Discourse Comprehension Test Performance of Elders With Dementia of the Alzheimer Type

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Spoken language comprehension, including comprehension for inferential material in narrative discourse, is diminished in dementia of the Alzheimer type (DAT). There are, however, no empirical data concerning comprehension by adults with DAT of main ideas versus details in narratives. Evidence from other groups with and without brain damage has shown that comprehension for main ideas is relatively better than for details and that comprehension for stated material is relatively better than comprehension for inferential material. Participants in the present investigation were 24 older adults, 8 with early-stage DAT (EDAT), 8 with middle-stage DAT (MDAT), and 8 with no brain damage (NBD). Selected narratives and associated sets of yes-no questions from the Discourse Comprehension Test (DCT) (Brookshire and Nicholas, 1993) were presented on videotape. Participants with EDAT and MDAT had significantly poorer overall comprehension of DCT narratives than did those in the NBD group (p < .0001), but they did not differ significantly from each other. Responses to DCT narratives by participants in the NBD, EDAT, and MDAT groups followed the same pattern of relatively better comprehension for main ideas than for details and relatively better comprehension for stated than for implied information. Working memory and episodic memory were shown to be significantly associated with DCT overall scores. Together, these findings suggest that although overall narrative comprehension is diminished in those with DAT, individuals appear to retain a mental representation for narratives that facilitates better comprehension of main ideas than of details as well as better comprehension of stated information than of implied information. This interpretation is consistent with schema-based accounts of narrative comprehension.

KEY WORDS: Alzheimer's disease, dementia, discourse comprehension, narrative comprehension

The tendency for expressive language skills to deteriorate early in dementia of the Alzheimer type (DAT) has been well documented (e.g., Bayles & Kaszniak, 1987; Murdoch, Chenery, Wilks, & Boyle, 1987). Relatively little attention, however, has been devoted to describing spoken-language comprehension deficits that may affect individuals with DAT. This oversight is all the more surprising because spoken language comprehension is an important component of functional communication. When comprehension for spoken language is diminished, individuals may have difficulty fully participating in conversation, with abstracting meaning from television and radio programs, and with following health care and other instructions.
Deficits in spoken language comprehension in DAT may result in altered communication that is readily apparent to family members and other caregivers. In a study by Orange (1995), nearly all family caregivers of persons with DAT in the early stage (EDAT) and middle stage (MDAT) reported awareness of their relative's difficulty with spoken language comprehension early in the development of dementia symptomatology. These family caregivers recalled that although comprehension difficulties began gradually and were initially subtle, they eventually became a significant source of frustration for both the caregiver and the individual with DAT (Orange, 1995). Similarly, Bayles and Tomoeda (1991) asked family and other caregivers of community-dwelling elders with DAT to report on the prevalence and order of appearance of 16 linguistic-communication behaviors. Results indicated that “difficulty comprehending instructions” was ranked fourth in prevalence (after “difficulty finding words,” “difficulty naming objects,” and “difficulty writing letters”) and sixth in order of appearance.

Diminished spoken language comprehension has also been reported for individuals with mild DAT on tests of word recognition, spoken commands, and sentence comprehension (e.g., Bayles & Kaszniak, 1987; Kempler, Almor, & MacDonald, 1998; Murdoch et al., 1987; Rochon, Waters, & Caplan, 1994). Other research has focused on the conversational skills of persons with DAT. Results from this line of research suggest that spoken language comprehension deficits are also discernible at the discourse level (Hamilton, 1994; Orange, Lubinski, & Higginbotham, 1996; Ripich, Vertes, Whitehouse, Fulton, & Ekelman, 1991).

Based on their finding that older adults with EDAT and MDAT produced significantly more utterances classified as “requestives” than did older adults without brain damage, Ripich et al. (1991) speculated that individuals with DAT might use this utterance category to compensate for their confusion about speakers’ utterances. Orange et al. (1996) studied trouble-source repair (TSR) variables in conversational dyads consisting of participants with EDAT and MDAT and their family caregiver. Videotape analyses revealed non-significant trends toward higher proportions of TSR initiators (e.g., “what,” “say that again”) produced by elders with DAT in the DAT-family partner dyads compared to elders with no brain damage (NBD) in the control dyads. Similar findings were also obtained by Hamilton (1994) in her report of a 4.5-year longitudinal participant-observer investigation with a single individual with DAT. These findings suggest that individuals’ comprehension for topic-directed and conversational discourse is diminished even in early-stage dementia.

Elders with DAT have also been shown to have difficulty comprehending other discourse genres, such as narratives. Narratives have been described as ubiquitous; they occur naturally within the context of conversations between older adults and are prevalent in a variety of programs on television and radio (e.g., talk shows, dramatic series) to which many older adults attend (Berger, 1997). Narratives are also said to be structured in specific ways within a given culture (e.g., Riessman, 1993; Rumelhart, 1977; Stein & Glenn, 1979) and tend to be relatively stable in content from one telling to another telling. Narratives therefore represent an important resource for investigating spoken language comprehension in DAT and other clinical populations. In an early study of narrative comprehension in individuals with DAT, LeDoux, Blum, and Hirst (1983) found that participants with severe DAT had difficulty inferring the appropriate pronoun referent in two-sentence paragraphs, whether given contextual, syntactic, or lexical constraints. Other research has shown that adults with mild-to-moderate probable DAT demonstrate severe impairment when answering yes-no questions pertaining to standardized spoken paragraphs, with further deterioration evident over a 3-year follow-up (Bayles & Kaszniak, 1987). More recently, Biassou, Onishi, Grossman, and D’Esposito (1995) asked participants with mild and moderate probable DAT to listen to passages being read aloud as the participants read along silently. Each participant retained a written copy of the text for reference when answering questions about information stated explicitly in the text and information that could only be inferred. Individuals with DAT were significantly impaired relative to participants with NBD in their comprehension of inferential but not factual questions.

Biassou and colleagues (1995) addressed a feature of narrative comprehension that has figured prominently in research with other groups of adults who have and do not have brain damage, namely the distinction between explicit and inferential (or implied) information. Mental model conceptualizations of discourse comprehension hold that although some information in discourse is stated explicitly, other information must be inferred from what is stated in the discourse and from readers’ or listeners’ “world knowledge” (e.g., Gernsbacher, 1990; Kintsch, 1988; van Dijk & Kintsch, 1983). According to Gernsbacher (1990) and van Dijk and Kintsch (1983), both stated and inferred information become part of readers’ or listeners’ mental model of the discourse; a working mental model of the discourse is retained in memory (and reinforced), or is modified or discarded depending on whether subsequent information is judged to be consistent or inconsistent with that model. Information explicitness is not, however, the only feature of discourse comprehension that has received attention in the literature. Another variable of interest, particularly in studies of narrative comprehension in adults with and
without brain damage, is information saliency (e.g., Nicholas & Brookshire, 1995). As a dichotomous variable, saliency has two alternatives, main ideas and details. Unfortunately, no research has investigated the relative comprehension of main ideas and details in narratives presented to adults with DAT.

Both explicitness and saliency were controlled for in a series of early studies completed by Brookshire and colleagues concerning the effects of unilateral brain damage on discourse comprehension (Brookshire & Nicholas, 1984; Nicholas & Brookshire, 1986; Wegner, Brookshire, & Nicholas, 1984). Using a set of narratives of equal reading level, length, syntactic complexity, and several other variables (see Brookshire & Nicholas, 1993), these investigators compared adults with aphasia, right-hemisphere damage (RHD), and NBD on their ability to answer questions related to stated (or explicit) and implied (or inferred) main ideas and details. As a group, adults with aphasia answered these questions less accurately than did adults with NBD and with RHD. Participants from all three groups, however, showed significantly better comprehension for main ideas than for details contained in the discourse (Brookshire & Nicholas, 1984; Nicholas & Brookshire, 1986, 1995). Further, Katsuki-Nakamura, Brookshire, & Nicholas (1988) and Nicholas and Brookshire (1986) showed that participants with brain damage comprehended stated information better than implied information, although the difference was not always statistically significant. Similarly, Bloise and Tompkins (1993) found that participants with NBD and those with RHD had more difficulty answering inferential than factual questions on their discourse comprehension task.

On the basis of the evidence described above, Brookshire and Nicholas (1993) developed a standardized assessment for narrative comprehension called the Discourse Comprehension Test (DCT). In 1995, Nicholas and Brookshire reported on the DCT performance of three groups of adults with brain damage (aphasia, RHD, and traumatic brain injury [TBI]) and adults with NBD. These more recent findings corroborated their earlier research results. Nicholas and Brookshire concluded that their results were consistent with resource allocation models of discourse comprehension, which claim that processing efficiency for discourse becomes reduced (particularly for persons with brain damage) when the attentional demands of the task increase (e.g., when processing inferential versus stated material and details versus main ideas) (see also McNeil & Kimelman, 1986; McNeil, Odell, & Tseng, 1991). Attentional resource allocation is related to working memory capacity, an alternative construct that has been identified often with models of discourse comprehension (e.g., Daneman & Carpenter, 1980).

The view that there exists a limited-capacity, short-term memory buffer, or “work space,” with its own processing capabilities is not new. Indeed, as Richardson (1996) noted, the idea that information is stored temporarily and processed in some form of working memory may have first been suggested by Atkinson and Shiffrin (1968). Since then, the concept of working memory has been applied to several models of discourse comprehension (e.g., Daneman & Carpenter, 1980; Gernsbacher, 1990; van Dijk & Kintsch, 1983). An alternative model of working memory has been proposed by Baddeley and his colleagues (see Baddeley, 1990), who claim that working memory consists of three integrated components: a central executive with supervisory capability; an articulatory loop for storing phonologically-based material; and a visual-spatial sketch-pad for storing visual and spatial information.

Employing a more general account of working memory, Daneman and Carpenter (1980), among others, have shown that individuals who demonstrate superior discourse comprehension performance also have superior working memory spans (or capacities). This relationship between working memory capacity and discourse comprehension has often been invoked to account for the diminished spoken language comprehension of older adults with DAT (e.g., Baddeley, Bressi, Della Sala, Logie, & Spinners, 1991; Kempler et al., 1998; Rochon et al., 1994).

There is, therefore, indirect and direct evidence for diminished discourse comprehension in DAT. Recent experimental research suggests that individuals with DAT have more difficulty comprehending inferential than factual material (Biasou et al., 1995), but evidence is lacking concerning their comprehension of main ideas versus details. Research on narrative comprehension for participants without brain damage as well as for those with aphasia, RHD, and TBI indicates that comprehension is relatively better for main ideas than for details and relatively better for stated information than for implied information for all groups (e.g., Nicholas & Brookshire, 1995).

The main purpose of the present investigation was to compare narrative comprehension performance (overall scores and subscores for main ideas, details, stated material, and implied material) among elders in the NBD, EDAT, and MDAT groups for selected DCT narratives (Brookshire & Nicholas, 1993). A secondary purpose was to examine the relationship between DCT overall scores and episodic memory and working memory capacity among participants in the NBD, EDAT, and MDAT groups.

Four hypotheses were developed to investigate narrative comprehension and memory in DAT: (a) Elders with NBD were expected to obtain significantly higher
DCT overall scores than elders with EDAT, who in turn were expected to obtain significantly higher DCT overall scores than elders with MDAT. (b) DCT subscores for main ideas and details and for stated and implied information were predicted to be significantly higher for participants with NBD than for those with EDAT and MDAT, and were likewise predicted to be higher for participants with EDAT than for those with MDAT. (c) Participants in the NBD, EDAT, and MDAT groups were all expected to show significantly higher DCT scores for stated information than for implied information and significantly higher DCT scores for main ideas than for details. (d) Participants’ scores on working memory and episodic memory measures were expected to be significantly associated with overall scores on the DCT.

Method

Participants

Twenty-four White adults age 61–89 participated in this study; 8 with probable EDAT, 8 with probable MDAT, and 8 with NBD. Means and standard deviations for age, years of formal education, score on the Standardized Mini-Mental State Examination (SMMSE; Molloy, Alemayehu, & Roberts, 1991), and estimated premorbid IQ (EIQ; Wilson, Rosenbaum, & Brown, 1979) are presented in Table 1. Differences among group means for age, educational level, and EIQ were all nonsignificant (p > 0.20). As expected, differences in mean SMMSE scores among groups were statistically significant [F(2, 21) = 98.60, p < 0.0001, R² = 0.90], with Tukey-Kramer HSD post hoc analyses revealing the expected significant differences for all pair-wise comparisons.

All participants resided in either their own home, the home of a family member, or in a retirement home; none of the participants lived in a nursing home or other long-term care facility. In addition, all participants met the following eligibility criteria: (a) native speaker of English, or use of English as the primary language for at least 30 years; (b) right-hand dominant, with no history of prior left-handedness; (c) no history of clinically diagnosed depression or major psychiatric disorders; (d) no history of ophthalmologic pathology sufficient to cause functional limitations in vision; (e) at least six years of formal education; (f) pure tone hearing acuity at 45 dB HL (American National Standards Institute [ANSI], 1989) or better in at least one ear at 1 and 2 kHz (adapted from Weinstein, 1986, with increased pass-fail criterion to compensate for ambient noise associated with home-based audiometric testing); (g) at least 78% accuracy on the Speech Discrimination subtest from the Arizona Battery for Communication Disorders of Dementia (ABCD) (Bayles & Tomoeda, 1993); and (h) corrected binocular visual acuity of 20/30 or better as measured by standard Snellen chart, at a test distance of 3 meters (Vaughan, Asbury, & Tabbara, 1989). Participants were either paid for their participation or had a donation made on their behalf to a charity of their choice.

Table 1 also contains data on visual acuity, best-ear pure tone average, and speech discrimination for each

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (Years)</th>
<th>Education</th>
<th>SMMSE (/30)</th>
<th>EIQ</th>
<th>Snellen Decimal</th>
<th>Best PTA</th>
<th>Speech Discrim</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBD (n = 8)</td>
<td>Mean</td>
<td>72.2</td>
<td>10.6</td>
<td>29.1**</td>
<td>104.1</td>
<td>1.7</td>
<td>46.0</td>
</tr>
<tr>
<td>SD</td>
<td>4.6</td>
<td>1.8</td>
<td>0.8</td>
<td>4.7</td>
<td>0.4</td>
<td>2.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Min-Max</td>
<td>68–82</td>
<td>8–13</td>
<td>28–30</td>
<td>97–110</td>
<td>1.0–2.0</td>
<td>45–50</td>
<td>83–100</td>
</tr>
<tr>
<td>EDAT (n = 8)</td>
<td>Mean</td>
<td>78.0</td>
<td>10.8</td>
<td>23.1**</td>
<td>106.0</td>
<td>1.3</td>
<td>45.8</td>
</tr>
<tr>
<td>SD</td>
<td>8.5</td>
<td>2.2</td>
<td>2.1</td>
<td>7.1</td>
<td>0.5</td>
<td>1.8</td>
<td>7.8</td>
</tr>
<tr>
<td>Min-Max</td>
<td>61–89</td>
<td>7–14</td>
<td>20–25</td>
<td>95–116</td>
<td>0.7–2.0</td>
<td>45–50</td>
<td>78–100</td>
</tr>
<tr>
<td>MDAT (n = 8)</td>
<td>Mean</td>
<td>76.7</td>
<td>11.1</td>
<td>16.8**</td>
<td>106.9</td>
<td>1.3</td>
<td>47.9</td>
</tr>
<tr>
<td>SD</td>
<td>6.2</td>
<td>4.6</td>
<td>2.0</td>
<td>13.4</td>
<td>0.4</td>
<td>4.2</td>
<td>9.4</td>
</tr>
<tr>
<td>Min-Max</td>
<td>63–83</td>
<td>6–18</td>
<td>13–19</td>
<td>92–128</td>
<td>1.0–2.0</td>
<td>45–57</td>
<td>78–100</td>
</tr>
</tbody>
</table>

Note. SMMSE = Standardized Mini-Mental State Examination score (Molloy et al., 1991); EIQ = Estimated Premorbid IQ (Wilson et al., 1979); Snellen Decimal = Snellen visual acuity ratio decimal equivalent, where 20/20 = 1.0; Best PTA = Pure Tone Average for the better ear in dB HL (ANSI, 1989); Speech Discrim = Percentage correct on the Speech Discrimination subtest from the Arizona Battery for Communication Disorders of Dementia (ABCD; Bayles & Tomoeda, 1993).

* p < 0.05, ** p < 0.0001. Comparisons with the same number of asterisks are significantly different.
participant. No significant between-group differences were found for visual acuity or for best-ear pure tone averages ($ps > .10$) using Kruskal-Wallis analyses. In contrast, a significant between-group difference was obtained for speech discrimination scores ($\chi^2 (2) = 6.57, p = 0.0374$). It should be noted, however, that all participants met the criterion established for the Speech Discrimination subtest of the ABCD (Bayles & Tomoeda, 1993). Wilcoxon-Mann-Whitney pair-wise comparison tests ($\alpha$ set to 0.02) showed that the mean speech discrimination score for participants with NBD was marginally significantly higher than for participants in the MDAT group ($z = -2.36, p = 0.0184$); whereas, means were not significantly different for NBD versus EDAT or for EDAT versus MDAT comparisons ($ps > 0.10$). Further consideration is given to this issue in the Results section.

Participants With Probable DAT

Potential participants with DAT were identified by staff of geriatric medicine clinics and day programs serving individuals with Alzheimer disease in two large urban centers in Southern Ontario, Canada. All diagnoses and staging interpretations were made by one of three certified specialists in geriatric medicine, two of whom were associated with the same facility. Individuals with DAT met the NINCDS-ADRDA diagnostic criteria for probable DAT (McKhann et al., 1984), and obtained 4 or less on the modified Hachinski scale (Hachinski et al., 1975). All potential participants with DAT were required to also meet the following criteria: (a) no current use of any anticholinergic medication (e.g., tacrine, E2020) and (b) a score of 20–25 for EDAT and 10–19 for MDAT on the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975). According to Reisberg and colleagues (1996), MMSE scores in these ranges correspond to Stage 3-4 and Stage 5-6, respectively, on the Global Deterioration Scale (GDS; Reisberg, Ferris, DeLeon, & Crook, 1982).

Each participant with EDAT and MDAT gave oral assent to participate. Family members (or other designated signatory) also provided written proxy consent. This protocol was approved by the Human Subjects Review Committee, State University of New York at Buffalo and by the ethics committees of each facility that contributed toward participant recruitment.

Participants Without Brain Damage

Older adults who participated in the NBD group had no significant history of any condition known to cause cognitive dysfunction, as reported on a self-administered health history questionnaire. Participants without brain damage were matched as closely as possible to those with DAT on the basis of age, years of education, and EIQ.

Additional Screening Measures

Additional measures were obtained to confirm participants’ cognitive status and to ensure that DAT participants were able to answer yes-no questions with greater than chance accuracy.

Standardized Mini-Mental State Examination

The MMSE has demonstrated clinical utility as a screening measure of cognitive performance and was used as a first-pass criterion for DAT participant recruitment (e.g., Giordani et al., 1990). The SMMSE was based on the original MMSE and has been shown to have greater interrater and intrarater reliability than the original version (Molloy et al., 1991). The SMMSE was administered to all participants to confirm or disconfirm the presence and severity of dementia.

Yes-No Questions

As the ability to respond accurately and reliably to yes-no questions was required for the narrative discourse tasks, the single-sentence yes-no subtest from the DCT (Brookshire & Nicholas, 1993) was administered to all participants with DAT. This subtest was designed by Brookshire and Nicholas to evaluate individuals’ comprehension of yes-no question pairs concerning general knowledge and personal and environmental information. With each question having a correct “yes” and “no” version, elders with DAT had to respond accurately to both versions of the same question to receive credit for correctly answering that question. All participants with DAT surpassed the criterion of at least 10 correct of 20 paired items.

Episodic Memory and Working Memory Measures

All participants were administered the following episodic memory and working memory tasks in their homes (or alternative setting) on a visit separate from the session in which screening measures were administered. Table 2 displays group means and standard deviations for these episodic and working memory task scores.

Episodic Memory Task. Five subtests from the ABCD (Bayles & Tomoeda, 1993) were administered to all participants. According to its authors, summary scores for the following five ABCD measures can be used to compute an Episodic Memory Construct score: Story Retelling (Immediate), Story Retelling (Delayed), Word Learning (Free Recall), Word Learning (Total Recall), and Word Learning (Recognition). Bayles, Tomoeda, Wood, Cruz, and McGeeagh (1996) have shown that the Episodic Memory Construct score (among others) correlates well
with more general measures of cognition, such as the MMSE ($r = 0.70$).

**Working Memory Task**

According to Daneman and Carpenter (1980), listening span (as an index of working memory) is significantly correlated with listening comprehension. In this task, listeners simultaneously process and store increasingly larger sets of spoken utterances, recalling as many utterance-final words as possible in each set. Listening span measures have revealed deficits in working memory capacity relative to older adults without brain damage in persons with aphasia, RHD, and DAT (e.g., Rochon & Saffran, 1995; Tompkins, Bloise, Timko, & Baumgaertner, 1994). The stimuli and procedures described by Tompkins et al. were utilized as the listening span measure in the present study. All stimulus sentences and task instructions were recorded on videotape (see Note 1) by the first author. These stimuli consisted of 42 simple active declarative sentences grouped into three sets of sentences at each of four difficulty levels (2–5 sentences). Participants were asked to respond “true” or “false” to the semantic content of each sentence and were asked to remember the sentence-final word. Word recall errors were recorded as a measure of listening span, modeled after Tompkins et al.

Two modifications were made to the procedures of Tompkins and colleagues (1994): (a) additional practice trials were provided, giving participants practice with each subtask (true-false verification and word recall), using single sentences as well as sentence pairs and (b) the stimulus tape was paused between sentences whenever participants’ true-false responses were delayed by at least 4 seconds. These modifications were necessary to ensure that participants with DAT understood the task and to prevent response delays from interfering with participants’ attention to upcoming stimulus sentences. All participants were successful on the working memory task one-sentence practice trials; however, 6 individuals with DAT (1 with EDAT, 5 with MDAT) were unable to complete the standard two-sentence practice trials.

**Stimulus Materials**

In standardized form, the DCT (Brookshire & Nicholas, 1993) contains 10 stories (2 sets of 5) and their associated yes-no questions for live or audiotaped presentation. The yes-no questions (eight per narrative) assess listeners’ comprehension of stated and implied main ideas and details contained in each narrative. In the present study, six DCT narratives (Practice Story 1 plus five test stories) and their associated sets of yes-no questions were presented on videotape to all participants. High-quality color videotapes, revealing the head and torso of a speaker of Standard North American English dialect, were made using a JVC professional video camera (Model GX-S700) and JVC professional videocassette recorder (Model BR-6400U). In keeping with Brookshire and Nicholas, all narratives were presented at a speaking rate of approximately 130 wpm, and all questions were spoken at approximately 110 wpm. The alert, “Ready? Listen” was recorded on videotape by the first author just prior to the presentation of each narrative and associated question set.

**Equipment**

For most participants, videotapes were played on a 51 cm Panasonic combination VCR (Model PVM-2036K). In a minority of cases, space restrictions prevented setup of this equipment in the participant's residence. When this occurred, the participant’s own 51 cm television monitor and VCR unit were used. Acoustic signals from the stimulus videotapes were presented to all participants at comfortable loudness through loudspeakers.

**Design and Procedures**

On the first visit, informed consent was obtained from each participant and screening tests were administered; participants passing these tests were retained. On a separate day, each participant was presented with the DCT narratives, in random order. Brief between-task

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**Table 2. Mean episodic memory and working memory scores by group.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Episodic Memory*</th>
<th>Listening Span*</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBD (n = 8)</td>
<td>4.6</td>
<td>9.5</td>
</tr>
<tr>
<td>Mean</td>
<td>0.2</td>
<td>4.5</td>
</tr>
<tr>
<td>SD</td>
<td>4.4–4.8</td>
<td>4–17</td>
</tr>
<tr>
<td>Min–Max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDAT (n = 8)</td>
<td>3.0</td>
<td>32.2</td>
</tr>
<tr>
<td>Mean</td>
<td>0.3</td>
<td>5.9</td>
</tr>
<tr>
<td>SD</td>
<td>2.4–3.4</td>
<td>25–42</td>
</tr>
<tr>
<td>Min–Max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDAT (n = 8)</td>
<td>2.9</td>
<td>38.1</td>
</tr>
<tr>
<td>Mean</td>
<td>0.5</td>
<td>5.5</td>
</tr>
<tr>
<td>SD</td>
<td>2.2–3.8</td>
<td>29–42</td>
</tr>
<tr>
<td>Min–Max</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .0001$. Comparisons across all three groups are significant; pairwise comparisons are significant for NBD versus EDAT and NBD versus MDAT pairs only.

Note: Episodic Memory score is from the ABCD (Bayles & Tomoeda, 1993); Listening Span (word recall errors) is a measure of working memory adapted from Tompkins et al. (1994).

1To maintain consistency with the Tompkins et al. (1994) approach, the stimulus videotape contained auditory but not visual information.
rest periods were offered to all participants during each experimental session and provided at each participants’ request. No participant with DAT required more than a brief rest period.

Participants were instructed to watch and listen carefully to a person telling stories on television. As recommended by Brookshire and Nicholas (1993), participants were also informed that within each story there was information concerning details and main ideas and that some of the information was stated, whereas other information needed to be “figured out.” Finally, they were told that they would be asked a series of yes-no questions at the end of each story. Practice Story 1 was presented, after which participants answered eight yes-no questions and received verbal feedback concerning their response accuracy. To proceed with the five test narratives, all participants were required to correctly answer at least 50% of the main idea questions (after Brookshire & Nicholas) and at least 50% of all eight questions (main idea, detail, stated, implied) from the practice story. Up to three presentations of the practice story were allowed. Participants were then presented with the five test narratives and their corresponding questions; the videotape was paused while participants formulated their response to each question. Participant responses were scored as correct or incorrect.

**Data Analyses**

Analysis of variance (ANOVA) and Tukey-Kramer HSD post hoc tests were conducted for data distributions meeting homogeneity of variance and normality assumptions. Highly skewed data distributions that could not be transformed using logarithmic or negative-inverse transformations were analyzed by nonparametric statistical tests, such as Kruskal-Wallis one-way analysis of variance (Siegel & Castellan, 1988). Participants’ scores on the experimental tasks were evaluated for the degree to which the observed variance was explained by Episodic Memory and Listening Span scores using regression analyses. To control for Type I errors, the general alpha level for all statistical tests was set to .05.

**Results**

**Narrative Comprehension Data**

**Narrative Overall Scores**

Table 3 reports mean overall scores and standard deviations for selected narratives from the DCT. According to the first hypothesis, DCT overall scores should decline progressively with the onset and progression of DAT. Using one-way ANOVA, mean DCT overall scores were found to differ significantly among groups [$F(2, 21) = 70.96, p < 0.0001, R^2 = 0.87$]. Post hoc analyses revealed that participants with NBD attained significantly higher DCT overall scores than participants in both EDAT and MDAT groups; elders with EDAT did not differ significantly from those with MDAT. Mean percent correct DCT overall scores (standard deviations in parentheses) were 92.5% (3.5) for the NBD group, 60.9% (5.8) for the EDAT group, and 62.8% (7.7) for the MDAT group.

<table>
<thead>
<tr>
<th>Group</th>
<th>MIS** ( /10)</th>
<th>MII* ( /10)</th>
<th>DTS** ( /10)</th>
<th>DTI** ( /10)</th>
<th>Overall*** ( /40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBD (n = 8)</td>
<td>9.9</td>
<td>9.8</td>
<td>9.4</td>
<td>8.0</td>
<td>37.0</td>
</tr>
<tr>
<td>Mean</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.9</td>
<td>1.4</td>
</tr>
<tr>
<td>SD</td>
<td>9–10</td>
<td>9–10</td>
<td>9–10</td>
<td>7–9</td>
<td>35–39</td>
</tr>
<tr>
<td>EDAT (n = 8)</td>
<td>7.9</td>
<td>6.6</td>
<td>5.9</td>
<td>4.0</td>
<td>24.4</td>
</tr>
<tr>
<td>Mean</td>
<td>0.8</td>
<td>2.0</td>
<td>1.4</td>
<td>1.4</td>
<td>2.3</td>
</tr>
<tr>
<td>SD</td>
<td>7–9</td>
<td>3–10</td>
<td>4–8</td>
<td>2–6</td>
<td>21–27</td>
</tr>
<tr>
<td>MDAT (n = 8)</td>
<td>7.4</td>
<td>6.6</td>
<td>6.2</td>
<td>4.9</td>
<td>25.1</td>
</tr>
<tr>
<td>Mean</td>
<td>1.1</td>
<td>1.3</td>
<td>2.1</td>
<td>0.8</td>
<td>3.1</td>
</tr>
<tr>
<td>SD</td>
<td>5–8</td>
<td>4–8</td>
<td>3–9</td>
<td>4–6</td>
<td>22–30</td>
</tr>
</tbody>
</table>

Note. MIS = Main Idea Stated; MII = Main Idea Implied; DTS = Detail Stated; DTI = Detail Implied; Overall = sum of MIS, MII, DTS, and DTI scores for 5 stories from The Discourse Comprehension Test (Brookshire & Nicholas, 1993).

* $p < .005$, ** $p < .001$, *** $p < .0001$. Comparisons across all three groups are significant; pair-wise comparisons are significant for NBD versus EDAT and NBD versus MDAT pairs only.
MDAT group, suggesting that the observed group differences may be clinically important as well as statistically significant. The first hypothesis was therefore only partially supported; although DCT overall scores showed a significant decline with the onset of DAT, they showed no significant additional decline with progression to the middle stage of DAT. This finding is surprising given the significant difference in SMMSE scores between EDAT and MDAT groups.

**Narrative Subscores**

Means and standard deviations for the subscores main idea stated (MIS), main idea implied (MII), detail stated (DTS), and detail implied (DTI) are also presented in Table 3. Given the near-ceiling DCT subscores for participants with NBD, nonparametric (or distribution-free) statistical analyses were selected (see Siegel & Castellan, 1988). The second hypothesis predicted that all DCT subscores would be significantly higher for participants with NBD than for those with EDAT and significantly higher for participants with EDAT than for those with MDAT. Separate Kruskal-Wallis analyses revealed significant group differences for MIS ($\chi^2(2) = 16.29, p = .0003$), MII ($\chi^2(2) = 13.65, p = .0011$), DTS ($\chi^2(2) = 14.73, p = .0006$), and DTI ($\chi^2(2) = 16.70, p = .0002$). Wilcoxon-Mann-Whitney comparisons ($\alpha = 0.02$ for each comparison) between NBD and EDAT groups and between NBD and MDAT groups indicated significant differences between means for MIS, MII, DTS, and DTI subscores (see Table 3). Means were not significantly different between the two DAT groups for any of the four DCT subscores. Thus, the second hypothesis, like the first, was only partially supported.

The third hypothesis predicted that NBD, EDAT, and MDAT groups would show similar patterns of response across DCT subscores. As displayed in Figure 1, all participant groups showed the same pattern of relative performance for DCT subscores; that is, NBD, EDAT, and MDAT groups demonstrated relatively better comprehension for main ideas than for details and relatively better comprehension for stated information than for implied information. The statistical significance of these trends was evaluated using separate paired one-tailed $t$ tests for each participant group for main ideas minus details and stated minus implied information difference scores. Results indicated superior comprehension for main ideas versus details for NBD ($t = 4.58, p = .0013$), EDAT ($t = 4.62, p = .0012$), and MDAT ($t = 3.75, p = .0036$) groups and superior comprehension for stated versus implied information for NBD ($t = 5.61, p = .0004$), EDAT ($t = 3.34, p = .0062$), and MDAT ($t = 4.15, p = .0021$) groups. Thus, the third hypothesis was upheld by these data. The above findings are consistent with the results of Brookshire and Nicholas (1993) and Nicholas and Brookshire (1995) for adults without brain damage, older adults with aphasia, older adults with RHD, and young adults with TBI.

The fourth hypothesis predicted that measures of episodic memory (ABCD Episodic Memory Construct score) and working memory (Listening Span score) would be significantly associated with DCT overall scores.

**Working Memory and Episodic Memory Data**

**Working Memory Task**

Means and standard deviations for the Listening Span (LS) task are presented in Table 2. One-way ANOVA indicated that NBD, EDAT, and MDAT groups differed significantly in the number of word recall errors produced [$F(2, 21) = 63.54, p < .0001, R^2 = 0.86$]. Pair-wise comparisons showed that the NBD group made significantly fewer word recall errors than both EDAT and MDAT groups, who did not differ significantly from one another. DCT overall scores were found to be highly linearly related to LS word recall errors ($r = -.83$). Using LS, LS$^2$, and SMMSE as predictor variables, a series of variables-added-in-order regression analyses were performed ($\alpha = .02$ for each test) to determine the best model for predicting DCT overall score. Results revealed that participants’ LS scores alone accounted for 69% of the variance in DCT overall scores. Participants’ SMMSE scores (as an index of cognitive status) made no significant contribution to the predictive power of the
regression model. These results lend support to the notion that working memory measures are highly predictive of spoken language comprehension (e.g., Daneman & Carpenter, 1980; Tompkins et al., 1994), irrespective of participants’ cognitive status, and thus offer support for the working memory portion of the fourth hypothesis.

**Episodic Memory Task**

Means and standard deviations for the ABCD Episodic Memory Construct (EM) are also reported in Table 2. Group differences were statistically significant \(F(2, 21) = 61.64, p < .0001, R^2 = .85\). Pair-wise comparisons revealed significantly higher EM scores for the NBD group than for EDAT and MDAT groups, whereas the EDAT and MDAT groups did not differ significantly from one another. The correlation between participants’ DCT overall scores and EM scores was found to be significant \(r = .91\). A series of variables-added-in-order regression analyses \(\alpha = .02\) for each test) were performed on the DCT overall score using EM, EM2, and SMMSE as predictor variables. Results indicated that 82% of the variance in DCT overall scores could be accounted for by participants’ EM scores alone. EM2 and participants’ SMMSE scores made nonsignificant contributions to the regression model. This finding suggests that the predictive relationship between EM and DCT scores is linear and that this relationship holds regardless of participants’ cognitive status. These results lend additional support to the fourth hypothesis and suggest that narrative comprehension is dependent on episodic memory as well as working memory.

**Speech Discrimination**

As noted in the Methods section, of the three sensory screening measures used as criteria for participation in the present study, only participants’ ABCD Speech Discrimination scores showed a significant between-group difference. Pairwise comparisons revealed that the NBD versus MDAT comparison was the only one with a marginally significant result (NBD > MDAT). On the basis of this finding, one might be tempted to attribute the observed group differences in DCT scores to poor speech discrimination (perhaps secondary to peripheral hearing loss) and not necessarily to the presence of dementia. Yet, when the effect of Speech Discrimination score was controlled for statistically (by including it as a predictor variable in multiple regression analyses on DCT overall score), results indicated that Speech Discrimination score did not contribute significantly to the predictive power of the regression model \(ps > 0.40\). Therefore, the argument that lower Speech Discrimination scores for participants with MDAT might alone account for group differences in DCT scores is untenable.

**Discussion**

Participants with EDAT and MDAT answered questions derived from DCT story content significantly less accurately than did elders with NBD. Differences between EDAT and MDAT groups were nonsignificant and judged to be clinically unimportant. The finding that individuals with DAT have diminished discourse comprehension is consistent with Biassou et al. (1995), Hamilton (1994), Orange et al. (1996), and Ripich et al. (1991). The finding of no significant difference in discourse comprehension between participants with EDAT and MDAT, however, was entirely unexpected. The reason for this null result is not entirely clear; although it may be related to the yes-no responses participants were encouraged to make when presented with questions about DCT story content. According to probability theory, responses to yes-no questions can be expected by chance alone to achieve a 50% level of accuracy. On the DCT, an overall score of 20 out of 40 would represent chance performance; none of the participants in the present study obtained an overall score less than 21 out of 40. One explanation, therefore, for the nonsignificant difference in DCT overall scores between participants with EDAT and MDAT may be that DCT test design promotes the realization of a “floor effect,” particularly for participants with MDAT. Despite this potential limitation, administration of the DCT still yields a robust significant difference between participants with NBD and those with DAT as a group.

An alternative explanation for the nonsignificant difference in DCT scores between EDAT and MDAT groups may be the relatively small sample sizes employed in the present study. Larger sample sizes typically afford more flexibility when choosing from among the myriad approaches to statistical analysis. With other variables held constant, larger sample sizes also tend to yield greater statistical power. Statistical power may not have been sufficient in the present study to detect a significant difference between EDAT and MDAT groups, given the small effect size found for this comparison. In contrast, the difference in DCT overall scores between NBD and DAT (pooled) groups was significant because of the large between-group effect size.

It could also be argued that the nonsignificant difference between EDAT and MDAT groups for DCT overall score occurred because the two groups did not truly represent different levels of dementia severity. This explanation is unlikely, however, because mean SMMSE scores for EDAT and MDAT groups were significantly different. Yet, some critics may argue that the SMMSE is not sensitive enough as a grouping variable for discourse comprehension and that another measure, such as EM scores, might be more appropriate. DAT groups
were therefore reconfigured (in accordance with Bayles & Tomoeda, 1993) using EM rather than SMMSE scores to yield the following groups: NBD ($M = 4.6, SD = 0.2$); EDAT ($M = 3.2, SD = 0.3$); and MDAT ($M = 2.6, SD = 0.2$). Although a significant between-group difference was found for DCT overall scores using this method ($F(2, 21) = 73.80, p < .0001, R^2 = .88$), the difference between EDAT and MDAT groups remained nonsignificant. Thus, the influence of a floor effect or of small sample size are more plausible explanations for the null findings between EDAT and MDAT groups on DCT overall score than are sample homogeneity or measure insensitivity.

Despite the quantitative difference in DCT overall scores between elders in the DAT and NBD groups reported above, elders with EDAT and MDAT showed a pattern of response to questions concerning main ideas, details, stated information, and implied information from DCT narratives that is qualitatively similar to that of participants with NBD. That is, all participants with DAT, like those in the NBD group, demonstrated better comprehension for main ideas than details and better comprehension for stated information than implied information. These findings are consistent with studies of narrative comprehension in adults with aphasia, RHD, and TBI (e.g., Bloise & Tompkins, 1993; Brookshire & Nicholas, 1984; Nicholas & Brookshire, 1995). The finding that participants with DAT were better able to comprehend stated information than implied information is parallel to results from other research on discourse comprehension in DAT (Biassou et al., 1995). Biassou and associates studied participants with DAT focusing on their comprehension of inferential and factual material but not their comprehension of main ideas and details. The present investigation extends the work of Biassou and associates by showing that elders with DAT (and other adults) understood implied information associated with main ideas in narratives better than implied information associated with details in narratives.

The results of the present study and other related research strongly suggest that elders with DAT retain a “schema” or other mental representation for the structure of narratives, which they use in combination with their world knowledge to comprehend narrative content. Main ideas can be said to represent themes or “macropropositions” in stories which may serve to abstract, delete, integrate, and construct information from the narrative, thus reducing the amount of meaningful information to be remembered (e.g., van Dijk, 1977). Stated information can be integrated with these macropropositions, whereas information not stated explicitly requires the construction of an inference. The results of the present investigation show that individuals with DAT are able to construct some types of inferences (particularly those involving main ideas), carry them forward through the narrative, and use them to facilitate comprehension of the story. The ability of participants with DAT (and other adults) to demonstrate better comprehension for main ideas than details and better comprehension for stated than implied information may be explained by working memory capacity or attentional resource allocation (e.g., Daneman & Carpenter, 1980; Nicholas & Brookshire, 1995; van Dijk & Kintsch, 1983). That is, as individuals listen to stories, stated and implied main ideas are retained in working memory as macropropositions. Stated and implied details are either deleted from the developing macroproposition (because of their perceived irrelevance) or are well integrated into the macroproposition and not immediately retrievable (e.g., van Dijk, 1977; van Dijk & Kintsch, 1983).

Evidence for the role of working memory in discourse processing was obtained in the present investigation. The correlation between DCT overall score and LS word recall errors exceeded .80. That is, participants with large working memory capacities (those who made few errors on the LS task) also tended to obtain high overall scores on the DCT. Also, discourse comprehension was shown to be significantly and highly associated with a measure of episodic memory, the EM score ($r = .91$). The latter relationship was not surprising given that the EM score is comprised of the individual scores from the Story Retelling (Delayed) and Word Learning subtests of the ABCD. Remembrance of word lists and story details requires that memory traces be stored at least temporarily. Thus, successful performance on the Word Learning and Story Retelling (Delayed) subtests from the ABCD would seem to depend as much on working memory as on episodic memory. Evidence for this interrelationship between working memory and episodic memory is implicit in the significant and high correlations between LS and DCT scores, between EM and DCT scores, and between LS and EM scores ($r = –0.85$). Alternatively, working memory, discourse comprehension, and episodic memory may be interrelated because each can be thought of as requiring the explicit retrieval (and declaration) of information (“explicit memory”) (see Smith, 1996). The pronounced difficulty that individuals with DAT demonstrate on tasks involving explicit but not implicit (or “automatic”) memory has been well documented (e.g., Kempler et al., 1998; Smith, 1996).

One limitation of the present study might be that the inclusion criteria employed were inadequate to differentiate elders with dementia from those with no dementia or to differentiate older adults with DAT from those with other forms of dementia. Such criticism would indeed be justified had considerable care not been taken to recruit only those participants who met current, established criteria for the diagnosis of probable DAT.
Clinical Implications

The present study represents the first documented use of the DCT (Brookshire & Nicholas, 1993) for assessing narrative comprehension in DAT. Although the DCT was not standardized for use with individuals with dementia, it has been shown to have considerable utility for documenting the narrative comprehension abilities of individuals with brain damage from other diagnostic groups. Examination of data from Brookshire and Nicholas and Nicholas and Brookshire (1995) show that mean DCT overall scores for aphasic, RHD, and TBI groups were all approximately 4 to 5 of 40 points lower than the NBD group. By comparison, results from the present study show that mean DCT overall scores for participants with DAT as a group, differ from the mean DCT overall scores for elders in the NBD group by greater than 10 of 40 points. This comparison between studies suggests that DCT overall scores might be used to accurately discriminate persons with DAT from older adults with unilateral brain damage (or TBI), as well as to discriminate them from older adults without brain damage. If so, the DCT might be a valuable complement to the clinical assessment of communication in DAT.

Clinicians may use the findings regarding DCT subscores from the present study to recommend discourse comprehension strategies to family and other caregivers of persons with DAT. Specifically, the finding that elders with DAT show better comprehension for main ideas than details in narratives suggests that caregivers should explicitly introduce the topic of conversation before providing details, and that they should reintroduce the topic of conversation when the family member begins to have difficulty understanding. For example, when initiating a topic of conversation, caregivers might say (topic in italics): “I want to tell you what I saw outside in the garden. I saw a bluejay and a cardinal.” When the individual with DAT indicates that he or she has not understood an utterance or demonstrates that he or she has forgotten the conversational topic, the caregiver might then say: “We were talking about what I saw in the garden.” The finding that stated information is better comprehended than implied information might be used to suggest to caregivers that most details (as well as topics) should be stated explicitly rather than left for the individual with dementia to infer.

Directions for Future Research

Results from the present study suggest at least two directions for future research. First, additional research should be conducted using a larger sample of individuals with DAT to provide normative information for the DCT. Future research projects should include participants in the late stage of dementia and elders from other linguistic and cultural groups. In addition, future research should compare narrative comprehension across adult populations with brain damage (e.g., aphasia, RHD, DAT) to examine the utility of the DCT for differentiating DAT from other diagnostic groups.

Second, worthwhile information concerning the deterioration of narrative comprehension in DAT might be obtained using longitudinal research designs. It is unknown, for example, how narrative comprehension changes with the onset and progression of DAT within a single individual. These data would not only advance scientific knowledge of the spoken language comprehension process, but would also provide caregivers with better information about the progression of Alzheimer’s disease.

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