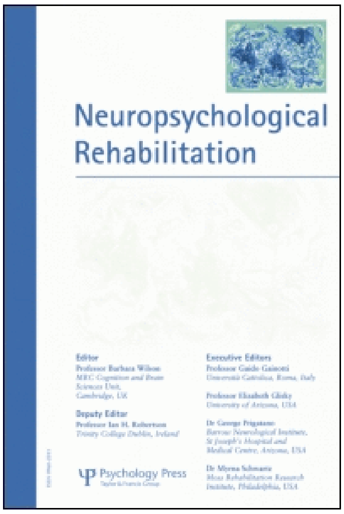

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The impact of goal cues on everyday action performance in dementia

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Everyday action performance is impaired as a consequence of dementia. Omissions (i.e., not performing task steps) are a frequent source of error in everyday tasks among dementia patients. External cues or notes are often suggested to improve everyday functioning and might specifically address omission errors; however, the efficacy of such strategies has not been evaluated. Thus, the primary aim of this study was to assess the efficacy of goal cues (i.e., reminders of everyday task objectives) for improving dementia patients' everyday action performance. Forty-four participants with mild to moderate dementia were administered the Naturalistic Action Test (NAT), a performance-based test that includes three everyday tasks. After participants indicated that they had completed each task, they were presented with a cue card restating the task goals. Videotapes were used to code task performance as well as responses to the cues. Most participants checked their work and showed significant improvement in task accomplishment/omission errors, but not commission errors, after the cues. However, effect sizes for the differences were small, and the proportion of cases in the impaired range did not differ before versus after the cues. Therefore, although statistically significant, we concluded that the goal cues did not meaningfully or clinically improve everyday functioning.

Keywords: Everyday action; Naturalistic action; Activities of daily living; Instrumental activities of daily living; Dementia.

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INTRODUCTION

The ability to perform everyday activities, such as meal preparation, is known to decline in dementia (American Psychiatric Association, 2000). This decline has been associated with numerous negative consequences, including depression, institutionalisation, caregiver burden, and so on (Knopman et al., 1988; Noale et al., 2003). In an effort to avoid these negative outcomes, clinical neuropsychologists often recommend strategies, such as notes and cue cards, to facilitate everyday functioning. However, very few studies have empirically evaluated the efficacy of these face-valid methods. This study aims to fill this gap in the literature.

Everyday action impairment in dementia

Omissions, or failures in accomplishing task steps, have been reported as the most frequent type of error in everyday tasks made by dementia patients (Giovannetti et al., 2002a; Rusted & Sheppard, 2002). Furthermore, our group has shown that relative to other error types, omissions were most strongly associated with caregiver complaints of everyday functioning, even after controlling for general dementia severity (Giovannetti et al., 2008a). Thus, we reasoned that a cueing intervention that specifically targeted omission errors might be especially meaningful for dementia patients.

Investigators have attributed omissions in everyday tasks to multiple mechanisms, including episodic memory failures, general resource limitations, and executive dysfunction. For example, work from our group has shown that omission errors made by patients with Alzheimer's disease (AD) were best predicted by overall cognitive impairment and a measure of episodic memory encoding (Giovannetti, Libon, Buxbaum, & Schwartz, 2002a; Giovannetti, Schimdt, Gallo, Sestito, & Libon, 2006; Giovannetti et al., 2008a). The association between omissions and episodic memory suggests that at least some omissions made by dementia patients may be due to the inability to recall the task goal after the task has been initiated.

The observed association between omissions and overall level of cognitive difficulty is consistent with the resource theory of everyday action impairment, which attributes everyday action errors, and specifically omission errors, to severe resource limitations or increasing task demands (Schwartz et al., 1998). The resource theory was proposed after Schwartz et al. (1998) observed consistently high rates of omission errors in individuals with moderate to severe cognitive deficits. By contrast, patients with mild cognitive deficits made omissions only on the most complex everyday tasks. Schwartz et al. (1998) postulated that omissions occurred because resource limitations imposed by brain damage, or by both brain damage and task demands, precluded patients from resolving competition among multiple possible actions.

Others have attributed omission errors to working memory/executive deficits (Duncan, 1986; Duncan, Emslie, Williams, Johnson, & Freer, 1996; Reason, 1990). Reason (1990) used the term "lapse" to denote everyday action errors due to the premature decay of an action plan. According to Reason, lapses typically manifest as omissions of tasks or task segments. Reason did not invoke episodic memory processes to explain these errors; rather he attributed lapses to executive control deficits. Similarly, in Duncan's (1986) description of "goal neglect", the task goal (or action plan) may be intact, but it is disregarded due to failures in exerting executive control over behaviour. Contrary to these executive accounts, we have not observed an association between omission errors and measures of working memory or executive control in our studies of dementia patients (Giovannetti et al., 2002a, 2006, 2008a). By contrast, we have found that measures of executive functioning have been more closely associated with various commission errors (i.e., anticipations, substitutions, etc.) in dementia and other populations (Giovannetti et al., 2008a; Kessler, Giovannetti, & MacMullen, 2007).

Interventions for everyday action impairments

Neuropsychological research efforts in everyday action rehabilitation have been sparse; the few rigorous studies in the literature have reported on only small groups or single cases. For example, Forde and Humphreys (2002) systematically evaluated a range of intervention strategies for a patient (FK) who exhibited everyday action impairment subsequent to carbon monoxide poisoning. The effect of pictures, written instructions, and concurrent modelling by the examiner was evaluated across discrete trials; the concurrent modelling condition was most effective, but did not substantially improve performance relative to baseline. In a follow-up study (Forde, Humphreys, & Remoundou, 2004), FK showed more substantial improvement following an intervention strategy designed to improve his knowledge of the task plan. While these studies offer rich detail on the effect of various, specific interventions, larger group studies are necessary. Moreover, studies with dementia participants are needed to determine the rehabilitative strategies that hold the most promise for this population.

The few studies that have included dementia or older adult participants have evaluated relatively complex intervention strategies. For instance, studies of Goal Management Training (GMT; Robertson, 1996), a rehabilitation strategy modelled after Duncan's account of goal neglect, have shown improvement of everyday action performance in a variety of participants with executive deficits, including community-dwelling older adults with subjective memory or cognitive complaint (Levine et al., 2007). However, GMT requires extensive training, deliberate processes, and considerable effort by the patient; thus, it might not be the most appropriate or straightforward strategy to use with moderately impaired patients. A study by Avila et al. (2004) showed significant improvement in everyday functioning among five dementia patients following a 14-week multidimensional neurorehabilitation programme that included external cues, as well as memory training and direct training and repetition of everyday tasks. Due to the complexity of the intervention, however, it is impossible to isolate the specific impact of external aids on performance. In sum, intervention studies that evaluate single cueing strategies among a relatively large sample of dementia participants are necessary before testing more complex or multidimensional training protocols (see Giovannetti et al., 2007).

The present study

The present study evaluated the efficacy of a single "goal cueing" strategy in 44 dementia participants using the three everyday tasks that comprise the Naturalistic Action Test (NAT; Schwartz, Buxbaum, Ferraro, Veramonti, & Segal, 2003). The cues were designed to target failures in executing task segments (i.e., omission errors), a common source of difficulty in dementia, by reminding participants of the task objectives *after* they had indicated that they were finished with the task. Therefore, we predicted that the cues would have the greatest impact on task accomplishment/omission errors, as these problems have been associated with memory failures (Giovannetti et al., 2006, 2008a). We were also interested in learning whether or not the cues would spur participants to check their work and perform compensatory behaviours.

The second aim of the study was to examine *how* the cues influenced performance, or, in other words, determine which participants benefited most from the goal cues. As stated, prior work from our laboratory has demonstrated a link between omissions and episodic memory deficits; thus, we designed the cueing intervention to address difficulties recalling the task goal. We acknowledge, however, that it is also possible that the cues could serve to reduce the cognitive resources necessary to perform the task at hand or may address working memory/executive functioning problems that cause premature decay of the action plan. Thus, to evaluate how the cues influenced behaviours, we performed simple correlation analyses between measures of the goal cue effects and independent measures of neuropsychological functioning, including measures of episodic memory, executive functioning, and general cognitive impairment. Again, based on our past work, we predicted that the goal cue effects would be most strongly related to independent measures of episodic memory. That is, the cues would be most beneficial to the participants with the greatest episodic memory problems. On alternative accounts, however, improvement in task accomplishment/omission errors would be associated with measures of executive functioning/working memory (Duncan, 1986; Duncan et al., 1996; Reason, 1990) or general resource limitations (i.e., severity of cognitive impairment; Schwartz et al., 1998). In addition to correlation analyses, we also explored our second aim through a qualitative comparison of clinical and neuropsychological characteristics of participants who benefited from the cues versus participants who did not benefit from the cues.

METHODS

Participants

Forty-four participants were recruited from an outpatient memory assessment programme that included evaluation by a neurologist, geriatrician and neuropsychologist, an MRI of the brain, and appropriate laboratory studies. All participants were diagnosed with dementia according to DSM-IV TR criteria (American Psychiatric Association, 2000) following collection of clinical data. Participants also met the following inclusion/exclusion criteria: (1) native English speaker; (2) no evidence of a focal lesion(s) or cortical cerebrovascular accident(s) on MRI; (3) no co-morbid mood disorder; and (4) no record of prior brain damage/disease, alcohol/drug abuse, or major psychiatric disorder. In order to offer an adequate test of the effect of cues, all dementia patients also had to show some degree of difficulty on the Naturalistic Action Test (described below). This was operationalised as an Accomplishment Score $<100\%$ and two or more errors on the Comprehensive Error Score (see below). A healthy control group was not recruited, because past studies have demonstrated that healthy older adults perform at or near ceiling on the NAT (Schwartz, Segal, Veramonti, Ferraro, & Buxbaum, 2002; Sestito, Schmidt, Gallo, Giovannetti, & Libon, 2005); this would have restricted our ability to detect improvement from cues.

Procedures

Participants performed the NAT on the same day in which they completed a clinical neuropsychological evaluation. All participants signed an IRB-approved informed consent form.

The Naturalistic Action Test (NAT)

The NAT requires participants to complete the following items: (1) prepare toast with butter and jelly and prepare coffee with cream and sugar; (2) wrap a gift while distractor objects that are visually/semantically similar to target objects are available on the table; and (3) pack a lunch box with a sandwich, snack, and a drink, and pack a school bag with supplies for school, while several of the necessary objects (e.g., knife, thermos lids) are stored out of view in a drawer with potentially distracting objects. The objects needed for the tasks are placed in standard locations on a U-shaped tabletop at the start of each item. NAT instructions are standardised; the examiner states the task objectives at the beginning of each item. Participants are asked to repeat the task instructions, and they do not begin the task until the instructions are accurately repeated. Once the participant begins working, the examiner does not answer specific questions or provide guidance on how to perform the task. Participants' questions (e.g., "Should I put the juice in the school bag?") are answered with vague responses (e.g., "Do what you think is best."). See the NAT manual for more details on administration (Schwartz et al., 2003).

Post-task goal cueing procedures

After the participant indicated he/she had finished each NAT item, a written cue card stating the main goal(s) of the task in 36-point font was presented directly in front of the participant. The cue text for each item is shown in Table 1. The wording used in the cues was identical to the instructions given prior to the beginning of each NAT task. As shown in Table 1, the nouns referring to major objects in the task were presented in bold and underlined text on the cue card.

After the examiner placed the card in front of the participant, she said, "This is a reminder of the task goals. Can you read this out loud for me?" If the participant did not spontaneously read the cue card aloud, then the examiner read the cue card aloud slowly, while pointing to each word on the card as it was read and encouraging the participant to read along. Only nine participants did not consistently read the cue card when it was presented. In each instance, however, the examiner read the cue card out loud for the participant. We cannot be sure whether or not these nine participants read the cue card sub-vocally or whether they were confused by the cues. Nevertheless, we performed all primary pre-cue versus post-cue analyses both with and without these nine participants and found no difference in the results. Therefore, we have no reason to believe that the cues were more or less effective if read by the participant or the examiner. After the task directions were read

TABLE 1
Cues administered after each NAT item

Item	*Text presented on goal cue(s) card*
1	1) Make **toast** with **butter** and **jelly** 2) Make **coffee** with **cream** and **sugar**
2	1) Wrap a **present**
3	1) Pack a **lunchbox** with a **sandwich**, a **drink**, and a **snack** 2) Pack a **schoolbag** with **supplies for school**

aloud (by the participant or the examiner), the examiner asked, "Are you sure you are finished?" If the participant restated that he/she was in fact finished with the task at hand after the cue, then the examiner administered the next task. However, participants who resumed working on the task after the cue were allotted as much additional time as needed to work on the task. The cue card remained on the tabletop for the participants to re-read as often as desired until they indicated that they were finished working on the task.

NAT scoring

NAT performance was videotaped for subsequent scoring. Previous publications have demonstrated high inter-rater reliability for NAT variables obtained with numerous clinical populations (Buxbaum, Schwartz, & Montgomery, 1998; Schwartz et al., 1998, 1999, 2003), including dementia (Giovannetti et al., 2002a). Additionally, prior studies have shown that scores are not affected by participants' education, gender, or motor difficulties (Giovannetti et al., 2002a; Schwartz et al., 2002, 2003). The following three NAT scores were obtained for this study:

1. *Accomplishment Score* – the percentage of task steps completed. The task steps for each NAT item have been outlined in the NAT manual (total task steps across the 3 items = 20). A step is marked as "accomplished" if the participant performs the task step, even if the task step is performed imperfectly. For example, the participant is credited for accomplishing the step "toast bread" even if she/he did so repeatedly (i.e., perseveration error) or after applying butter and jelly (i.e., sequence error). Thus, the accomplishment score does not reflect the quality of the performance of task steps, but indicates only whether or not a task step was performed. Thus, failure to accomplish a task step is comparable to an omission error. According to data from healthy older adults, the normative mean Accomplishment Score is 92.32% ($SD = 11.24$); an Accomplishment Score below 76% indicates impairment (i.e., -2 *SD* from normative *M* score).
2. *NAT score* – a composite score of task accomplishment and a subset of key commission errors that have been shown to occur frequently in neurologically impaired patients and reliably distinguish patients from healthy controls. A score ranging from 0 (Accomplishment Score $<$ 50% with or without key errors) to 6 (Accomplishment Score = 100% with at most 1 key error) is assigned to each NAT item. Then, the 0–6 scores for each item are summed to equal the NAT Score (i.e., range = 0–18; Schwartz et al., 2003). Because the NAT score reflects both accomplishment and commission errors, it is considered a measure of overall level of NAT performance/impairment.

According to norms from healthy older adults, a NAT score below 14 indicates impairment (Sestito et al., 2005).

3. *Commission errors* are the total number of errors, excluding the omission of task steps, committed while performing the NAT tasks. Readers should refer to the NAT manual and earlier publications (Buxbaum et al., 1998; Giovannetti et al., 2002a; Schwartz et al., 1998, 1999, 2003) for details on commission error types. In brief, commission errors include misordering task steps (sequence), selection of a distractor object in place of a target tool/object (substitution), the addition of an extra task step (action addition), and so on. According to older adult normative data, Total Commission Scores greater than 4 fall below 2 *SD* of the control mean and indicate impairment.

Post-cue scoring

After administration of the goal cues, the following variables were collected:

1. *Checking behaviours* – coded when participants moved or scanned objects on the tabletop after administration of the cues.
2. *Post-cue accomplishment* – the number of additional task steps completed correctly after the cues were administered (Post-Cue Raw Accomplishment). Like the Pre-Cue Accomplishment Score, a task step was marked as newly accomplished post-cue even if that task step was performed imperfectly. Pre-Cue and Post-Cue Accomplishment do not reflect the quality of actions. The number of additional steps accomplished also was added to the Pre-Cue Accomplishment Score to form the Post-Cue Accomplishment Score.
3. *Post-cue commission errors* – the number of new, additional commission errors committed after the administration of the cues was recorded (Post-Cue Raw Additional Errors). The number of commission errors corrected after post-task cues also was calculated (Post-Cue Raw Corrected Errors). Then, the pre-cue total commission score was adjusted to account for both new and corrected errors using the following formula: Post-Task Total Commissions = Pre-Cue Total Commissions + Post-Cue Raw Additional Errors − Post-Cue Raw Corrected Errors.

Neuropsychological assessment

The Mini Mental-State Examination (MMSE), a measure of overall level of cognitive impairment/severity (Folstein, Folstein, & McHugh, 1975), the

Geriatric Depression Scale (GDS; Yesavage, 1986), a rating scale to screen for clinical depression, and a core set of neuropsychological tests examining executive functioning and episodic memory were administered to all participants as part of their clinical evaluation. Table 2 provides a description of the neuropsychological measures. Caregiver reports of patients' abilities to perform activities of daily living (ADL) and instrumental (I) ADL in the home (Lawton & Brody, 1969) also were obtained for 43 of the 44 participants.

Data analysis

All analyses were performed using SPSS version 15.0. Descriptive analyses revealed that most NAT variables were not normally distributed and not

TABLE 2
Neuropsychological measures

Test	*Description*	*References*
Overall Cognitive Severity		
Mini-Mental State Examination (MMSE)	Participants were asked to answer questions on temporal orientation, attention, immediate and short term recall, language, etc. The Total Score ranges from 0–30, with lower scores reflecting greater overall impairment/dementia severity.	Folstein et al., 1975
Working Memory/ Executive Functions		
Boston Revision of the Wechsler Memory Scale- Mental Control Subtest (WMS Mental Control)	The accuracy of performance on three nonautomatised tasks (months backward, alphabet rhyming, alphabet visualisation) was calculated with the following algorithm: [1 – (false positives + misses)/(#possible correct)] × 100	Cloud et al., 1994; Lamar et al., 2002
Phonemic word list generation (FAS)	The dependent variable is the number of words produced in 60 seconds beginning with F, A, or S, excluding proper nouns.	Spreen & Strauss, 1998
Clock Drawing Test	Participants were asked to 1) draw a clock with the hands set to 10 past 11 and 2) copy a drawing of a clock. Ten possible errors were scored on each trial.	Libon et al., 1996
Episodic Memory		
Philadelphia (Repeatable) Verbal Learning Test (PrVLT)	Participants were asked to remember a 9 word list, as on the CVLT. The dependent variables included total words recalled across trials 1–5 (PrVLT 1–5) and the accuracy on the delayed recognition memory task (PrVLT Discriminability).	Libon et al., 2005

easily transformed; therefore, non-parametric analyses were performed. The effect of post-task cues was assessed by comparing NAT performance variables before and after the cues using Wilcoxon signed-rank tests and chi square analyses. Effect sizes were calculated for all primary comparisons. For small samples, the power efficiency of non-parametric analyses is nearly 95% of the *t*-test (Siegal & Castellan, 1988). Therefore, effect sizes were estimated by Cohen's *d* calculations (0.2 = small; 0.5 = medium; 0.8 = large; Cohen, 1988).

Relations between NAT variables and neuropsychological measures were assessed using Spearman rank order correlation analyses. Neuropsychological test data from a minority of patients were missing (see Table 3). Missing data were due to recording errors, time constraints, patient frustration, and/or other random factors.

RESULTS

Sample characteristics

On average, participants ($n = 44$) were 76.39 years old ($SD = 9.42$) and had completed 11.70 years of education ($SD = 2.45$). Sixty-one percent of the sample was comprised of women ($n = 27$). The sample included participants with a range of diagnoses, reflecting the variety of patients typically seen in an outpatient memory clinic. Specifically, 50% of participants were diagnosed with Alzheimer's disease (AD; $n = 22$), 20% with subcortical ischaemic vascular dementia ($n = 9$), 16% with mixed dementia ($n = 7$), 9% with frontotemporal ($n = 4$), and 5% with Parkinson's disease dementia/dementia with Lewy bodies ($n = 2$).

The mean MMSE score of the sample was 22.64 ($SD = 3.42$), suggesting mild to moderate overall impairment, with the majority of participants exhibiting mild dementia ($n = 30$; MMSE = 22–29) and 14 participants

TABLE 3
Mean neuropsychological test scores

	Dementia participants M (SD)	*Normative scores M (SD)*
WMS Mental Control ($n = 35$)	62.14 (24.73)	91.14 (10.62)
FAS ($n = 38$)	19.97 (9.63)	35.27 (3.28)*
Clock-Drawing Test (errors; $n = 43$)	4.67 (2.64)	1.5 (1.5)
PrVLT 1-5 ($n = 39$)	21.74 (6.03)	32.48 (5.20)
PrVLT Discriminability ($n = 39$)	73.26 (15.01)	96.61 (4.00)

*Spreen & Strauss, 1998; all other normative data taken from Libon et al., 2004 and Price et al., 2005.

exhibiting moderate to severe dementia (MMSE = 13–21; Folstein et al., 1975). Scores on the Geriatric Depression Scale were well within normal limits (M = 5.49, SD = 5.87; Yesavage, 1986). Caregivers reported a mild to moderate level of ADL impairment (maximum possible score = 6, M = 4.77, SD = 1.63), and moderate IADL impairment (maximum possible score = 17, M = 10.74, SD = 4.74; Lawton & Brody, 1969). Mean neuropsychological test scores for the sample and normative scores from prior publications are reported in Table 3. As shown in Table 3, on average, our sample demonstrated impairment on all neuropsychological measures of executive control/working memory and episodic memory.

NAT performance before cues

Mean NAT Scores (11.71, SD = 5.00), Accomplishment Scores (74.20, SD = 23.00), and Total Commissions (9.30, SD = 6.43) fell within the impaired range relative to published norms (Giovannetti, Schwartz, & Holz, 2005; Giovannetti et al., 2008b; Sestito et al., 2005). Moreover, all scores were within the range of those previously reported for mild to moderately impaired dementia participants (Giovannetti et al., 2002a; 2006; 2008a).

Post-cue behaviours

Most participants (n = 32; 73%) checked their work after at least one of the three post-task cues. On average, participants performed 1.49 (SD = 1.52) checks across the NAT items (maximum number of possible checks = 3). Almost one-third (i.e., 32%) of participants (n = 14) accomplished one step or more after the cues; on average, 0.61 new steps were accomplished (SD = 1.30). Only six participants (14%) corrected at least one error after the cues (mean number of corrected errors = 0.23; SD = 0.60). Interestingly, 11 participants (25%) made one or more additional NAT error(s) after the post-task cues (M = 0.52, SD = 1.07).

NAT scores before post-task cues versus after post-task cues

As shown in Table 4, NAT Scores and Accomplishment Scores were significantly higher after the implementation of post-task cues than before the cues; however, the effect sizes for these differences were small ($d \leq 0.12$). Total commission errors did not differ across the two conditions. We also performed all pre- versus post-cue analyses separately for participants with mild overall cognitive impairment (n = 30; MMSE = 22–29) and participants exhibiting moderate to severe overall cognitive impairment (n = 14; MMSE = 21–13). Both groups demonstrated comparable patterns of performance, and, consistent with analyses for the entire sample, effect sizes were small. Thus, we concluded that the effect of the cues did not differ

TABLE 4
Mean scores on the NAT before post-task cues versus after post-task cues

	Before cues *M (SD)*	*After cues* *M (SD)*	*Wilcoxon* *Z*	*Signed ranks* *p* value	*Effect* *size d*
NAT Score	11.06 (4.67)	11.61 (4.75)	2.67	.01	0.11
Accomplishment Score	74.20 (23.00)	77.00 (23.00)	3.20	<.01	0.12
Total Commission Errors	9.30 (6.43)	9.30 (6.43)	0.01	.99	0.00

for patients with mild overall impairment versus those with moderate/severe overall impairment.

When participants' pre- and post-cue scores were compared to previously published normative NAT data (Giovannetti et al., 2005, 2008b; Sestito et al., 2005), we found that 70% of the sample ($n = 31$) fell within the impaired range (i.e., -1.5 *SD* below the normative *M*) before the cues; 68% fell within the impaired range after the goal cues, $\chi^2(1) = 0.01$, $p > .05$. With respect to Accomplishment Scores, 47% of participants were impaired before the cues and 39% after the cues, but this difference was not significant, $\chi^2(1) = 0.42$, $p > .05$. Additionally, the percent of participants that produced rates of commission errors within the impaired range was not significantly different before versus after the cues, 79% vs. 77%; $\chi^2(1) = 0.01$, $p > .05$.

Were the goal cues ignored, ineffective, or both?

As reported above, not all participants checked their work following presentation of the goal cues. We considered the possibility that participants who had never checked their work (total checks $= 0$; $n = 12$) had ignored the cues because they had accomplished the task objectives with few errors, and therefore, could not benefit from the goal cues. To explore this possibility, we compared NAT performance before the cues for participants who never checked their work ($n = 12$) versus those who consistently checked their work (total checks $= 3$; $n = 14$) in response to the cues. We found that these subgroups of participants did not differ on the NAT Score ($M = 10.67$ vs. 11.07; $z = 0.60$, $p = .56$), Accomplishment Score ($M = 68.35$ vs. 71.25; $z = 0.38$, $p = .40$), nor Total Commissions ($M = 9.67$ vs. 9.30; $z = 0.86$, $p = .86$). Therefore, the performance of participants who did not check their work after the presentation of the cues was impaired on the NAT, and could have been improved. For some reason, however, the goal cues were *both* ignored and ineffective for this subgroup of participants.

Next, we evaluated the effects of the goal cues only for those participants who consistently checked their work after the cue. These analyses allowed us to assess the effectiveness of the cues for those participants who actually used the cues on each trial (total checks $= 3$; $n = 14$). In other words, we evaluated whether or not the cues were effective when they were not ignored. Over half of this subgroup ($n = 8$) accomplished more task steps after the cues; on average, 1.43 new steps were accomplished ($SD = 1.99$). Only three participants (21%) corrected at least one error after the cues (M number of corrected errors $= 0.36$, $SD = 0.74$), but six participants (43%) committed additional errors (M number of new errors after the cue $= .79$, $SD = 1.21$). When NAT scores before the cues were compared to NAT scores after the cues for this subgroup, the results showed the same pattern of findings as with the entire sample. That is, Accomplishment Scores were significantly higher after the cues ($M = 77.15$ vs. 83.95; $Z = 2.39$, $p = .02$), and there was a trend for higher NAT Scores ($M = 12.79$ vs. 11.86; $Z = 1.90, p = .06$). However, there was no difference in Total Commission Errors ($M = 11.93$ vs. 11.86; $Z = 0.33, p = .74$). The effect sizes for the differences in Accomplishment ($d = 0.61$) and NAT Score ($d = 0.29$) in this subgroup were markedly greater than the effect sizes observed for the entire sample (i.e., medium vs. small). However, the percent of participants whose scores fell within the impaired range did not significantly differ before versus after the cues, NAT Score 71% vs. 79%; Total Accomplishment 71% vs. 64%; Total Commission Errors 79% vs. 79%; $\chi^2(1) < 0.19$, $p > .05$ for all. These analyses suggest that although the effects of the goal cues were stronger in this subgroup, the cues did not meaningfully improve performance on the NAT even among the subgroup of participants who responded to the cues by checking their work.

We conclude that the cues were ignored or not useful for a subgroup of dementia participants ($n = 12$; 27% of the sample did not check their work after the cues). Another subgroup of participants consistently responded to the cues ($n = 14$; 32% of the sample consistently checked their work after the cues), but even among this subgroup, the cues did not lead to clinically meaningful improvement in action performance.

Correlations between post-task cue behaviours and neuropsychological scores

Spearman rank order correlations among post-cue behaviours and neuropsychological tests are reported in Table 5. For the most part, correlations were relatively weak. However, the number of commission errors corrected across the three items (i.e., Post-Cue Raw Corrected Commissions) significantly and positively correlated with a measure of working memory/executive functioning (WMS – Mental Control). The direction of this relation suggests that

TABLE 5
Spearman rank order correlation coefficients for post-task variables × neuropsychological test scores

	Overall cognitive severity	*Working memory/ executive functions*			*Episodic memory*	
	MMSE $n = 44$	*WMS mental control* $n = 35$	*FAS* $n = 38$	*Clock drawing test* $n = 43$	*PrVLT 1–5* $n = 39$	*PrVLT disc.* $n = 39$
Post-Cue Raw Accomplishment	−.05	.11	−.25	−.01	−.20	−.12
Post-Cue Raw Corrected Commissions	−.01	.38*	−.03	.13	−.06	−.07
Checking Behaviours	−.04	.18	−.13	−.04	−.10	−.30*

$^{*}p < .05$. disc. = discriminability.

patients with better working memory/executive abilities corrected more errors following presentation of the goal cues. The correlation between checking behaviours and a measure of episodic memory (PrVLT discriminability) was significant and negative, suggesting that patients with greater episodic memory impairment exhibited more checking behaviours following the presentation of the goal cues. Contrary to expectation, however, there were no significant relations between the number of new steps accomplished after the cues (i.e., Post-Cue Raw Accomplishment) and measures of episodic memory or any other neuropsychological variable.

Characteristics of participants most responsive to the goal cues: Responders vs. non-responders

Upon inspection of individual participant data, we observed that only six participants accomplished two or more additional steps on the NAT after the goal cues, whereas all other participants accomplished only one ($n = 8$) or no ($n = 30$) additional steps. We arbitrarily designated the former subgroup of six participants "Responders" ($n = 6$) and compared them to the remaining participants (i.e., "Non-responders", $n = 38$), as we were interested in identifying characteristics that differentiated those participants who benefited substantially from the goal cues from those who did not. Thus, mean demographic variables, neuropsychological test scores, NAT scores before the presentation of cues, and checking behaviours in response to the cues were examined between the two groups (see Table 6). Because there were too

TABLE 6
Mean demographic variables, neuropsychological test scores, and NAT scores for responders and non-responders

	Responders n = 6			*Non-responders n = 38*		
	M		*SD*	*M*		*SD*
Demographics and Neuropsychological Variables						
Age	75.5		3.39	76.53		10.08
Education	12.8		1.1	11.55		2.54
Sex (% women)		50%			63%	
Diagnosis (% AD)		83%			45%	
MMSE	22.17		2.35	22.71		4.91
WMS Mental Control	66.93		25.37	61.15		24.93
FAS	13.67		3.83	21.16		9.96
Clock Drawing Test	4.83		2.14	4.64		2.74
PrVLT 1–5	17.33		5.09	22.55		5.9
PrVLT Discrminability	66.37		20.39	74.51		13.86
NAT Variables before Cues						
NAT Score	9.5		2.34	11.31		4.91
Accomplishment Score	65.85		11.59	72.11		23.73
Total Comission Errors	8.67		3.88	9.39		6.77
Response to Cues						
Checking Behaviours	2.83		0.4	1.32		1.16

few responders, only qualitative comparisons could be made. As shown in Table 6, we noted that relative to non-responders, on average, responders had completed high school, were more likely to have a diagnosis of AD, generated 7.5 fewer words on an executive test of verbal fluency (FAS), recalled 1.8 fewer words on a list learning task (PrVLT 1–5) and obtained lower scores when asked to identify these words on a yes/no forced-choice recognition test format (PrVLT Discriminability). On the NAT, responders showed lower NAT scores due to reduced task accomplishment/more omission errors as compared to non-responders, who demonstrated higher task accomplishment/fewer omission errors and slightly more commission errors. Finally, as expected, Responders were much more likely to check their work after the cues compared to non-responders.

DISCUSSION

The primary goal of the present study was to determine the efficacy of written reminders of task objectives or goals (i.e., goal cue) on everyday action performance in a group of individuals diagnosed with degenerative dementia. As predicted, the cues resulted in participants accomplishing more task steps (i.e., fewer omission errors). The cues did not spur participants to correct commission errors that were made earlier, before presentation of the cues (i.e., Total Commission Errors did not differ). Thus, as predicted, the cues had a circumscribed effect on task accomplishment/omission errors; they did not reduce commission errors.

It is important to note that the effect size for the difference in task accomplishment was small and the proportion of cases that fell in the impaired range did not differ before the cues versus after the cues. We did observe stronger effect sizes for a subgroup of participants who checked their work after presentation of the cues; however, even among this subgroup, the cues did not shift NAT performance from the impaired to unimpaired range. Therefore, although pre-cue versus post-cue analyses were statistically significant, we concluded that the significant increase in accomplishment scores after the goal cues was not clinically meaningful.

The second goal of the study was to determine *how* the cues influenced performance on everyday tasks. We predicted that if the cues targeted episodic memory failures, then we would observe an association between episodic memory functioning and the number of steps accomplished after the cues. Earlier, however, we acknowledged that other accounts for omission errors would predict associations between accomplishment/omission scores and measures of executive functioning/working memory (Duncan, 1986; Duncan et al., 1996; Reason, 1990) or overall level of cognitive impairment (Schwartz et al., 1998). Correlation analyses did not support any of these accounts. That is, contrary to prediction, the number of additional steps accomplished after the cues was not significantly correlated with any of the neuropsychological tests of episodic memory, executive functioning/working memory, or overall cognitive impairment. This may have been due to the relatively weak effect of the goal cues among the sample.

Qualitative analysis of the small subgroup of participants who did show improvement in task accomplishment/omission errors following the cues (i.e., responders), however, showed that responders performed more poorly than non-responders on measures of episodic memory (P[r]VLT 1–5, P[r]VLT Discriminability) and a single measure of executive control/working memory that reflects generative verbal abilities (FAS). Moreover, the responders were more likely to have AD, which, relative to the other dementia diagnostic subgroups in the sample, is more strongly associated with episodic memory deficits (Libon, Price, Garrett, & Giovannetti, 2004). Thus, inspection of the clinical and neuropsychological characteristics of the participants who made the most accomplishment gains subsequent to the cues lends some support for the prediction that the cues may have successfully targeted omissions that were due to episodic memory failures and executive functioning/working memory problems. However, the small group of responders precluded statistical analysis of the data. Thus, these interpretations are speculative and should be the focus of future studies.

Correlation analyses including the entire sample did show a link between episodic memory performance and checking behaviours, such that participants with greater memory deficits were more likely to exhibit checking behaviours after presentation of the goal cues. If participants with greater memory deficits were more likely to check their work following the cues, why did they not show a greater benefit from the cues? One possibility is that participants may not have known what to do in response to the goal cues. That is, dementia may have caused degraded knowledge of the task or poor problem solving skills, in which case a cue of the task goal may have been insufficient to improve performance. Another possibility, however, is that patients with memory deficits were unable to recall past actions (i.e., what they had or had not accomplished prior to the cue), which may be essential to successfully utilise the goal cues.

The correlation analysis also demonstrated an association between the number of errors corrected after the cues and executive functioning/working memory ability. Specifically, participants who performed best on a measure of working memory corrected more errors after presentation of the goal cues. This suggests that in order for dementia patients to correct their everyday action errors after a cue, they must be able to keep in mind what they did or did not do earlier in the task. In sum, patients with greater working memory abilities are more likely to benefit from the form of goal cues presented in this study. This finding is consistent with our past work showing an association between executive control/working memory abilities and everyday commission errors in dementia patients (Giovannetti et al., 2008a, 2006).

Taken together, the results demonstrated that the goal cues did increase the number of task steps accomplished but did not lower the rate of commission errors. This result suggests that at least some omission errors, but not commission errors, are due to the inability to recall task goals. Clinically, however, the cues did not meaningfully improve task performance. In fact, 25% of participants actually made additional, new errors after the cues. Therefore, written cue cards should not be recommended to improve everyday functioning for people with dementia.

It is worth noting that the analyses of "checking behaviours" after presentation of the cues demonstrated that the cues successfully urged most participants to check their work. That is, the cues were often effective in urging participants to monitor the table top and evaluate their past performance. However, the failure of the cues to meaningfully improve performance also suggests that monitoring task progress may not be the primary cause for everyday action deficits in this population (see Bettcher, Giovannetti, & MacMullen, 2008). It is possible that interventions that target degraded task knowledge may be more successful than goal reminders (see Forde et al., 2004). Alternatively, it is possible that the goal cues would have been more effective if they were available to participants during the planning and execution of the task rather than at the end of the task after participants had lost track of what they had already done.

We acknowledge that this study had limitations. First, the linguistic nature of the cues may have deterred their benefits. Participants may have experienced difficulty translating the linguistic information to an action plan for task performance, or language/reading deficits among participants may have precluded comprehension of the task cues. Without independent measures of language/reading comprehension, it is difficult to know whether participants fully comprehended the goal cues. It is quite possible that pictorial cues, illustrating the end state of each task, may have been more effective. Second, we included a heterogeneous sample and did not have a sample large enough to examine differential effects of the cues across individuals with different dementia diagnoses (e.g., Alzheimer's disease versus vascular dementia, etc.). Our heterogeneous sample was comprised mostly of patients with Alzheimer's disease and reflected the distribution of patients commonly evaluated at an outpatient memory clinic. When the Alzheimer's subgroup was analysed separately, the effects of the cues were significant with small effect sizes, consistent with the entire sample. The other subgroups did not show significant pre-cue versus post-cue differences, but this might have been due to the small size of the subgroups ($n < 10$) and insufficient statistical power. Future work should evaluate whether the efficacy of goal cues differs across dementia subgroups. Third, some neuropsychological test data were missing for a minority of participants in the study ($<5\%$ of the sample); this reduced the statistical power of some of the correlational analyses. A fourth limitation is that we did not collect data on our participants' medication regimen. It would have been interesting to learn whether participants who were taking cholinesterase inhibitors (e.g., donepezil) were more or less likely to benefit from the cues. Future studies should evaluate the combined effects of behavioural/environmental cues and medications. Clearly, more work is needed to determine the efficacy of cues and intervention strategies in the hope of understanding the nature of functional difficulties and reducing the negative consequences associated with everyday action errors in individuals with dementia.

Despite the aforementioned limitations, this study had numerous strengths. First, it offered a clear test of a single cueing procedure. Second, the study included a large sample of participants from an outpatient memory assessment clinic. Most prior studies included only small groups, a series of case studies, or a single case report. Third, everyday action performance was evaluated using a standardised procedure and a comprehensive analysis of errors and accomplishment. Checking or evaluative behaviours were recorded in addition to variables reflecting improved performance; this offered the opportunity to disambiguate whether participants failed to respond to the cues or failed to improve their performance following the cues.

In conclusion, our results suggest that in general, cues or reminders, particularly when presented at the *end* of an everyday task, should not be strongly recommended as a method for improving everyday action in people with dementia. Instead, alternative behavioural/environmental strategies, such as the strategic placement of objects in the workspace, which have been shown to have larger and clinically meaningful effects on everyday action performance, should be more routinely recommended to patients and their caregivers (see Giovannetti et al., 2007). Finally, behavioural strategies for improving everyday action (e.g., note cards, lists, calendars, etc.), even when intuitive or face valid, should be tested for dementia patients, and patients and their caregivers should be informed when recommended interventions or strategies have not been rigorously evaluated.

REFERENCES

American Psychological Association (2000). *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.). Arlington: American Psychiatric Association Press.

Avila, R., Bottino, C. M. C, Carvalho, I. A. M., Santos, C. B., Seral, C., & Miotto, E. C. (2004). Neuropsychological rehabilitation of memory deficits and activities of daily living in patients with Alzheimer's disease: A pilot study. *Brazilian Journal of Medical and Biological Research*, *37*, 1721–1729.

Bettcher, B. M., Giovannetti, T., & MacMullen, L. (2008). Error detection and correction in dementia: A breakdown of error monitoring processes and their neuropsychological correlates. *Journal of the International Neuropsychological Society, 14*, 199–208.

Buxbaum, L. J., Schwartz, M. F., & Montgomery, M. (1998). Ideational apraxia and naturalistic action. *Cognitive Neuropsychology, 15*, 617–643.

Cloud, B. S., Swenson, R., Malamut, B. L., Kaplan, E., Sands, L. P., Gitlin, H., & Libon, D. J. (1994). The Boston revision of the Wechsler Memory Scale – Mental Control Subtest. *Journal of the International Neuropsychological Society*, *1*, 354.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cosentino, S., Jefferson, A. J., Chute, D. L., Kaplan, E., & Libon, D. L. (2004). Clock drawing errors in dementia: Neuropsychological and neuroanatomic considerations. *Cognitive and Behavioral Neurology*, *17*, 74–83

Duncan, J. (1986). Disorganization of behavior after frontal lobe damage, *Cognitive Neuropsychology*, *3*, 271–290.

Duncan, J., Emslie, H., Williams, P., Johnson, R., & Freer, C. (1996). Intelligence and the frontal lobe: The organization of goal-directed behavior, *Cognitive Psychology*, *30*, 257–303.

Folstein, M., Folstein, S., & McHugh, P. (1975). Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*, 189–198.

Forde, E. M. E., & Humphreys, G. W. (2002). Dissociations in routine behavior across patients and everyday tasks. *Neurocase*, *8*, 151–167.

Forde, E. M. E., Humphreys, G. W., & Remoundou, M. (2004). Disordered knowledge of action order in action disorganisation syndrome. *Neurocase*, *10*, 19–28.

Giovannetti, T., Bettcher, B. M., Brennan, L., Libon, D. J., Kessler, R. K., & Duey, K. D. (2008a). Coffee with jelly or unbuttered toast: Commissions and omissions are dissociable aspects of everyday action impairment in Alzheimer's disease, *Neuropsychology*. *22*, 235–245

Giovannetti, T., Bettcher, B. M., Libon, D. J., Brennan, L., Sestito, N., & Kessler, R. (2007). Environmental adaptations improve everyday action performance in Alzheimer's disease: Empirical support from performance-based assessment, *Neuropsychology*, *21*, 448–457.

Giovannetti, T., Lamar, M., Cloud, B. S., Grossman, M., & Libon, D. J. (1997). Impairment in category fluency in ischemic vascular dementia. *Neuropsychology*, *11*, 400–412.

Giovannetti, T., Libon, D. J., Buxbaum, L. J., & Schwartz, M. F. (2002a). Naturalistic action impairments in dementia. *Neuropsychologia*, *20*, 1220–1232.

Giovannetti, T., Libon, D. J., & Hart, T. (2002b). Awareness of naturalistic action errors in dementia. *Journal of the International Neuropsychological Society*, *8*(5), 633–644.

Giovannetti, T., Schimdt, K., Gallo, J., Sestito, N., & Libon, D. J. (2006). Naturalistic action in dementia: Evidence for differential deficits in Alzheimer's disease versus vascular dementia. *Journal of the International Neuropsychological Society*, *12*(1), 45–53.

Giovannetti, T., Schmidt, K. S., Lieto, J. M., Gallo, J. L., Ferri, C., Sestito, N., & Libon, D. J. (2008b). Using the Naturalistic Action Test (NAT) with older adults: Norms and validity data. Manuscript submitted for publication.

Giovannetti, T., Schwartz, M. F., & Holz, D. (2005) A comparison of two scoring methods for naturalistic action assessment. *Journal of the International Neuropsychological Society*, *11-S1*, 75–76.

Kaplan, E., Goodglass, H., & Weintraub, S. (1983). *The Boston Naming Test.* Philadelphia: Lea and Febiger.

Kessler, R. K., Giovannetti, T., & MacMullen, L. (2007). Everyday action in schizophrenia: Performance patterns and underlying cognitive mechanisms. *Neuropsychology*, *21*, 439–447.

Knopman, D. S., Kitto, J., Deinard, S., & Heiring, J. (1988). Longitudinal study of death and institutionalization in patients with primary degenerative dementia. *Journal of the American Geriatric Society*, *36*, 108–112.

Lamar, M., Price, C., Davis, K. L., Kaplan, E., & Libon, D. J. (2002). Capacity to maintain mental set in dementia. *Neuropsychologia*, *40*, 435–445.

Lawton, M., & Brody, E. (1969). Assessment of older people self-maintaining and instrumental activities of daily living. *Gerontologist*, *9*, 179–186.

Levine, B., Robertson, I., Clare, L., Carter, G., Hong, L., Wilson, B. A., Duncan, J., & Stuss, D. (2000). Rehabilitation of executive functioning: An experimental-clinical validation. *Journal of Clinical and Experimental Neuropsychology*, *20*, 30–41.

Levine, B., Stuss, D. T., Winocur, G., Binns, M. A., Fahy, L., Mandic, M., et al. (2007). Cognitive rehabilitation in the elderly: Effect on strategic behavior in relation to goal management. *Journal of the International Neuropsychology Society*, *13*, 143–152.

Libon, D. J., Malamut, B. L., Swenson, R., & Cloud, B. S. (1996). Further analysis of clock drawings among demented and non-demented subjects. *Archives of Clinical Neuropsychology*, 11, 193–211.

Libon, D. J., Price, C., Garrett, K. D, & Giovannetti, T. (2004). From Binswanger's disease to Leukoaraiosis: What we have learned about subcortical vascular dementia. *Clinical Neuropsychologist*, *18*, 83–100.

Libon, D. J., Schmidt, K. S., Gallo, J. L., Penney, D. L., Swenson, R., Giovannetti, T., & Miller, J. A. (2005). The prototypicality of extra-list intrusion errors produced on a serial list-learning task by patients with mild dementia. [Abstract] *Journal of the International Neuropsychological Society*, *11*(Suppl. 1), 92–93.

Libon, D. J., Swenson, R., Barnoski, E., & Sands, L. P. (1993). Clock drawing as an assessment tool for dementia. *Archives of Clinical Neuropsychology*, *8*, 405–416.

Noale, M., Maggi, S., & Minicuci, N. (2003). Dementia and disability: Impact on mortality. *Dementia and Geriatric Cognitive Disorders*, 16(1), 7–14.

Price, C. Jefferson, A. L., Merino, J., Heilman, K., & Libon, D. J. (2005). Towards an operational definition of the research criteria for subcortical vascular dementia: Integrating neuroradiological and neuropsychological data. *Neurology*, *65*, 376–382.

Reason, J. T. (1990). *Human Error*. London: Cambridge University Press.

Robertson, I. H. (1996). *Goal Management Training: A Clinical Manual.* Cambridge, UK: PsyConsult.

Rusted, J., & Sheppard, L. (2002). Action-based memory in Alzheimer's disease: A longitudinal look at tea-making. *Neurocase*, 8, 111–126.

Schwartz, M. F., Buxbaum, L. J., Ferraro, M., Veramonti, T., & Segal, M. (2003). *The Naturalistic Action Test.* Bury St. Edmunds, UK: Thames Valley Test Company.

Schwartz, M. F., Buxbaum, L. J., Montgomery, M. W., Fitzpatrick-DeSalme, E., Hart, T., Ferraro, M., Lee, S., & Coslett, H. B. (1999). Naturalistic action production following right hemisphere stroke. *Neuropsychologia*, *37*, 51–66.

Schwartz, M. F., Montgomery, M. W., Buxbaum, L. J., Lee, S., Carew, T. G., Coslett, H. B., Ferraro, M., Fitzpatrick-Desalme, E., Hart, T., & Mayer, N. H. (1998). Naturalistic action impairment in closed head injury. *Neuropsychology*, *12*, 13–28.

Schwartz, M. F., Segal, M., Veramonti, T., Ferraro, M., & Buxbaum, L. J. (2002). The naturalistic action test: A standardized assessment for everyday action impairment. *Neuropsychological Rehabilitation*, *12*(4), 311–339.

Seigal, S., & Castellan, N. (1988). *Nonparametric Statistics for the Behavioral Sciences* (2nd ed.). Boston: McGraw-Hill.

Sestito, N., Schmidt, K., Gallo, J., Giovannetti, T., & Libon, D. (2005). Using the Naturalistic Action Test (NAT) to assess everyday action in healthy older adults and patients with dementia. [Abstract] *Journal of the International Neuropsychological Society*, *11*(Suppl. 1), 90–91.

Spreen, O., & Strauss, E. (1998). *A Compendium of Neuropsychological Tests* (2nd ed.). New York: Oxford.

Yesavage, J. (1986). The use of self-rating depression scales in the elderly. In: Poon, L. W. (Ed.), *Handbook of Clinical Memory Assessment Older Adults* (pp. 213–221). Washington, DC: American Psychological Association.

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