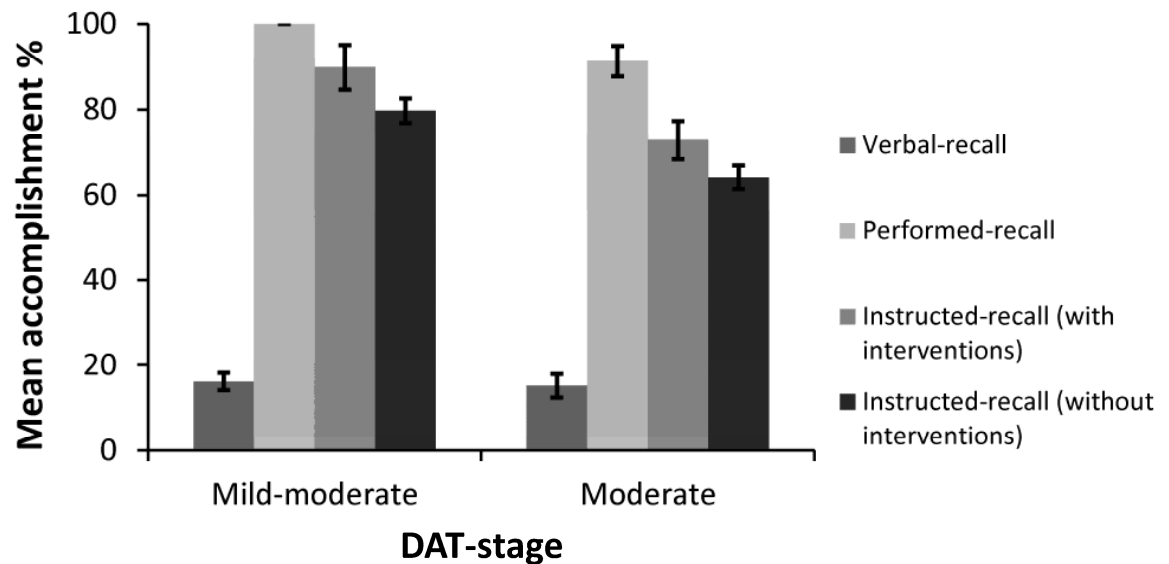


Figure 2. TL's mean accomplishment % (+/-1 SEM bars) across DAT-stages, as a function of condition.

Case DB. There was a significant main effect of condition on accomplishment, $F(2, 10) = 136.14, p < .0001$. Similar to AH, DB's accomplishment score was comparable in performed-recall and instructed-recall conditions, $p > .05$, with both these conditions significantly higher than the verbal-recall condition: $F(1, 5) = 239.55, p < .0001, r = .99$; $F(1, 5) = 118.24, p < .0001, r = .98$, respectively. There was no significant main effect of DAT-stage and no DAT-stage x condition interaction (all $ps > .05$). After excluding the interventions from the instructed-recall condition, the ANOVA was conducted again, which showed a significant main effect of condition, $F(2, 10) = 197.24, p < .0001$: performed-recall was significantly higher than instructed-recall, $F(1, 5) = 163.87, p < .0001, r = .99$, and in

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turn, instructed-recall was significantly higher than verbal-recall, $F(1, 5) = 147.04, p < .0001, r = .98$.

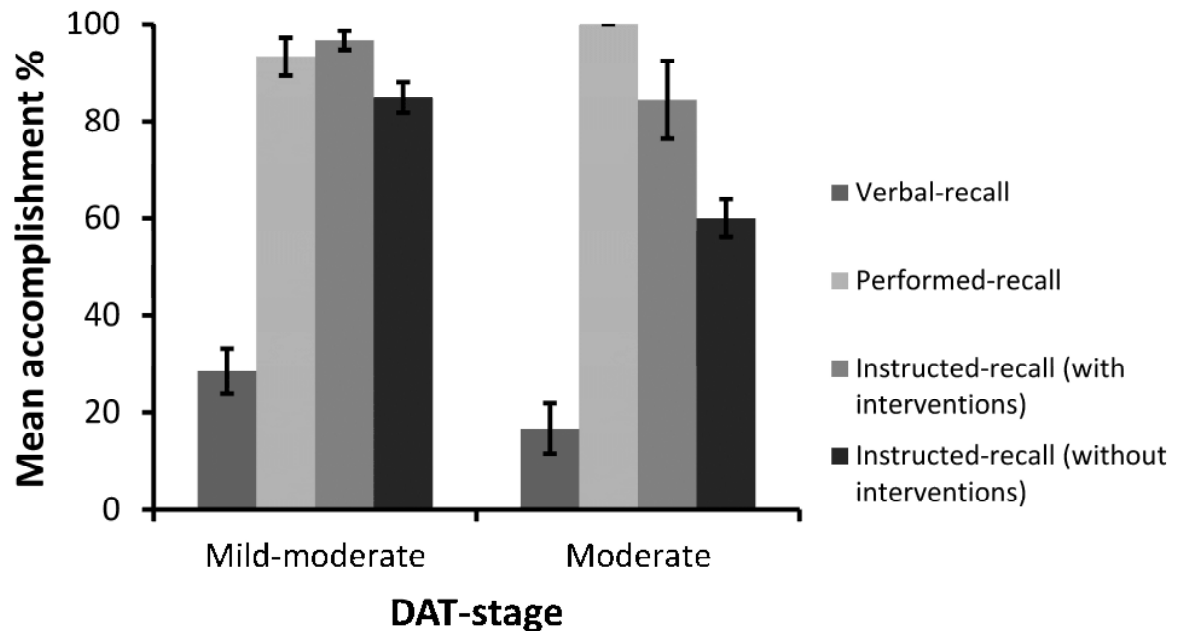


Figure 3. DB's mean accomplishment % (+/-1 SEM bars) across DAT-stages, as a function of condition.

Case FM (control for time). The main effect of condition was significant, $F(2, 30) = 736.71, p < .0001$. Similar to AH and DB, FM showed comparable accomplishment scores in the performed-recall and instructed-recall conditions, $p > .05$, and accomplished significantly less in the verbal-recall condition: $F(1, 15) = 846.28, p < .0001, r = .99$; $F(1, 15) = 871.07, p < .0001, r = .98$, respectively. There was no significant effect of time and no significant condition x time interaction (all $ps > .05$). In an ANOVA that excluded interventions from the instructed recall condition, the main effect of condition was significant, $F(1.40, 20.96) = 511.48, p < .0001$. Performed-recall was significantly higher than instructed, $F(1, 15) = 6.40,$

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$p = .02$, $r = .55$, and in turn instructed-recall was significantly higher than verbal-recall, $F(1,15) = 452.74$, $p < .0001$, $r = .98$.

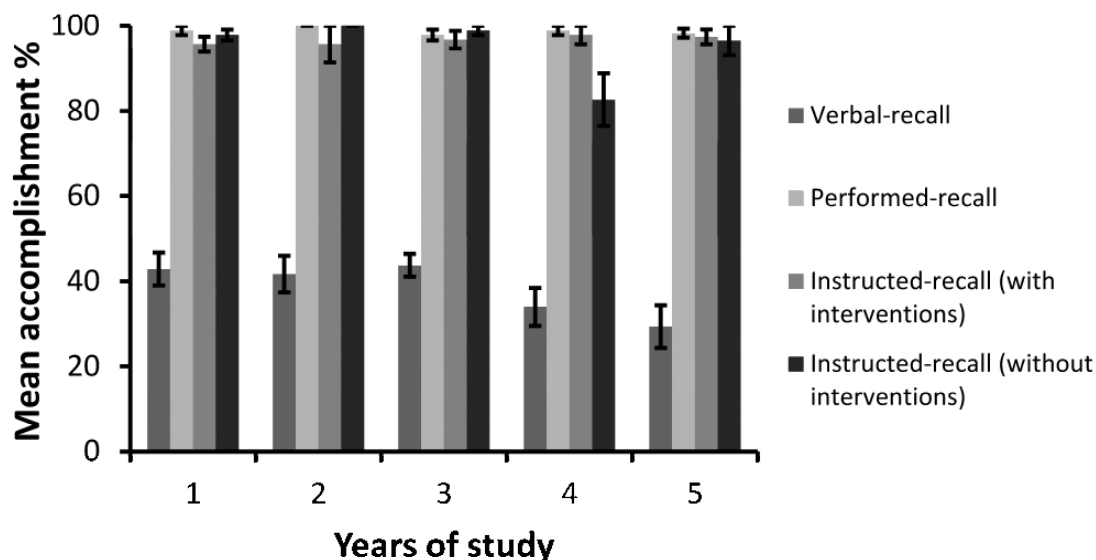


Figure 4. FM's mean accomplishment % (+/-1 SEM bars) across time, as a function of condition.

Errors. There were individual differences in error patterns, with benefits of the instructed-recall condition only observed in AH. Tables 1-4 depict error data for each individual case-study.

Case AH. The MANOVA and subsequent ANOVAs revealed a significant condition x DAT-stage interaction on omissions only, $F(2, 18) = 4.40$, $p = .03$. There were fewer errors of omission in the instructed-recall condition than in the performed condition for the moderate and severe stages of dementia, but not for the mild-moderate stage (where few errors occurred). The MANOVA revealed no significant main effects of condition or DAT-stage on omissions (all $ps > .05$).

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Table 1. AH's means (+ standard deviations) for everyday task performance categories in performed and instructed recall conditions across DAT-stages of severity.

	Errors			Error-monitoring	
	Omissions	Commissions	Anticipations	Non-verbal checks	Verbal checks
AH					
Mild-moderate (n = 6)					
Performed-recall	0.33 (0.82)	1.50 (1.23)	0.67 (0.82)	1.67 (2.25)	6.50 (2.35)
Instructed-recall	1.50 (1.23)	2.00 (1.90)	1.50 (1.52)	0.67 (.82)	2.83 (2.86)
Moderate (n = 9)					
Performed-recall	2.44 (2.13)	2.22 (2.78)	0.33 (.50)	2.67 (2.00)	3.33 (2.06)
Instructed-recall	0.56 (1.33)	2.67 (1.94)	1.78 (1.48)	0.67 (0.87)	3.67 (2.06)
Severe (n = 6)					
Performed-recall	3.50 (3.21)	1.67 (1.21)	0.33 (.21)	1.50 (1.05)	5.67 (3.78)
Instructed-recall	2.50 (.55)	4.00 (1.79)	0.83 (.98)	0.33 (.52)	2.83 (1.73)

Case TL. The MANOVA and subsequent ANOVAs confirmed significant main effects of condition on both omissions, $F(1, 5) = 21.12$, $p = .01$, $r = .90$, and commissions, $F(1, 5) = 51.57$, $p = .001$, $r = .95$, with more errors in the instructed-recall condition. The MANOVA revealed no main effect of DAT-stage, $p > .05$, but there was a significant condition x DAT-stage interaction, $V = .78$, $F(2, 4) = 7.26$, $p = .05$. Further ANOVAs revealed an interaction on commissions only, $F(1, 5) = 17.29$, $p = .01$, $r = .88$: commissions increased with dementia progression more dramatically in the instructed-recall condition, than the performed-recall condition.

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Table 2. TL's means (+ standard deviations) for everyday task performance categories in performed and instructed recall conditions across DAT-stages of severity.

	Errors			Error-monitoring	
	Omissions	Commissions	Anticipations	Non-verbal checks	Verbal checks
<u>TL</u>					
<u>Mild-moderate (n = 3)</u>					
Performed-recall	0.00 (0.00)	0.33 (0.58)	0.33 (0.58)	2.67 (3.79)	6.33 (1.16)
Instructed-recall	2.67 (1.53)	1.00 (0.00)	0.67 (0.58)	0.67 (0.58)	4.67 (3.79)
<u>Moderate (n = 4)</u>					
Performed-recall	1.75 (1.26)	0.75 (0.96)	0.00 (0.00)	4.50 (2.08)	4.50 (3.70)
Instructed-recall	6.00 (1.83)	3.25 (0.96)	1.25 (0.96)	1.00 (2.00)	1.00 (0.82)

Case DB. The MANOVA and subsequent ANOVAs revealed a significant interaction on omissions only, $F(1, 5) = 7.12$, $p = .04$, $r = .77$: showing that as dementia progressed omissions increased in the instructed-recall condition, but decreased in the performed-recall condition. There were no significant main effects of condition or DAT-stage on omissions, and although DB made commissions, the ANOVA revealed no significant results for commissions (all $ps > .05$).

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Table 3. DB's means (+ standard deviations) for everyday task performance categories in performed and instructed recall conditions across DAT-stages of severity.

	Errors			Error-monitoring	
	Omissions	Commissions	Anticipations	Non-verbal checks	Verbal checks
<u>DB</u>					
<u>Mild-moderate (n = 4)</u>					
Performed-recall	1.00 (1.16)	2.50 (3.32)	0.00 (0.00)	0.25 (0.50)	7.25 (4.27)
Instructed-recall	0.50 (0.58)	1.00 (1.16)	0.50 (1.00)	0.50 (.58)	8.00 (2.59)
<u>Moderate (n = 3)</u>					
Performed-recall	0.00 (0.00)	0.67 (1.16)	0.00 (0.00)	1.67 (1.16)	7.67 (3.22)
Instructed-recall	2.33 (2.08)	3.33 (3.51)	0.67 (0.58)	1.00 (1.00)	9.67 (6.43)

Case FM (control for time). Omissions were rare for FM and thus excluded from his MANOVA. Although, FM made commissions, an ANOVA revealed no significant main effects of condition or time, and no interaction (all $ps > .05$).

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Table 4. FMs means (+ standard deviations) for everyday task performance categories in performed and instructed recall conditions over years in study.

	Errors			Error-monitoring	
	Omissions	Commissions	Anticipations	Non-verbal checks	Verbal checks
<u>FM</u>					
<u>Year 1 (n = 4)</u>					
Performed-recall	0.00 (0.00)	1.50 (1.73)	0.00 (0.00)	2.75 (2.75)	6.00 (4.08)
Instructed-recall	1.00 (0.82)	2.75 (2.22)	0.75 (0.96)	0.75 (0.96)	4.25 (2.63)
<u>Year 2 (n = 3)</u>					
Performed-recall	0.00 (0.00)	4.33 (2.08)	0.67 (0.58)	3.67 (1.16)	10.00 (3.46)
Instructed-recall	1.00 (1.73)	1.33 (0.58)	0.33 (0.58)	0.33 (0.58)	3.33 (1.53)
<u>Year 3 (n = 4)</u>					
Performed-recall	0.00 (0.00)	4.75 (2.22)	0.75 (0.96)	4.50 (1.73)	11.25 (6.08)
Instructed-recall	0.75 (0.96)	3.00 (1.83)	0.25 (0.50)	1.25 (1.26)	4.50 (1.00)
<u>Year 4 (n = 4)</u>					
Performed-recall	0.00 (0.00)	5.75 (2.63)	1.00 (0.82)	5.50 (1.29)	12.00 (2.94)
Instructed-recall	0.50 (1.00)	5.25 (1.26)	0.75 (0.50)	4.50 (2.65)	8.00 (3.37)
<u>Year 5 (n = 5)</u>					
Performed-recall	0.20 (0.45)	4.20 (4.92)	2.00 (0.45)	2.20 (1.64)	13.20 (2.95)
Instructed-recall	0.40 (0.89)	6.40 (0.89)	0.80 (0.84)	1.80 (1.31)	5.80 (1.64)

Prediction 2: The instructed-recall condition will promote more efficient error-monitoring, compared to the performed-recall condition

Error-monitoring. Verbal checks were the most common type of error-monitoring variable across all participants, followed by non-verbal checks. Microslips and corrections were very rare; thus, excluded from the MANOVA. Tables 1-4 depict error-monitoring data

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for each case-study.

Case AH. The MANOVA and subsequent ANOVAs revealed only a significant main effect of condition: AH made significantly fewer checks in the instructed-recall condition than the performed-recall condition: $V = .38$, $F(2, 17) = 5.22$, $p = .02$; non-verbal checks, $F(1, 18) = 8.10$, $p = .01$, $r = .56$; verbal checks, $F(1, 18) = 7.26$, $p = .02$, $r = .54$. There was no significant main effect of DAT-severity, and no significant interaction (all $ps > .05$).

Case TL. There was some evidence of decreased checking in the instructed-recall condition when compared to performed-recall, but the MANOVA revealed no significant main effect of condition, $p > .05$. Although, TL continued to use checking behaviours throughout the study and well into the moderate stage of dementia, there was no significant main effect of DAT-stage and no interaction (all $ps > .05$).

Case DB. Although DB made substantial numbers of checks (especially verbal checks), the MANOVA revealed no significant main effects of condition, DAT-stage, and no significant interaction (all $ps > .05$).

Case FM. The MANOVA and subsequent ANOVAs confirmed that FM made checks predominantly in the performed-recall condition: $V = .75$, $F(2, 14) = 20.69$, $p < .0001$; non-verbal checks, $F(1, 15) = 18.03$, $p = .001$, $r = .74$; verbal checks, $F(1, 15) = 24.75$, $p < .0001$, $r = .79$. There was a significant main effect of time on both non-verbal and verbal checks: $V = .90$, $F(8, 30) = 3.07$, $p = .01$; non-verbal, $F(4, 15) = 4.01$, $p = .02$; verbal checks, $F(4, 15) = 3.24$, $p = .04$, with checks generally increasing over time. However, there was no condition x DAT-stage interaction ($p > .05$).

Prediction 3. Sequence/anticipation errors will be reduced in the instructed-recall

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condition, in relation to the performed-recall condition

Case AH. AH made significantly more anticipation errors in the instructed-recall condition, $F(1, 18) = 10.23$, $p = .01$, $r = .60$, but the ANOVA revealed no significant main effect of DAT-stage and no interaction (all $ps > .05$).

Cases TL, DB and FM. Anticipations were very rare for these participants, thus were not analysed.

Prediction 4. As dementia becomes more severe, task accomplishment will decline in all conditions, but mostly in the verbal-recall condition, whilst task accomplishment in the instructed recall will remain equivalent to task accomplishment in the performed-recall condition

The ANOVAs that tested Prediction 1, also addressed Prediction 4. In summary, only AH supported this prediction: there was a significant main effect of DAT-stage on accomplishment, revealing a linear trend. As AH's dementia became more severe, his accomplishment score declined in all conditions, but the rate of decline was equivalent in performed-recall and instructed-recall conditions, but more pronounced in the verbal-recall condition. There was no effect of DAT-stage on accomplishment in any of the remaining participants.

Discussion

The present study explored whether verbalising instructions during observed performance of an everyday task would improve recall and error monitoring in people with

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dementia. We anticipated that instructed-recall would improve retrieval of the required actions, and would be comparable in terms of task accomplishment and the number of errors made to performed-recall. We found that three of our four participants accomplished just as many of the task actions in the instructed-recall condition, as they did in the performed-recall condition, and they accomplished significantly more in these conditions than they did in the verbal-recall condition. Interestingly, although in the instructed-recall condition, participants used interventions to supplement their verbal recall, even without these interventions the instructed-recall outperformed the verbal-recall condition, suggesting potential benefits of overt verbalising when visual cues are present. Furthermore, for the participant whose dementia progressed to the severe stage, instructed-recall continued to outperform the verbal-recall, suggesting that memory for an everyday sequence is better when supported by visual cues, than simply by verbal recall alone.

In terms of errors, the results revealed considerable individual differences. Indeed, while there were benefits to task accomplishment, and one of our participants showed decreased errors in the instructed-recall condition, for two of our participants there was an increase in commission errors in the instructed condition, which warrants further study. The fourth participant, who remained stable in the moderate stage of dementia until near to the end of the five years of study, made errors of commission throughout the study and very few omissions, but showed no change across conditions or time. These results suggest that verbal instruction may not benefit all individuals with dementia, and it is possible that the process of instructing may actually be an additional burden on cognitive resources that are already compromised in people with dementia. Therefore, cognitive capacity must inform behavioural strategies aimed at helping everyday task performance in people with dementia

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We anticipated that the instructed-recall condition would promote more efficient error-monitoring than the performed-recall condition. Again, there were individual differences; for two of our participants, checking was highest in the performed-recall condition, but for the other two there was no change across conditions. Interestingly, all our participants continued to use checking behaviours throughout the task, well into the moderate and severe stages of dementia, but this did not reduce the number of errors, which increased with dementia progression. This result supports findings from our previous study (Balouch & Rusted, 2013) that found that healthy young and older adults use verbal and non-verbal checking behaviours in tea-making tasks, but that these behaviours were unrelated to error rate. These data all suggest that checking is not a useful means of error prevention/detection.

Finally, we anticipated reduced anticipation/sequence errors in the instructed-recall condition, because previous findings suggested that observing a sequence of goal-directed actions from an outsider's perspective benefits the recall of the organisation and sequence of the task actions (Hutton et al., 1996; Steffens, 2007). Of our four participants, only one produced sufficient anticipation errors for statistical analysis and this revealed fewer anticipation errors in the performed-recall condition, contrary to what we expected.

In Balouch and Rusted (2014), where we provided a more detailed analysis of change over time/dementia progression in the performed-recall condition, the participants showed a general decrease in accomplishment, increase in errors, and individual differences in error-monitoring. We hypothesised that the instructed-recall condition would provide protection to this decline in everyday task performance. Hence, we predicted that although accomplishment score would decline with dementia severity in all conditions, instructed recall would remain comparable with performed recall. This prediction was confirmed in AH only (the participant with the most number of sessions at each stage of DAT), indicating that

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participant-generated instruction can sustain a substantially improved retrieval, as in the performed-recall, helping to keep the participant 'on task'. However, for the remaining participants there was no significant decline in task accomplishment with dementia severity. This is most likely due to the small number of sessions available in all stages of DAT for those remaining participants, resulting in a loss of power.

In terms of recalling the various actions of the task and preventing errors, the instructed-recall condition was just as good as (if not better than) the performed-recall condition and was significantly better than the verbal-recall. Critically, this sometimes was achieved through interventions that helped them maintain the output of the task schema in the instructed-recall condition. Grinstead and Rusted (2001) found similar results in a study of mild-moderate DATs who were required to respond verbally to questions about an item's function: they found substantial deficits, when compared to controls, but the deficit was significantly reduced when participants were encouraged to provide information motorically, i.e. to act out the actions required to use the object. Grinstead and Rusted (2001) suggested that the knowledge of functional information is not degraded in DAT participants in the mild-moderate stage, but instead the deficit is apparent in the retrieval of this type of information. They suggested that the retrieval of functional information depends upon the mode that it was encoded into memory, i.e. motorically. In relation to our study, memory for everyday tasks is normally learned through performance of the task; thus, motoric retrieval, especially when cognitive resources are limited, is the most effective.

Interventions did not increase over time with dementia progression. This is surprising because one would expect more reliance on interventions as cognitive resources reduced with dementia progression. As mentioned earlier, when interventions were excluded from the analyses, the instructed-recall condition continued to outperform the verbal-recall condition.

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This suggests that interventions alone were not responsible for the good performance in the instructed-recall condition, but more likely, it was the presence of the visual cues in both performed-recall and instructed-recall conditions, that enhanced recall of the actions.

A wide body of research has shown that cortical motor areas are activated simply by observing actions, as well as performing actions (Cross et al., 2009; di Pellegrino et al., 1992; Gallese et al., 1996; Grèzes, Armony, Rowe, & Passingham, 2003b; Jenkins et al., 1994; Rizzolatti et al., 1996; Rizzolatti & Craighero, 2004b; Sakai et al., 2002). This implies that memory for everyday actions is activated through observing another person perform the actions. Two studies of observational learning in people with dementia learning a computerised motor-learning task (van Tilborg, Kessels, & Hulstijn, 2011) and two everyday tasks (van Tilborg, Kessels, & Hulstijn, 2011) found promising results, but further investigation is required.

The competence of our volunteers in instructing another person on how to perform an everyday task was quite remarkable, given the poverty of their unsupported verbal-recall. In the verbal-recall condition, participants were instructed to ‘provide as much detail as possible’, but in pilot work it was clear that it was difficult to elicit highly detailed outputs. In the original study (Rusted & Sheppard, 2002) this issue was addressed with an analysis based on “key actions” of the individual protocols – these key actions closely mirrored the basic recall elicited in the verbal condition. A separate set of analyses comparing performed and verbal recall on the key action protocols revealed that performed-recall was still superior to verbal recall. Thus, we feel confident that it was the combined effect of verbal instruction, visual and motor cues that led to the superior recall in the instructed-recall condition when compared to the verbal-recall condition.

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Seeing the static tea-making objects in the kitchen may also prompt the objects' affordances, triggering the task schema. There is substantial evidence suggesting that this conversion from vision to action is automatic and takes place even when the person has no intention to act on a viewed object (see Tipper, 2004, for a review). For example, viewing a teacup activates the motor responses to grasp the cup, regardless of whether or not it was necessary to grasp the cup at any given point in time. Therefore, simply viewing tea-making objects in front of them is likely to have contributed to sustaining the schema in the instructed-recall condition.

Another reason why our participants performed well in the instructed-recall condition, may be due to the joint-attention aspect that this condition provided, which was absent from the performed-recall and verbal-recall conditions. In the instructed-recall condition, participants were required to interact with the experimenter in order to achieve the goal of tea-making, and this interaction forced participants to keep on task. The archive data analysed here do not allow us to disentangle the potential effects of joint-attention from the impact of visual and motor cues. Some researchers have already shown that joint-attention benefits patient-caregiver communication and relationships (e.g. Astell et al., 2010; Sävenstedt et al., 2005), but to our knowledge the role of joint-attention in performing everyday tasks in people with dementia has not been studied, and warrants attention.

The present data do not allow us to differentiate the separate contributions of verbal instruction, visual and motor cues. Further experimental studies that explore each of these processes separately, in larger sample sizes, are required. This knowledge would certainly have implications for behavioural strategies to aid recall of everyday tasks in people with dementia. If visual and motor cues were found to be effective, then tasks could be re-learned through observation. For example, one (e.g. occupational therapists or a family member)

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could teach a person with dementia an everyday task by demonstrating step-by-step the sequence of actions in order to prompt his/her memory. It would be important to teach the task in the associated setting (e.g. make a sandwich in the kitchen, rather than in the living room) and using the actual objects that they would need to use (e.g. knife and bread), because the results of this study hint that visual cues of the setting and task objects are important in prompting memory. This observational learning would be particularly useful in errorless learning techniques where errors are avoided in the learning process to prevent the learner learning an incorrect motor trace (Clare & Jones, 2008). In contrast, if verbal instruction was found to be more effective, then people with dementia could be encouraged to verbalise their actions step-by-step whilst carrying out day-to-day tasks. Although, it may be difficult for the person with dementia to remember to verbally instruct themselves.

We recognise that the small number of sessions at each stage of dementia for each participant posed a limitation in our study. Although, the statistical analysis used (MANOVAs/ANOVAs) is robust and can withstand most violations of assumptions, the small number of sessions may have pushed this to its limit. For two participants, where the number of sessions was particularly low, the conclusions regarding condition were independent of dementia severity, thus increasing the pool of sessions from which the conclusion was drawn. Nonetheless, the outcomes should be interpreted cautiously.

In conclusion, the current study builds on Rusted and Sheppard's (2002) original study and Balouch and Rusted's (2014) retrospective analysis of the archive data. Rusted and Sheppard (2002) documented the recall of the everyday task steps and the types of errors that emerged with dementia progression; concluding that recall of the task became degraded with dementia progression and errors of omission became more prominent as the disease progressed. Developing on this, Balouch and Rusted (2014) documented errors and error-

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monitoring as dementia developed; concluding that error-monitoring was rarely observed. In the current study, we explored whether a verbal strategy (verbal instruction) could potentially aid the recall of the everyday task, enhance error-monitoring and reduce errors. We found that our four participants were able to verbally instruct surprisingly well and used verbal recall appropriately and fluently to instruct a third party in a tea-making activity. The presence of visual and motor cues appears to be fundamental to their sustained verbal recall of the task schema. Our study was an exploratory investigation that optimised detailed observational data, but focussed on just a small number of individual case studies. The data do show some benefits to instructed recall, in terms of task accomplishment, but there was no evidence for benefits to error-monitoring, or sequencing (i.e. anticipation) errors. In addition, our participants exhibited individual differences, making generalization of the impact and potential of the instructed-recall condition difficult. Our data explored changes longitudinally through at least two stages of dementia, and to our knowledge is the first study to do this. It provides a platform for further studies to explore the impact of verbal, observational and motoric strategies for people with dementia.

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Appendices

Appendix A.

Table A. Demographic data and the number of sessions per case-study.

Participant	Sex	Age at outset	Dates in study	MMSE at outset
AH	Male	71	Apr 1992-Sep 1994	17
TL	Male	67	Oct 1991-Apr 1994	19
DB	Female	81	April 1993-Nov 1994	15
FM	Male	83	Oct 1992-Sep 1997	18

Number of sessions by DAT-stage				
Participant	Mild	Mild-Moderate	Moderate	Severe
AH	0	6	9	6
TL	0	3	4	0
DB	0	4	3	0

Number of sessions by year (FM was a control for time)					
	Year 1	Year 2	Year 3	Year 4	Year 5
FM	4	3	4	4	5

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Appendix B.

Table B. Error-monitoring taxonomy*

Error monitoring process	Description	Example
Verbal checks	Verbalization indicating that the participant is checking or monitoring their progress.	<p>In performed-recall condition: “I’m just going to check I put the teabag in the cup.”</p> <p>In instructed-recall condition: <i>To the experimenter</i> “Did you put the teabag in the cup?”</p>
Non-verbal checks	<p>A non-verbal gesture, which indicates that the participant is checking or monitoring their progress.</p> <p>In the instructed-recall condition this physical gesture should NOT include the participant moving/touching the task objects.</p>	<p>In performed-recall condition: Physically checks the cup to see if he/she has put the teabag in the cup.</p> <p>In instructed-recall condition: Moves toward and looks at task progress, but does not touch/move objects.</p>
Intervention (<i>in instructed-recall condition only</i>)	Participant gets up from seat and physically intervenes with the task, by carrying out task actions him/herself, rather than instructing.	Instead of telling experimenter to locate cup, he gets up from seat and opens the cupboard and retrieves the cup him/herself.

Rules for coding interventions:

1. Only code as an intervention if the action is related to the protocol.
2. Do not include repetitions of actions already performed by experimenter.
3. Do not include actions that the participant later instructs the experimenter to carry out.

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4. Several interventions involving the same action are only coded once.
5. Interventions do not include verbal/non-verbal checks.
6. Interventions can include corrections, but not microslips.
7. Interventions cannot be substitutions or action-additions, but the errors still remain.

*The full error-monitoring taxonomy is reported elsewhere (Balouch & Rusted, 2013, 2014); only additional categories related to the

instructed-recall condition are described here.