Verb Confrontation Naming and Word–Picture Matching in Alzheimer’s Disease

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Patients with Alzheimer’s disease (AD) were asked to name pictures and perform a multiple-choice word–picture matching task with verbs and nouns. AD patients were significantly more impaired with verbs than nouns for both naming and word–picture matching, and their patterns of semantic naming errors differed for verbs and nouns. One subgroup of AD patients was compromised on both naming and word–picture matching consistent with a semantic memory deficit. Naming was worse for verbs than for nouns in these patients, and they produced significantly fewer hierarchically related semantic substitutions for verbs than for nouns. Other AD patients without semantic memory difficulty did not demonstrate these form class-sensitive patterns. The investigators hypothesize that form class-specific effects in AD patients’ naming are due in part to differences in processing verbs and nouns in semantic memory.

Nutting difficulty is a common problem in patients with probable Alzheimer’s disease (AD; Bayles & Tomoeda, 1983; Hodges, Salmon, & Butters, 1991; Martin & Pedio, 1983). The basis for this deficit, however, is unclear. Some investigators have suggested that the naming impairment is due to degraded processing of a concept’s mental representation in semantic memory (Bayles, Tomoeda, & Trosset, 1990; Chan et al., 1993; Chertkow, Bub, & Caplan, 1992; Hodges, Salmon, & Butters, 1992), and others have argued that the naming deficit is due to compromised retrieval from an output lexicon (Biassou et al., 1995; Huff, Spanier, & Protech, 1990). Verbs and nouns may differ both with respect to processing the mental representation in semantic memory and the output lexicon in which their names are represented, so comparisons of verb naming and noun naming may provide considerable insight into the basis for a naming deficit. Most naming studies in AD have been restricted to assessments with nouns, but one study has documented verb naming difficulty, and AD patients in fact performed worse in naming verbs than nouns (Robinson, Grossman, White-Devine, & D’Esposito, 1996). The purpose of this study was to investigate the basis for this verb confrontation naming deficit in AD.

The mental representation of a word contains multiple types of information, including its semantic attributes and phonologi-
include thematic roles such as agent, theme, manner, and goal that are encoded in the verb’s argument structure, and the sentence frame that is typically associated with the verb may support verb meaning (Fisher, Gleitman, & Gleitman, 1991; Gleitman, 1990; Shapiro & Nagel, 1995). This partial source of word meaning may supplement semantic processing for verbs and lead to more accurate verb naming compared with noun naming.

Naming also requires retrieval of a word’s phonological shape. While the precise nature of lexical retrieval remains controversial (Levitt, 1989), this complex process appears to involve at least an organized mental search through the output lexicon for the target word and its abstract phonological representation. Because a word must be retrieved as part of the naming process regardless of its form class, a naming deficit due to a retrieval impairment may interfere equally with verb naming and noun naming. However, there is some evidence to support the claim that nouns and verbs are associated with different output lexicons. Several patients with focal brain insult have been described with selective difficulty restricted to the retrieval of nouns or verbs (Caramazza & Hillis, 1991; Damasio & Tranel, 1993; Hillis & Caramazza, 1991; McCarthy & Warrington, 1985; Miceli, Silveri, Villa, & Caramazza, 1984; Miceli, Silveri, Nocecenti, & Caramazza, 1988; Zingesser & Berndt, 1990). These findings suggest the possibility that insult to a form class-specific output lexicon may result in a pattern of relative naming impairment due to difficulty retrieving nouns or verbs.

Previous studies of AD patients allow us to develop predictions regarding their relative accuracy at naming with verbs and nouns and to begin investigating the basis for differences between these major form classes. Assessments of naming in AD have focused almost exclusively on the appreciation of nouns. Evidence for a naming deficit due to impaired understanding of noun meaning has come from the observation of semantic substitutions, including the frequent substitution of superordinates on picture naming tasks and on semantically guided category naming fluency measures (Bayles & Tomaeda, 1983; Bayles et al., 1990; Hodges et al., 1992; Martin & Fedio, 1983; Mickanin, Grossman, Onishi, Auriacombe, & Clark, 1994). This suggests that AD patients may be able to take advantage of the hierarchically redundant properties of noun matrix organization in semantic memory to compensate in part for a meaning-based naming deficit. Additional evidence that naming difficulty in AD is not easily attributable to a lexical retrieval impairment is said to come from the observation of difficulty on measures of multiple-choice word–picture matching (Huff, Corkin, & Growdon, 1986; Huff et al., 1990; Martin & Fedio, 1983), category membership judgments (Grossman, D’Esposito, et al., 1996), recognition of perceptual and functional associates of nouns (Chertkow & Bub, 1990b; Grober, Buschke, Kwas, & Fuld, 1985), and anomaly judgments of pictures and simple, subject–predicate sentences (Chertkow & Bub, 1990a; Grossman & Mickanin, 1994; Grossman, Mickanin, Robinson, & D’Esposito, 1996).

Several studies have begun to demonstrate verb comprehension impairments in AD as well. One study found that AD patients are more impaired than controls in their judgments of verb meaning on a triadic comparison task (Grossman, Hughes, Mickanin, Carvell, & D’Esposito, 1996). Another report described difficulty learning about the meaning of a new verb (Grossman, Mickanin, Onishi, Robinson, & D’Esposito, in press). Both of these studies also appeared to show a partial dissociation between semantic and grammatical aspects of verbs. For example, the acquisition of semantic meaning and thematic role information about a new verb was impaired in AD compared with relatively preserved information about grammatical form class. There was no correlation between verb confrontation naming and sentence comprehension in a previous study of verb naming (Robinson et al., 1996). It is thus less likely that AD patients can use information such as the argument structure or sentence frame associated with a verb to compensate for verb naming difficulty.

Naming difficulty in AD also has been attributed to compromised lexical retrieval (Biassou et al., 1995; Huff et al., 1990). This has been evident in previous studies of nouns in AD patients by their relative confrontation naming difficulty in comparison with their word–picture matching performance (Martin & Fedio, 1983). Additional support for a lexical retrieval deficit in AD has come from detailed studies of speech errors (Biassou et al., 1995), and the results of several priming studies indicate that AD patients are able to process semantic associations in an automatic setting (Nebes, Martin, & Horn, 1984; Ober & Shenaut, 1988; Ober, Shenaut, Jagust, & Stillman, 1991). However, the earlier study of verb and noun confrontation naming (Robinson et al., 1996) did not find a selective correlation between a measure of lexical retrieval (phonemic fluency) and naming accuracy with verbs or nouns. An assessment of spontaneous speech in AD demonstrated little difference in retrieving verbs or nouns (Blanken, Dittman, Haas, & Wallesch, 1987). These findings suggest that the retrieval component of AD patients’ naming deficit does not selectively interfere with nouns or verbs.

In the present study, we administered a confrontation naming task for verbs and nouns to AD patients. We expected to confirm our previous finding that verb naming is relatively more difficult than noun naming for AD patients (Robinson et al., 1996). To assess the relative roles of semantic processing and lexical retrieval in AD patients’ difficulty naming with verbs, we adopted three approaches. First, we administered a multiple-choice word–picture matching task for verbs and nouns. Difficulty on both confrontation naming and word–picture matching tasks was likely to be associated with a semantic memory impairment, and greater difficulty for verbs than nouns on both of these tasks would be consistent with the view that verb naming difficulty is due in part to differences in processing the semantic representation of verbs and nouns. Alternatively, relatively compromised confrontation naming compared with word–picture matching would be most consistent with the view that AD patients have a lexical retrieval impairment, and differences between verbs and nouns would suggest impairment of a form class-specific output lexicon.

A second approach involved analyses of the semantically related naming errors and the nature of the misnamed verbs in AD. Thus, the role of verb and noun matrix organization in semantic memory was assessed by determining the relative frequency of semantically related hierarchical substitutions for verbs and nouns. A deficit associated with differences in
participants would have prevented them from interpreting the target pictures, and patients were mildly or moderately impaired according to the clinical probable Alzheimer's disease were recruited for participation in this patient subgroups in greater detail.

We then compared with difficulty restricted to confrontation naming or associated with compromised semantic memory processing naming and word-picture matching were more likely to be assumption that significant impairments on both confrontation profiles. We partitioned patients into subgroups based on the individual confrontation naming and word-picture matching to identify subgroups of AD patients on the basis of their performance profiles thus should be analyzed to clarify the can be misleading if the results merely reflect an averaging spurious effects across the group. Group studies nevertheless can be misleading if the results merely reflect an averaging across several subgroups, as may be the case in AD. Individual performance profiles thus should be analyzed to clarify the nature of the naming deficit in AD. Specifically, we attempted to identify subgroups of AD patients on the basis of their individual confrontation naming and word–picture matching profiles. We partitioned patients into subgroups based on the assumption that significant impairments on both confrontation naming and word–picture matching were more likely to be associated with compromised semantic memory processing compared with difficulty restricted to confrontation naming or relatively preserved performance on both tasks. We then investigated verb and noun naming patterns in these AD patient subgroups in greater detail.

Method

Participants

Twenty-one right-handed, native-English-speaking patients with probable Alzheimer's disease were recruited for participation in this study. They were diagnosed according to NINCDS-ADRDA criteria (McKhann et al., 1984) by experienced neurologists in the Cognitive Neurology Clinic at the Hospital of the University of Pennsylvania. All patients were mildly or moderately impaired according to the clinical evaluation and an independent measure of overall dementia severity, the Mini-Mental State Examination (MMSE) score (Folstein, Folstein, & McHugh, 1975). They did not have visual difficulties that would have prevented them from interpreting the target pictures, and they could read single words. Exclusionary criteria included the presence of other neurodegenerative conditions such as Parkinsonian, frontal, vascular, or metabolic dementias; a history or diagnosis of other neurological diseases such as stroke or hydrocephalus; a primary psychiatric diagnosis such as depression or schizophrenia; the presence of medications such as antidepressants or benzodiazepines at the time of testing; or a metabolic or systemic disorder that might influence cognitive performance. Each AD patient participated in all aspects of the study described below to maintain a complete within-patient design, but we also compared AD patient performance to 14 age-matched, right-handed, native English-speaking control participants to place AD patient performance in context. The control participants were spouses or volunteers from the same communities as the AD patients. Clinical and demographic features of AD patients and control participants are summarized in Table 1.

Materials

The participants were evaluated with line drawings depicting 20 familiar actions and 20 familiar objects labeled by 20 frequency-matched nouns and verbs, \( t(38) = 1.96, \) ns, according to form class-sensitive norms (Francis & Kucera, 1982). The line drawings were taken from published tests of object naming (Kaplan, Goodglass, & Weintraub, 1983) and action naming (Obler & Albert, 1982) and corresponded to the stimulus words listed in Table 2. The pictures of objects and actions were judged to be of equal visual complexity during pilot testing. The nouns were equally divided between natural kinds \((n = 10)\) and manufactured artifacts \((n = 10)\). All of the verbs named actions and were nearly equally divided between verbs that do not typically take a direct object \((n = 9)\) and thus are usually associated only with two sentence frames (with or without a prepositional phrase) and verbs that may also take a direct object \((n = 11)\) and thus are

### Table 1

<table>
<thead>
<tr>
<th>Feature</th>
<th>Control</th>
<th>Alzheimer's</th>
<th>Correlations with Alzheimer's naming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>75.21</td>
<td>72.05</td>
<td>( .163 )</td>
</tr>
<tr>
<td>Education (years)</td>
<td>15.57</td>
<td>14.62</td>
<td>( .021 )</td>
</tr>
<tr>
<td>Disease duration (months)</td>
<td>75.21</td>
<td>72.05</td>
<td>( .160 )</td>
</tr>
<tr>
<td>Disease severity (MMSE)</td>
<td>29.00</td>
<td>18.52</td>
<td>( .068 )</td>
</tr>
</tbody>
</table>

Note. MMSE = Mini-Mental State Examination.

<table>
<thead>
<tr>
<th>Nouns</th>
<th>Verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>carrot</td>
<td>ladder</td>
</tr>
<tr>
<td>strawberry</td>
<td>pineapple</td>
</tr>
<tr>
<td>alligator</td>
<td>refrigerator</td>
</tr>
<tr>
<td>envelope</td>
<td>rabbit</td>
</tr>
<tr>
<td>potato</td>
<td>doll</td>
</tr>
<tr>
<td>umbrella</td>
<td>camel</td>
</tr>
<tr>
<td>cigarette</td>
<td>bow</td>
</tr>
<tr>
<td>elephant</td>
<td>turtle</td>
</tr>
<tr>
<td>kite</td>
<td>trumpet</td>
</tr>
<tr>
<td>balloon</td>
<td>skunk</td>
</tr>
<tr>
<td>weightlifting</td>
<td>painting</td>
</tr>
<tr>
<td>milking</td>
<td>saluting</td>
</tr>
<tr>
<td>brushing</td>
<td>ironing</td>
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<tr>
<td>skiing</td>
<td>swinging</td>
</tr>
<tr>
<td>climbing</td>
<td>fencing</td>
</tr>
<tr>
<td>dripping</td>
<td>weightlifting</td>
</tr>
<tr>
<td>erupting</td>
<td>knitting</td>
</tr>
</tbody>
</table>
Statistical Analyses

Because of the ceiling effect in control participants' performance, nonparametric statistics such as Friedman's analysis of variance (ANOVA) by ranks and the Mann-Whitney U test were performed to compare groups of AD patients and control subjects. Within-group analyses in AD were performed with parametric statistical tests such as analysis of variance, t test, and product-moment correlation. Discriminant analyses (Dixon, 1988) were used to identify subgroups of AD patients with specific patterns of relative difficulty on confrontation naming and word–picture matching. The discriminant analysis algorithm divided the entire population, including control participants and AD patients, into two groups based on their performance for a particular variable of interest. A discriminant analysis must have been significant at least at the F = 4.00 level to be considered valid. In practice, one group identified by the discriminant analysis included the overwhelming majority of controls, and this was considered to be the relatively "intact" subgroup for a task. We then examined the distribution of individual AD patients. We noted whether they were grouped with control subjects and thus were considered relatively intact in their performance on a task, or were grouped separately from control subjects and thus were considered to be relatively impaired in their performance.

Results

Group Analyses

A Friedman ANOVA by ranks compared the overall ability to name nouns and verbs correctly across conditions in AD patients and control participants with a Condition (confrontation naming, word–picture matching) × Form Class (noun, verb) design. This demonstrated a significant effect, $F(3) = 72.97, p < .0001$. Additional analyses with the Mann-Whitney U test revealed that AD patients perform worse than control subjects on confrontation naming, $U(1) = 225.0, p < .0001$, and word–picture matching, $U(1) = 205.0, p < .001$. Planned within-group comparisons demonstrated that AD patients do worse at confrontation naming than their own word–picture matching, $t(19) = 3.95, p < .001$. These findings are summarized in Figure 1.

Additional analyses were performed to determine whether AD patients are equally impaired at naming with nouns and verbs. We found that AD patients are less accurate than controls on confrontation naming with nouns, $U(1) = 250.0, p < .0001$, and confrontation naming with verbs, $U(1) = 285.0, p < .0001$. Moreover, planned within-group comparisons demonstrated that AD patients do worse at confrontation naming with verbs than their own confrontation naming with nouns, $t(19) = 2.06, p < .05$. This pattern of relative difficulty naming with verbs compared with nouns was evident in 75% of AD patients with nonzero differences in their noun- and verb-naming performance. Neither verb naming nor noun naming correlated with AD patients' demographic features or overall dementia severity, as summarized in Table 1. These findings suggest that the confrontation naming deficit in AD is relatively pronounced for verbs compared to their own naming with nouns.

Analyses of confrontation naming error patterns indicated that AD patients make significantly more semantically related errors, $U(1) = 52.5, p < .002$; descriptive errors, $U(1) = 28.5, p < .0001$; and unrelated errors, $U(1) = 40.0, p < .0001$, compared with control subjects. Planned within-group analyses demonstrated that AD patients produce significantly more semantic, descriptive, and unrelated errors than phonemic errors according to t tests significant at least at the $p < .05$ level. This pattern of errors was similar for verbs and nouns, as summarized in Table 3. Despite the generally similar propor-
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Table 3
Percentage of Responses on the Confrontation Naming Task That Are Semantic, Phonemic, Descriptive, or Other Types of Errors for Verbs and Nouns in Alzheimer's Disease

<table>
<thead>
<tr>
<th>Target</th>
<th>Semantic</th>
<th>Phonemic</th>
<th>Descriptive</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Verb</td>
<td>26.6</td>
<td>28.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Noun</td>
<td>37.3</td>
<td>31.4</td>
<td>0.8</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Table 4
Percentage of Responses on the Word-Picture Matching Task That Are Semantic, Perceptual/Phonemic, or Other Types of Errors for Verbs and Nouns in Alzheimer's Disease

<table>
<thead>
<tr>
<th>Target</th>
<th>Semantic</th>
<th>Perceptual/phonemic</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Verb</td>
<td>26.3</td>
<td>41.6</td>
<td>13.5</td>
</tr>
<tr>
<td>Noun</td>
<td>35.2</td>
<td>41.4</td>
<td>12.9</td>
</tr>
</tbody>
</table>

Note. These data do not include trials where the patient did not produce a response within the allotted time.

We also examined whether the grammatical properties of the verbs influenced confrontation naming accuracy by comparing the verbs associated with a narrower variety of sentence frames and the verbs associated with a wider variety of sentence frames. However, we did not find that accuracy naming verbs associated with more sentence frames (57% ± 31% correct) differs from naming verbs associated with fewer sentence frames, 51% ± 41% correct, t(20) = 1.37, ns. It is also noteworthy that accuracy of naming objects that are natural kinds (65% ± 35% correct) did not differ from accuracy of naming objects that are manufactured, 58% ± 33% correct, t(20) = 1.48, ns.

Analyses of performance on the word-picture matching procedure revealed significantly worse performance in AD patients than control subjects for word-picture matching with nouns, U(1) = 180.5, p < .03, and with verbs, U(1) = 223.5, p < .0001, as summarized in Figure 1. Moreover, planned within-group analyses demonstrated that AD patients' word-picture matching with verbs is less accurate than their own word-picture matching with nouns at a level that approached significance, t(20) = 2.03, p < .059. This pattern of relative difficulty for word-picture matching with verbs compared with nouns was evident in 71% of AD patients with nonzero differences in their performance with verbs and nouns. Thus, AD patients' word-picture matching paralleled their confrontation naming, revealing a greater impairment with verbs than with nouns on both measures.

We also examined error patterns during AD patients' word-picture matching. As summarized in Table 4, within-group comparisons revealed that AD patients choose semantically related foils significantly more often than perceptual/phonemic foils, t(19) = 2.97, p < .009, and choose unrelated foils significantly more often than perceptual/phonemic foils, t(19) = 3.69, p < .002. These findings indicate that semantic errors are more common than phonemic/perceptual errors in AD for both confrontation naming and word-picture matching.
Subgroup Analyses

We sought to identify the subgroup of AD patients most likely to have a semantic memory impairment, that is, patients with difficulty on both the confrontation naming measure and the word–picture matching task. Separate discriminant analyses were performed for overall confrontation naming accuracy and for overall word–picture matching accuracy. Two subgroups of AD patients were identified with this method: patients impaired on both confrontation naming and word–picture matching who were more likely to have a semantic memory impairment \((n = 12)\), and patients without a semantic memory impairment, including patients impaired only on confrontation naming \((n = 3)\) and patients with relatively preserved confrontation naming and word–picture matching \((n = 6)\). These subgroups are summarized in Table 5. These subgroups did not differ in age, \(F(1, 20) = 0.18, \text{ns}\); education, \(F(1, 20) = 0.19, \text{ns}\); or disease duration, \(F(1, 20) = 0.83, \text{ns}\). However, the subgroups differed in their overall dementia severity as measured by the MMSE, \(F(1, 20) = 11.82, p < .003\). This difference was due to the lower MMSE score among AD patients with impaired confrontation naming and word–picture matching performance in comparison with the remaining AD patients.

The AD patient subgroups differed in their confrontation naming, \(F(19) = 29.12, p < .001\). An analysis of covariance (ANCOVA), covarying for MMSE, demonstrated that the discrepancy in the MMSE score could not fully account for subgroup differences in naming, \(F(18) = 11.19, p < .004\). Nine of 11 (82%) semantically impaired AD patients with nonzero differences had more difficulty in their confrontation naming with verbs than confrontation naming with nouns, significant at \(p < .05\), according to the binomial test. As summarized in Table 5, this difference between verb-naming accuracy and noun-naming accuracy approached significance according to the Wilcoxon matched-pairs signed-ranks test \((z = -1.86, p < .06)\). This form class effect was not evident in the AD subgroup with relatively preserved semantic memory.

The semantically impaired AD subgroup also differed significantly from the semantically preserved AD subgroup in their word–picture matching, \(F(1, 19) = 11.35, p < .003\). An ANCOVA covarying for MMSE demonstrated that the discrepancy in the MMSE score could not fully account for the difference between subgroups in word–picture matching, \(F(1, 18) = 3.32, 18, p < .05\). Eight of the 11 AD patients with nonzero differences had more difficulty with verb word–picture matching than noun word–picture matching, significant at \(p < .05\), according to the binomial test. In summary, the subgroup of AD patients likely to have compromised semantic memory appeared to have disproportionate difficulty with verbs compared with nouns on both confrontation naming and word–picture matching tasks, and this was associated with their production of superordinate semantic substitution errors only during noun naming but not verb naming.

Discussion

In the present study, we sought to evaluate the basis for verb-naming difficulty in AD by performing groupwide and individual patient assessments of confrontation naming and word–picture matching with verbs and nouns. We found that AD patients as a group are more compromised in their confrontation naming than their word–picture matching, suggesting that lexical retrieval limitations contribute to the naming deficit of AD patients. AD patients also were impaired in their word–picture matching compared with controls. This suggests that semantic memory limitations also play a role in AD patients' naming difficulty. AD patients as a group were

Table 5

<table>
<thead>
<tr>
<th>AD subgroup profile</th>
<th>MMSE M (SD)</th>
<th>Confrontation naming M (SD)</th>
<th>Word–picture match M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semantically preserved ((n = 9))</td>
<td>21.00 (8.75)</td>
<td>15.40 (8.50)</td>
<td>10.50 (9.25)</td>
</tr>
<tr>
<td>Semantically impaired ((n = 12))</td>
<td>14.67 (4.12)</td>
<td>21.60 (30.85)</td>
<td>18.90 (7.91)</td>
</tr>
</tbody>
</table>

Note. Patients with intact performance were clustered with controls during a discriminant analysis of performance on the corresponding task. Patients with impaired performance were not grouped with controls during a discriminant analysis on the corresponding task. All discriminant analyses were significant at least at the \(F = 4.00\) level. MMSE = Mini-Mental State Examination.

Table 6

<table>
<thead>
<tr>
<th>AD subgroup profile</th>
<th>Superordinate substitution errors</th>
<th>Noun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semantically preserved ((n = 9))</td>
<td>Verb 16.5 (8.0)</td>
<td>Noun 14.2 (14.2)</td>
</tr>
<tr>
<td>Semantically impaired ((n = 12))</td>
<td>Verb 0.0 (0.0)</td>
<td>Noun 25.1 (16.9)</td>
</tr>
</tbody>
</table>
more impaired in their naming and word–picture matching with verbs than nouns. Evidence that this form class difference is related to the processing of meaning came from three sources: AD patients had greater difficulty with verbs than nouns for both confrontation naming and word–picture matching, AD patients had a different pattern of semantic substitution errors for verbs and nouns, and individual patient analyses indicated that only the subgroup of AD patients likely to have a semantic memory impairment were more compromised with verbs than nouns. On the basis of these observations, we hypothesize that the verb-naming impairment in AD is due in part to impaired semantic processing.

It is well known that AD patients have a naming impairment and this impairment has frequently been attributed in part to a deficit in processing semantic memory. One source of evidence concerning the semantic basis for naming difficulty in AD includes reports of impaired performance on tasks that do not require lexical retrieval such as word–picture matching (Huff et al., 1986, 1990; Martin & Fedio, 1983), category membership judgments of words and pictures (Grossman, D’Esposito, et al., 1996), and anomaly judgments of pictures and simple subject–predicate sentences (Chertkow & Bub, 1990a; Grossman & Mickanin, 1994; Grossman, Mickanin, et al., 1996). This evidence has been supplemented by careful analyses of confrontation naming errors in AD that demonstrate frequent semantic and superordinate substitutions (Bayles & Tomoeda, 1983; Martin & Fedio, 1983). In the present study, we observed difficulty on confrontation naming as well as word–picture matching, consistent with the hypothesis that a semantic memory impairment contributes to naming difficulty in AD. We also found that AD patients are more impaired with verbs than nouns on both tasks. This confirms our previous observation of greater naming difficulty for verbs than nouns on a set of homophonic and homographic stimuli (Robinson et al., 1996).

We found little support in the present study for an alternative possibility, namely, that verb meaning may be selectively supported in part by grammatical aspects of verbs, resulting in relatively greater accuracy naming with verbs than nouns in AD. Our assessment instead revealed that verb grammatical information has little impact on verb naming accuracy. Shapiro and colleagues (Shapiro, Gordon, Hack, & Killackey, 1993; Shapiro & Levine, 1990; Shapiro & Nagel, 1995) have demonstrated in an elegant series of studies that the number of different sentence frames associated with a verb plays a crucial role in verb processing. However, this effect appears to be salient only for verb processing in a sentence context.

AD is a heterogeneous disorder that can interfere with confrontation naming at several levels of processing in different patient subgroups. Previous studies have underlined broad differences in cognitive and regional brain activity profiles within AD (Grady, Haxby, Schlageter, & Berg, 1986; Haxby, Duara, Grady, Cutler, & Rapoport, 1985; Haxby, Grady, Koss, & Horwitz, 1988; Martin, Brouwers, & Lalonde, 1986; Schwartz, 1990). In the present study, individual patient analyses identified a subgroup of 12 AD patients likely to have a semantic memory impairment. These patients were relatively impaired across both confrontation naming and word–picture matching tasks. Most of these AD patients were more compromised with verbs than nouns on both tasks. This form class-sensitive pattern of impaired naming in a subgroup of AD patients likely to have semantic memory difficulty provides additional support for the claim that verb-naming difficulty in AD is due in part to a semantic processing deficit.

Although these findings associate form-class specific naming patterns with semantic processing deficits in AD, our observations do not fully clarify the basis for this semantic deficit. At least three possible accounts can explain the greater difficulty with verbs than nouns: The first is concerned with the mental representation of verbs and nouns in semantic memory. It has been suggested that verbs have a much sparser and less redundant hierarchical organization than nouns in semantic memory (Jackendoff, 1983; Levin, 1993; Miller & Fellbaum, 1991). The highly structured and redundant organization of matrix relations for nouns may explain in part the frequent finding that AD patients name objects with superordinate terms even if they cannot find the appropriate basic object-level terms (Bayles & Tomoeda, 1983; Martin & Fedio, 1983). Relatedly, we observed an important difference in the type of semantic substitution that was associated with verbs compared with nouns: AD patients’ semantic naming errors rarely consisted of superordinate substitutions for verbs, although superordinate semantic substitutions were frequently observed for nouns. This pattern was also evident in the subgroup of AD patients likely to have a semantic memory impairment. Redundant and overlapping information is more likely to resist degradation as semantic memory processing becomes impaired in AD, and this may assist AD patients in their naming with nouns compared to their naming with verbs. Verb matrix relations, by comparison, are sparser and much less redundant, and this may result in more difficulty naming with verbs than nouns.

A second possible explanation for the form class-sensitive naming difference in AD is that verbs contain more information than nouns—including at least semantic meaning, argument structure, and grammatical information. Verbs thus may require more cognitive processing resources than nouns. AD patients are known to have limitations in such working memory resources (Baddeley, Logie, Bressi, Della Sala, & Spinnler, 1986; Morris, 1994), and verb processing thus may be relatively compromised because of the greater resource demands associated with verb processing than noun processing. Indeed, the subgroup of AD patients with greater difficulty for verbs than nouns on both confrontation naming and word–picture matching tasks had a lower MMSE score and thus may have had relatively limited cognitive processing resources than the AD patients who did not manifest a form class-specific effect. This discrepancy in MMSE could not fully account for the form class-sensitive subgroup differences, but additional work is needed to assess the contribution of resource limitations in AD patients‘ verb processing.

A third possible explanation for greater verb-naming difficulty in AD is related to the claim that lexical retrieval may vary depending on the form class of the target word. Several sources of evidence suggest that AD patients have a word-retrieval deficit. For example, much of the naming deficit in AD is said to disappear when the patients are given choices of names in a word–picture matching context (Huff et al., 1990). Using an entirely different technique, a recent study demon-
strated that the pattern of paraphasias in AD patients' word-use errors is most consistent with a lexical retrieval deficit (Bissou et al., 1995). The findings of the present study are consistent in part with the view that lexical retrieval is compromised in AD. Thus, we found that AD patients perform worse on a confrontation naming task than on a word–picture matching task. We sought evidence for a form class-specific lexical retrieval deficit in AD in the context that several patients with focal cerebral insult have been described with selectively greater difficulty retrieving verbs or nouns (Caramazza & Hills, 1991; Damasio & Tranel, 1993; Hills & Caramazza, 1991; McCarthy & Warrington, 1985; Miceli et al., 1984, 1988; Zinger & Berndt, 1990). A performance profile in keeping with a deficit to a form class-specific output lexicon would include consistently greater difficulty naming with verbs or nouns, particularly among AD patients who do not have a semantic memory impairment. However, this was not found. A previous evaluation of AD patients' spontaneous speech on a picture description task has revealed a fairly normal distribution of nouns and verbs (Blanken et al., 1987). A lexical retrieval impairment thus appears to contribute to confrontation naming difficulty in AD, but this deficit does not appear to be associated with a compromised form class-specific output lexicon.

Several additional shortcomings must be kept in mind when considering our findings. The critical contrasts in our study were within-subject comparisons in the AD group, although a ceiling effect in neurologically intact control participants limited our ability to interpret groupwide contrasts between AD patients and control participants. The confrontation naming results reported here replicate AD patients' relative difficulty naming with verbs found in a previous study (Robinson et al., 1996), but the verb–picture matching deficit requires replication with another technique that does not involve lexical retrieval. Confrontation naming was assessed orally, but the word–picture matching task used written word stimuli, so additional studies are needed to rule out the possibility that AD patients have a lexical retrieval deficit for verbs restricted to the oral modality. With these caveats in mind, we conclude that naming difficulty in AD is multifactorial. A semantic memory impairment contributes to AD patients' naming difficulty, and we hypothesize that consistently greater difficulty naming with verbs than nouns is due in part to differences in processing the mental representation of these words in semantic memory. A lexical retrieval impairment also appears to contribute to AD patients' naming difficulty, although this does not apparently compromise a form class-specific output lexicon.

References


