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Spontaneous speech in senile dementia and aphasia: Implications for a neurolinguistic model of language production*

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Abstract

We analyzed spontaneous speech production in semi-standardized interviews conducted with 10 patients suffering from moderate senile dementia of the Alzheimer type (SDAT), 5 Wernicke's aphasics, and 5 elderly controls without brain damage. Data analysis revealed in both patient groups a reduction of sentence length but absence of systematic paragrammatic symptoms on the part of the demented patients. A relatively selectively diminished use of nouns was striking in the production of both patient groups, whereas word finding ability was surprisingly well preserved in the SDAT patients. Both patient groups exhibited marked deficits but different patterns of pathological behaviour on the discourse level of responding to the interviewer's questions. Results are interpreted within a proposed neurolinguistic language production model. It is argued that the formulation process may be preserved in demented patients but is disturbed in aphasia. Language-related disturbances in senile dementia are assumed to result from pre-linguistic disorders in the formation of the conceptual structure of the intended speech act.

Introduction

Impoverishment of vocabulary, word finding difficulties, and verbal paraphasias have often been reported as characteristic of verbal behaviour in dementia (Ajuriaguerra & Tissot, 1975; Critchley, 1964; Stengel, 1964). Circumlocutions and lack of coherent information have also been noted as typical and common features of the spontaneous language production in demented patients (Appell, Kertesz, & Fisman, 1982; Obler & Albert, 1981) and naming deficits have frequently been mentioned and described as a prominent symptom (e.g., Bayles, 1982; Bayles & Tomoeda, 1983; Martin & Fedio, 1983; Kirshner, Webb, & Kelly, 1984). Irigaray (1973) found a class-specific lexical reduction in spontaneous speech. Function words and verbs were better preserved than nouns and adjectives. With respect to syntax, she suggested that the capacity for sentence formation remains relatively intact. The author, however, described an increase in the number of discontinued sentence constructions and of digressions from initiated syntactic structures in more severely demented patients. Schwartz, Marin and Saffran (1979) reported a patient suffering from presenile dementia with relatively preserved syntactic abilities and severe semantic confusion. This patient could alter statements to questions and affirmative sentences to negations and could modify noun and verb inflections. The authors stressed that agrammatic aphasic patients failed in these tasks.

A number of recent studies have argued in favour of a similarity of linguistic behaviour in patients suffering from senile dementia of the Alzheimer type (SDAT) and in fluent aphasics. Albert (1980) and Obler and Albert (1981) stressed parallels to Wernicke's and transcortical sensory aphasia. Appell et al. (1982) pointed out common aspects between mild SDAT and anomic aphasia, whereas moderate SDAT subjects' productions rather resembled Wernicke's aphasia. Hier, Hagenlocker and Shindler (1985) described similarities between the productions of "late" SDAT patients and Wernicke's aphasics on a lexical level and with anomic aphasics in their syntactic behaviour.

Some authors emphasized differentiating features. Obler and Albert (1981) argued that pragmatic aspects are more severely disturbed in demented patients than in Wernicke's aphasics. Albert (1980) stated that even in severe cases of Wernicke's aphasia the listener is able to interpret the intentions of the patient, while in advanced senile dementia not only are linguistic abilities reduced but also communicative intentions are lost.

Form-related disorders in word production such as phonemic paraphasias and neologisms appear to be rare in dementia (Ajuriaguerra & Tissot, 1975; Appell et al., 1982; Critchley, 1964) and, if they do occur, are usually ob-

served in a late stage of the disease (Constantinidis, Richard, & Ajuriaguerra, 1978).

To summarize, the reviewed literature indicates some similar features in the language production of fluent aphasics, especially those without severe phonological disorders, and that of patients suffering from degenerative dementia.

The present study aimed at a contrastive analysis of spontaneous speech of patients with presumed senile dementia of the Alzheimer type (SDAT) and Wernicke's aphasics. Patient groups were chosen on the basis of the assumption that their deficits were functionally located close to the borderline between linguistic and conceptual-pragmatic functions and that contrastive analysis of their verbal behaviour should reveal insights into the highest linguistic planning processes.

Preliminary outlines of a neurolinguistic model of oral language production

Fundamental progress has been achieved in modelling the functions of human language production, especially by psycholinguistic speech error analysis (e.g., Dell, 1985; Garrett, 1982, 1984; Stemberger, 1985). In addition, efforts have been made to use neurolinguistic data for constructing models of oral language production or for confirming psycholinguistic theories (e.g., Caplan, Vanier, & Baker, 1986; Caramazza & Berndt, 1985; Ellis, Miller, & Sin, 1983; Garrett, 1982, 1984; Saffran, Schwartz, & Marin, 1980; Schwartz, Linebarger, & Saffran, 1985). With respect to neuropsychological methodology for modelling human language functions, Caramazza (1984) formulated two related assumptions for a cognitive approach, the "fractionation assumption" and the "transparency assumption". The first states that brain damage really opens a window to the relevant internal componential organization underlying linguistic behaviour and not to an accidental disorganization. The second holds that, while brain damage affects certain functions, others may be spared and may act in a fashion similar to the premorbid state. The remaining verbal behaviour therefore gives insight into the patterns of potential associations and dissociations and reveals the componential structure of the opaque language apparatus of intact brains.

On the basis of the results of other neurolinguistic studies and of our own aphasiological data, we constructed a preliminary model of language production. In many aspects the model presented here is not unique. The outlines of other psycholinguistic models are similar to ours. The explicitness of its presentation here is restricted by the specific purpose of this paper (for a more detailed discussion see Blanken, 1986; Dittmann & Blanken, 1985).

The model consists of three major functional apparatuses, which are called "pragmatic-conceptual apparatus", "formulation apparatus", and "articulatory apparatus" (see Figure 1).

The function of the pragmatic-conceptual apparatus is to generate the conceptual structure of the intended speech act. Conceptual structures are assumed to precede form-related procedures of language production. It is important to note that this pre-linguistic conceptual level determines and controls meaning-related processes of the formulation apparatus.

The formulation apparatus is supposed to consist of three functional components: the lexicalization component, the grammaticalization component, and the prearticulatory-segmental processing component. It is assumed that aphasic symptoms arise from disturbances of the formulation apparatus and that aphasic syndromes are characterized by specific patterns of breakdown within the componential structure of this apparatus.
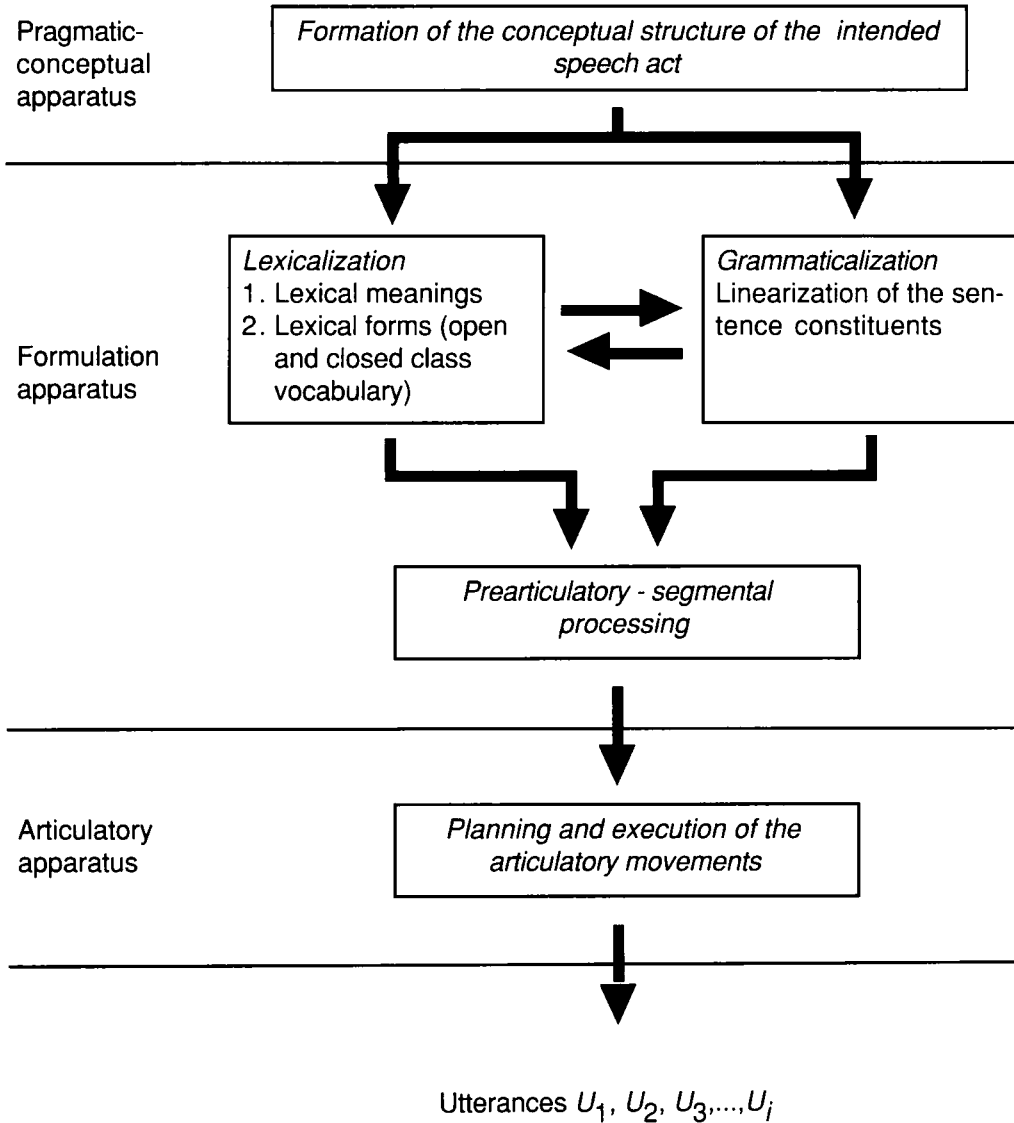
Access to lexical items is mediated within the lexicalization component. Semantic paraphasias are caused by disturbed processes of access to lexical meanings (see Garrett, 1982, 1984), while phonemic neologisms can be explained by disturbed mechanisms of access to lexical forms (see Butterworth, 1979). In principle, we assume for volitional speech a successive activation of meaning and form-related access mechanisms (see Garrett; and others).

The grammaticalization component is supposed to perform the linearization of the sentence constituents and to insert morphological elements and function words according to the rules of sentence formation. Generally, this component provides a final left-to-right sequence of the sentence surface. The function of this component is assumed to be disturbed in agrammatism (see e.g., Berndt & Caramazza, 1980; Saffran, Schwartz, & Marin, 1980).

Lexicalization and grammaticalization operate in an interactive and parallel processing organization (see for psycholinguistic argumentation Bock, 1982; Stemberger, 1985). Thus sentence formation is based upon a close and simultaneous cooperation of both components. As a consequence, severe disturbances of the lexicalization component may lead to paragrammatic symptoms (e.g., sentence fragments, anacolutha) and phenomena of disequilibration (logorrhoeic pressure of speech).

The prearticulatory-segmental processing component is supposed to be activated subsequent to the processes of lexicalization and grammaticalization. As soon as the planned position in the sentence frame is reached, the respective lexical form determines the detailed phonological word processing on a prearticulatory level. Finally, the executive and perhaps further antecedent motor planning processes of the articulatory apparatus, which are controlled by the prearticulatory-segmental processing component, are put into operation.

Figure 1. *A neurolinguistic working model of language production.*

Pragmatic-
conceptual
apparatus

Formation of the conceptual structure of the intended speech act

Formulation
apparatus

Lexicalization
1. Lexical meanings
2. Lexical forms (open and closed class vocabulary)

Grammaticalization
Linearization of the sentence constituents

Prearticulatory - segmental processing

Articulatory
apparatus

Planning and execution of the articulatory movements

Utterances U_1, U_2, U_3,...,U_i

There is a high level of agreement in the pertinent linguistic debate on postulating that the language production process can be divided into a pre-linguistic or language initiating stage, sometimes called a communicative intention, and a language encoding or sentence constructing stage which is influenced by the speaker's intentions.

Concerning the linguistic theory of grammar, Chomsky (1980) stated in his modular approach of mental organs that "grammatical competence" is dissociable from "pragmatical competence", the latter being defined as the communicative use of a speaker's mental grammar. Following this approach, Bierwisch (1981, 1982) regards the "linguistic system", the "conceptual system", and the "system of social interaction", (and other systems) as candidates for relatively autonomous mental systems and their representations.

In psycholinguistics, for instance, Bock (1982) developed a model of language production by reviewing evidence from many sources of psycholinguistic research and proposed within it a "referential arena" situated higher than the sentence encoding process and responsible for "the translation or coding of the nonlinguistic representation of thought into a format that can be used by the linguistic system" (p. 3). In the same line, Garrett (e.g., 1982) argues in favour of a language production unit of communicative intent or "message" that instructs and controls the speaker's sentence processing level. He offers no data but feels that a failed correspondance between intent and sentence structure (e.g., in cases of anacolutha or formulation restarts) may support the plausibility of a distinction between "message level" and "sentence level". In his view "the message level may be viewed as a real time conceptual construct based upon the speaker's current perceptual and affective states and on his general knowledge of the world (...)" (p. 25). Moreover he characterizes the "message level" as "the locus of the myriad inferential processes which must necessarily be a part of structured discourse" (p. 25).

In neurolinguistics the question of whether aphasics suffer from high-level conceptual disorders and how far aphasic language disorders may reach into more general cognitive information processing is controversially discussed (see e.g., Cohen, Kelter, & Woll, 1980; Ellis, Miller, & Sin, 1983; Goldstein, 1948; Orgass, Hartje, Kerschensteiner, & Poeck, 1972; Weinstein, 1981). As to pragmatic aspects of verbal behaviour (see for a review Foldi, Cicone, & Gardner, 1983), there is some evidence that aphasics are able to integrate textual and contextual constraints in language processing (Green & Boller, 1974; Hirst, Ledoux, & Stein, 1984; Huber & Gleber, 1982; Stachowiak, Huber, Poeck, & Kerschensteiner, 1977; Ulatowska et al. 1983 a,b; Wilcox, Davis, & Leonard, 1978).

At the present state of research we should like to draw the strongest inference from the studies mentioned above, that is, that aphasics do not necessar-

ily suffer from a primary dysfunction of pragmatic-conceptual abilities. On the other hand, the clearly cognitively impaired SDAT patients are presumed to show primary disorders in pragmatic-conceptual processing without necessarily demonstrating additional primary aphasic symptoms. Based on these considerations our first working hypothesis may be specified:

(H1) The pragmatic-conceptual apparatus may be disturbed in a manner independent of the formulation apparatus in SDAT. In aphasic patients the formulation apparatus is damaged, but not necessarily the pragmatic-conceptual apparatus.

H1 generates a number of related hypotheses, which can be derived from the neurolinguistic component model described above:

(H2) Mechanisms of lexical access and operations of the grammaticalization component are not necessarily defective in SDAT. Demented patients therefore need not show symptoms of agrammatism nor paragrammatism.

The central assumption of our hypotheses is that of non-identity of the basic deficits underlying language behaviour in patients suffering from SDAT and aphasia. We suppose that dementive and aphasic verbal disorders represent two different and dissociable patterns of symptoms, the causative mechanisms of which are located at different loci of the language production apparatus. Indeed, if we were successful in supporting the hypotheses H1 and H2 then we would have provided some neurolinguistic evidence in favour of hypothesis H3 that is of crucial interest for any language production model:

(H3) The pragmatic-conceptual apparatus and the formulation apparatus are autonomous processors of language production.

Subjects and procedure

Subjects

Ten patients suffering from SDAT of moderate severity were investigated. All patients exhibited severe mnestic disturbances, were disoriented in time and eight of them also in place. They were severely impaired in dealing with everyday problems and needed regular assistance in everyday activities. All patients were native German speakers and had never suffered from cerebrovascular accidents or brain trauma. The diagnosis of SDAT had been made on the basis of psychiatric and neurological evaluation including EEGs, and in all but two patients, a CT scan. All patients were in long term stationary care.

Rating for severity included two procedures. Subjects were tested with the Standard Progressive Matrices (Raven, 1956) and were all placed within the bottom 5 percentiles. Additionally, the responsible physicians had been asked to indicate degrees of severity according to a three stage taxonomy (mild-moderate-severe) consisting of gradual features for seven parameters of behaviour (see Table 1). Only those SDAT patients were selected for this study who had been rated as moderately impaired.

Since naming performance seems to be crucially involved in language-related pathology of dementia, a short confrontation naming examination was administered to all subjects of the SDAT group. The material consisted of 8 unambiguous and visually simple line drawings of the Aachen Aphasia Test (AAT) naming stimuli which are related to 1–3 syllabic target words (Tisch, Buch, Koffer, Besen, Zigarre, Kerze, Waage, Bagger; respectively, table, book, suitcase, broom, cigar, candle, scale, dredger). The subjects' overall correct naming reactions made up 47/80 items. Each patient made 1 or 2 semantic paraphasias mostly closely related to the target by coordination (e.g. Kran (crane) > Bagger (dredger)) or superordination (e.g. Auto (car) > Bagger (dredger)). Additionally, the patients exhibited 1 or 2 verbal paraphasias each, the referents of which possessed visual similarity to the target object (e.g.,Büchse (can) > Kerze (candle)). Only one perseveration was observed. Other responses consisted of unspecific (e.g., "I don't know") and verbal nil-reactions (e.g., shaking the head).

Five Wernicke's aphasics were selected to form the comparison group. In all cases aphasia was due to vascular etiology. They were comparable to the demented patients with respect to level of schooling and premorbid social status, but were out-patients and markedly younger. For the methodological reason of the intelligibility of their utterances and the better comparability to the speech production of the demented subjects only aphasics without or with only mild phonological disturbances were included. All aphasic patients demonstrated fluent and well-articulated language output and none of them exhibited agrammatic symptoms. All language data included in the present study were collected more than 4 weeks post CVA. The syndrome classifications were defined according to the AAT (Huber, Poeck, Weniger, & Willmes, 1983; Huber, Poeck, & Willmes, 1984). Table 2 shows the results of the aphasic group in five AAT-subtests.

We also included a control group of five elderly subjects without neurological or psychiatric abnormalities which was matched to the patient groups with respect to level of education and social status. Age differences in comparison with the SDAT patients were not significant (t-test; $p > .3$). All controls inconspicuously led a normal life in their familiar social community.

Table 3 specifies demographic data of the three experimental groups.

Table 1.   *Three-stage-taxonomy of severity of SDAT[a]*

Functions	Mild SDAT	Moderate SDAT	Severe SDAT
Verbal communication	A meaningful conversation about familiar topics is possible	A meaningful conversation about familiar topics is only possible with restrictions or with the assistance of the discussion partner	A meaningful conversation even about familiar topics is not possible
Social behaviour	Outside the familiar community social behaviour is markedly reduced	Social activities are largely restricted to the familiar community	Most severe restrictions of social activities even within the familiar community
Memory	Marked memory deficits especially for recent events	Severe memory deficits for recent events; events long past may often be recalled	Severe memory deficit; only memory fragments are preserved
Orientation	Orientation to time, place, and person are largely still possible	Orientation to time is markedly disturbed; orientation to place may additionally be restricted; orientation to person is still possible	Severely disorientated with respect to time and place; orientation to person is sometimes possible
Everyday problems	Marked troubles in autonomously dealing with everyday problems	Severe troubles in autonomously dealing with everyday problems	Inability for problem solving
Interests	Markedly reduced interest in topics of public and intellectual affairs	Interests are restricted to topics of simple and familiar manner like family, visitors, meals, etc.	Extensive loss of interests
Need of personal care	Only occasional assistance in hygiene, dressing, etc.	Frequent or periodical assistance in hygiene, dressing, etc.	Permanent personal care and nursing

[a]Partly based on Hughes, Berg, Danziger, Coben and Martin (1982).

Table 2.   *Results of the Wernicke's aphasics in five AAT-subtests*

	Raw scores		Percentile ranks	
AAT-subtests	Median	Range	Median	Range
Token test	38	10–45	31	16–81
Repetition	116	71–136	55	24–81
Written language	44	1–88	47	11–99
Naming	76	26–112	49	23–97
Comprehension	56	30–108	24	7–95

Table 3.   *Distribution of sex and age of SDAT patients, Wernicke's aphasics, and elderly controls*

		Sex		Age	
Group	N	Male	Female	Median	Range
SDAT	10	7	3	82.5	67–89
Wernicke's	5	2	3	53	48–71
Elderly	5	2	3	77	69–80

Procedure

To elicit spontaneous speech a "semi-standardized interview" of 5–10 minutes duration was performed with all subjects. In the AAT a "semi-standardized interview" is defined as a type of discourse in which the examiner acts as much as possible as a natural interlocutor but which is simultaneously directed and controlled by the examiner's purposive and openly formulated questions. Succession and wording of the questions are only approximately fixed. The topics of our interview included the subjects' personal data, biography, health, and information concerning family and surroundings. All demented patients were able to participate in this more informal language examination and to cooperate with the examiner for the duration of the interview. The whole interview was tape recorded and subsequently completely transcribed by using the "Freiburger Transkriptionsformular" (see Fuchs & Schank, 1975) and the notation conventions of Ehlich & Rehbein (1976). The transcription was carried out prior to, and independent of, the analysis and the transcriber was unaware of the theoretical reflections which guided this investigation. Statistical analyses of the data were exclusively carried out on raw scores.

The grammatical organization of spontaneous speech

Methods

For scoring of sentence structure and sentence length, simple and complex sentences were differentiated. The latter type was subdivided into subordinated and coordinated structures according to structure and conjunction use. Concatenated sentences were segmented into (two or more) simple sentences if there was no close thematic relationship between the utterances or if perceptually noticeable pauses existed between them, thus rendering a more complex sentence plan as unlikely. All sentences starting with the conjunction "und" (and) or "und" followed by an adverb (e.g., "und dann" (and then), "und da" (and there)) which were thematically only loosely connected to the anteceding utterances were also scored as simple sentences. Utterances made in parentheses within the boundaries of another syntactic construction were regarded as standing outside the current syntactic unit. Some sentences had to be carefully grammaticalized for scoring, for example, repetitions without syntactic function were deleted or some sentential supplements were regarded as standing within the sentence frame, if such an operation made the utterance grammatically acceptable. For the analysis of sentence type and length all sentence fragments (aborts of sentences with recognizable syntactic structures) and anacolutha (changes of syntactic structures or contaminations of two or more syntactic structures within one utterance) were excluded. Likewise excluded from scoring were all elliptic answers and verbal settings without syntactic organization (e.g., noun clusters, particles). Finally, some sentence-like utterances with unintelligible and/or totally unacceptable structures could not be included in the scoring procedure. For word class analysis all uttered words were classified according to their grammatical class and function. Classification of, and segmentation into, word units were made on the basis of the German Duden-Grammar (1984).

Results

1. Sentence planning in spontaneous speech

Table 4 shows the sentence lengths of the speech productions for all experimental groups. The average length of simple sentences is significantly reduced in both patient groups in comparison to the elderly controls. On the other hand both demented and aphasic patients produced sentence frames including subordinate and combined clauses, thus demonstrating their preserved ability to generate long and complex syntactic constructions. Both Wernicke's apha-

sics' and demented patients' productions gave no evidence for the presence of agrammatism. Furthermore, our data demonstrate that sentence length is not an appropriate criterion for the differentiation of SDAT patients from Wernicke's aphasics.

The percentage of fragmentary sentences and anacolutha in our corpus is shown in Table 5. We found no significant differences between SDAT patients and the elderly controls. Wernicke's aphasics, however, produced a significantly greater number of fragments and anacolutha.

Table 6 illustrates types and numbers of errors of inflection and in the use of function words. The performance of four Wernicke's aphasics was characterized by typical paragrammatic disturbances of selection of free and bound grammatical morphemes and of function words. Errors of this type were very infrequent in demented patients. In sum, there was no reliable evidence even for a mild systematic paragrammatism in SDAT patients.

Our results support in a general way the findings of Irigaray (1973) and others that dementia does not include disturbances of grammatical organization. Moderate SDAT patients predominantly produced simple sentences of five and more words and were able to plan and realize longer and more complex syntactic constructions. Both sentence fragments and anacolutha and incorrect use of closed class words were rare in SDAT patients. We conclude that there are no genuine grammatical deficits in moderate SDAT patients. Wernicke's aphasics, on the other hand, seem to be disturbed in

Table 4.   *Lengths (in words) and instances (Inst) of sentence types in the spontaneous speech of SDAT patients, Wernicke's aphasics, and elderly controls*

		Simple sentences		Complex sentences					
				Subordinated			Coordinated		
	Inst	Length		Inst	Length		Inst	Length	
Group		$\bar{x}$	SD		$\bar{x}$	SD		$\bar{x}$	SD
SDAT	232	5.81	(2.09)	16	13.53	(4.92)	11	14.27	(4.00)
Wernicke's	116	5.42	(1.96)	17	11.59	(4.30)	7	11.57	(3.10)
Elderly	53	7.58	(2.52)	13	11.38	(2.29)	10	13.40	(1.58)

s^{**} = significant (U-test (Mann/Whitney)): $p < .01$.

Table 5. *Sentence fragments and anacolutha among all sentence-like ut-*
terances

Group	Instances of sentences-like utterances	Instances of sentence fragments and anacolutha		Percent
SDAT	298	38	┌ s**	12.75
Wernicke's	219	72	├ ┌ s**	32.87
Elderly	93	11	└	11.82

s** = significant (χ-square: $p < .01$).

sentence planning, which, however, to some extent may be a consequence of problems of access to lexical items and their insertion into syntactic frames resulting in frequent fragments and anacolutha.

2. Word classes in spontaneous speech

Table 7 shows the distribution of grammatical word classes in the language production of our experimental groups. The most important finding is that both patient groups, and Wernicke's aphasics more than demented patients, showed a significant decrease in the production of nouns. The frequency of verbs, however, exceeded the verb production of the healthy controls. Similarly, adverbs seem to be easily produced by both patient groups with the result of a quantitative increase in their use. This exaggerated use could be explained by the frequently vague and unspecific semantic value of many adverbs. Concerning the production of adjectives and modal verbs our results do not agree with the findings of Irigaray (1973), who found a quantitative reduction of their use. Adjectives, especially in predicative positions, and modal verbs were easily accessible to patients of both syndromes. Contrary to our expectation there was no increased production of function words in the patient groups compared with the elderly controls. This finding might be interpreted as an effect of the generally longer and more complex sentence frames used by the healthy controls.

Table 8 indicates that both patient groups tend to use verbs and nouns repeatedly (see Irigaray, 1973). In most of these instances the repeated verbs and nouns were used in a manner which was semantically quite appropriate.

Table 6.   *Paragrammatic errors in word inflection and in the use of function words*

| Group | Types of errors | | | | | | Sum of errors | Error percent | |
| | Inflectional | | Function words | | | | | | |
	Nouns	Verbs	Article	Auxiliary	Pronoun	Others		Uttered words	Error (%)
SDAT	1	2	–	–	–	–	3	3301	0.09
Wernicke's	1	3	1	3	3	1	12	2046	0.59
Elderly	–	–	–	–	–	–	–	811	–

s** = significant (χ-square: $p < .01$).

Table 7.   *Use of word classes in spontaneous speech (in %; ranges in brackets)*

Group Nouns		Content words				Function words
		Full-verbs	Modal-verbs	Adjec-tives	Adverbs	Articles, proforms etc.
SDAT	10.3	8.3	1.2	4.0	18.8	57.4
	(7.3–12.5)	(5.1–10.1)	(0.4–2.2)	(2.4–7.0)	(15.3–22.4)	(53.1–63.6)
Wer-nicke's	5.2	7.2	2.5	3.5	21.3	60.3
	(4.2–7.4)	(5.7–10.4)	(1.2–3.6)	(1.6–4.7)	(18.2–27.7)	(58.5–64.9)
Elder-ly	14.4	6.3	1.5	3.1	12.4	62.3
	(12.0–27.3)	(4.5–9.1)	(0.9–3.9)	(1.8–5.3)	(10.4–15.5)	(45.8–73.6)

Significance brackets: Nouns SDAT–Wernicke's s*, Wernicke's–Elderly s**; Nouns overall (SDAT–Elderly) s**; Adverbs SDAT–Elderly s**, Wernicke's–Elderly s**; Articles etc. (SDAT–Elderly) s*.

s** = significant (χ-square: $p < .01$).
s*   = significant (χ-square: $p < .05$).

Table 8.   *Type/token ratios of totally produced and newly introduced nouns and verbs*

Group	Nouns	Verbs
SDAT	0.64	0.61
Wernicke's	0.54	0.50
Elderly	0.86	0.78

Significance brackets: Nouns SDAT–Wernicke's s**, Wernicke's–Elderly s**; Verbs SDAT–Wernicke's s*, Wernicke's–Elderly s*.

s** = significant (χ-square: $p < .01$).
s*   = significant (χ-square: $p < .05$).

We conclude that there are a number of similarities between demented patients and Wernicke's aphasics in the use of word classes. Both groups produce fewer nouns and more verbs and adverbs and tend to reproduce content words already used. Our results thus support Irigaray's finding that there seems to be a reduction of lexical usage with respect to specific word classes in SDAT patients. To be more precise, our data indicate that both patient groups are relatively selectively disturbed in the production of nouns in their spontaneous speech.

Word finding difficulties and word finding behaviour in spontaneous speech

Methods

We considered the following phenomena to be indicators of word finding problems:

Phenomena of delay. These include, firstly, time gaining behaviour such as repetition and the use of particles without informational content, secondly, the use of signals of delay (e.g., uh, mhm) and thirdly, silent pauses. In accordance with the "Freiburger Transkriptionsformular", silent pauses were differentiated into short (up to 2 seconds duration), medium (2–3 seconds duration) and long ones (up to 7 seconds duration). Delay strategies may also be indicated by utterances followed by attempts at self-correction or approximation. However, phenomena of delay do not necessarily indicate a disturbance of word finding, for example, pauses may occur during periods of reflexion, verbal planning, exhaustion, or may be used rhetorically. Therefore, only such phenomena were included which constituted a disruption of the flow of speech and which delayed the production of a content word. Delays at the beginning of a phrase or clause were excluded as these may correspond to other planning processes.

Sentence fragments and anacolutha. In patients with severe word finding disorders sentence fragments and anacolutha may indicate disturbed word retrieval. This is of course only true if severe articulatory disorders and agrammatism can be ruled out. Discontinuations at the very beginning of an utterance were excluded from this category as these may result from disturbed higher planning processes or from changes of the communicative intention.

Vocalizations. Clearing of the throat, coughing and laughing were included as indicators if they delayed the production or occurred instead of a content word.

Reactive behaviour. We employed the following classification of types of reactive behaviour in situations of word finding difficulties:

(a) We call behaviour "non-strategic" if the speaker does not try to continue to convey his message if his first attempt was unsuccessful because of a word finding problem. There are two types of surrender behaviour, that is, "discontinuation" without completion of the message in altered form and "commenting behaviour". The latter is characterized by thematization of the word finding problem or cursing instead of an attempt to find or substitute the missing word.

(b) With "substituting behaviour" the speaker may apply semantic strategies, either paradigmatic ones (e.g., hyponyms) or syntagmatic ones (e.g., periphrases, descriptions). In a second type the speaker produces a substitute without semantic content (e.g., "thing") or deictic forms and the listener is implicitly demanded to get at the missing target word by inferring from the context.

(c) The goal of "searching strategies" is to identify the target word. The speaker may apply a monological approach and use a delay or a conduite d'approche, a dialogic strategy and ask his partner for help, or a combined strategy including elements of both monologic and dialogic attempts.

The latter two forms of reactive behaviour are summarized as "strategic behaviour" because the speaker attempts to continue the message by producing a substitute or by trying to identify the target word.

Results

Word finding problems have been reported to be one of the most prominent features of language disturbances in dementia and are a constituent symptom of all syndromes of aphasia. A quantitative and qualitative analysis of word finding difficulties and of the patients' reactive behaviour should give evidence as to whether both groups—SDAT patients and Wernicke's aphasics—result in similar or different deficits in word production.

Table 9 shows the frequency of occurrence of word finding problems in all experimental groups. Surprisingly, the number of word finding difficulties in the demented patients does not differ significantly from controls, whereas the aphasics exhibited marked deficits in word retrieval. This result indicates that in moderately demented patients the mechanisms of lexical access may not be disturbed. Our finding supports the observation made by Stengel (1964) who stressed that word finding difficulties in dementia are more prominent in test situations and less in spontaneous speech. The mere word retrieval capacity, of course, does not indicate full appropriateness of the selected words. However, we must acknowledge that the spontaneous speech of the demented speakers—other than that of Wernicke's aphasics—was not characterized by frequent anomic situations. Table 10 describes the strategies used

Table 9.   *Instances of word finding difficulties in relation to the total amount of uttered words*

Group	Sum of uttered words	Instances of word finding difficulties		Percent	
SDAT	3301	29		0.88	
			ns		s**
Wernicke's	2046	84		4.10	
					s**
Elderly	811	6		0.74	

s**   = significant (χ-square: $p < .01$).
ns   = nonsignificant.

by both patient groups in the case of word finding problems. The demented patients applied delay and searching strategies in about 80% of such incidents, thus demonstrating active behaviour aiming at substitution or identification of the missing word. The aphasics, on the other hand, resigned in most of their word finding problems. Both groups significantly differed in respect to strategic versus non-strategic behaviour in anomic situations (χ-square: $p < .01$). These findings are contrary to expectation as we should have thought that the cognitively less impaired aphasics would show more active and goal-orientated behaviour. Commenting behaviour was only found in the group of the aphasic patients. Its presence may constitute a differential diagnostic feature.

Table 10.   *Reactive behaviour in situations of word finding difficulties (total scores and percent)*

Reactive behaviour	Subtype	Total	%	Total	%
Substituting strategy	Semantic	3	10.3	1	1.2
	Contextual	3	10.3	8	9.5
Searching strategy	Monologic	16	55.3	25	29.8
	Dialogic	–	–	2	2.4
	Combined	1	3.4	1	1.2
Non-strategical behaviour	Discontinuance	6	20.7	36	42.8
	Commenting	–	–	11	13.1

Analysis of responding behaviour

Methods

To evaluate features of the patients' communicative abilities we analyzed their behaviour in response to the interviewer's questions within the semi-standardized interviews. For scoring, a response classification scheme was developed which consists of the following types of verbal reactions:

Fulfilling responses. This type of reply is able to satisfy the need for information defined by the interviewer's questions. These reactions may even give a surplus of information which either can be partly redundant for the evolution of discourse or can anticipate and constitute a new thematic string of the conversation.

Partly-fulfilling responses. Three subtypes are differentiated: "Fragmentary responses" leave open a piece of information demanded by the question, "vague responses" are characterized by indefinite answers caused by unspecific lexical units, which do not meet the more precise expectations of the listener. Finally, in "evasive responses" the locutor tries to avoid an exact answer by the use of flourishes or by referring to generally valid rules instead of giving a specific answer.

Non-fulfilling responses. They are subdivided into "confabulated responses", the propositions of which are not in accordance with the true facts, "non-related reactions", which are characterized by a missing semantic question-answer-relation, and "don't-know responses", a type of reply in which the patient tries to pretend missing knowledge even in respect to simple questions.

Other types of reactions. In "nil-reactions" the patient gives no verbal reaction at all. "Echolalic reactions" repeat the question of the investigator in the same or in a varied form. "Check-backs" aim at obtaining or securing comprehension of a question or just to win some time for answering. At last, "metacommunicative utterances", which refer to aspects of the running dialogue, can be produced instead of giving a specific answer.

Table 11 gives some examples for those types of verbal reactions which were not considered as fulfilling.

Results

In all, 180 question-answer-sequences could be collected from the demented subjects ($\bar{x} = 18$; $SD = 6.8$; per patient) and 65 sequences from the aphasic group ($\bar{x} = 13$; $SD = 3.7$; per patient). Table 12 gives a survey of the answering profiles for the two patient groups. It must be stressed that the results only allow a quantitative description without statistical validity of the observed

Table 11. *Examples of the types of verbal reactions (translated from*
German)

Types of verbal reactions	Examples
Fragmentary	I: when have you been born P: february 23rd
Vague	I: how old are you mr. (NAME OF THE PATIENT)[a] P: yes I don't know—very old—now
Evasive	I: where are you now P: uh usually I am am uh longer uh in contact with the old old uh old folks' home
Confabulated	I: do you know where your are P: in in (NAME OF THE PATIENT'S HOME TOWN)
Non-related	I: where are you born P: yes—I don't know—that my mother used to I know
Don't know	I: is this the home for the aged or what—where we are here P: here? I have no idea
Nil-reactions	I: which day of the week is today P: (SILENT PAUSE OF 23 SECONDS)
Echolalic	I: what is she doing at home P: at home what is she doing
Check-backs	I: where are you here P: please?
Metacommunicative	I: what are you doing P: I am still (WORD FINDING DISTUR-BANCE) what is this—this is always away again

[a]Brackets and capital letters indicate comments of the transcriber.

responding behaviour. Both demented seniles and Wernicke's aphasics exhibited marked deficits in their responding behaviour towards the interviewer's questions. Only in about 40% of all instances were both groups able to give an informationally satisfactory reply, revealing drastic handicaps on the level of pragmatics of discourse. The reactions of the demented seniles, more often than those of the aphasics, did not fulfil at all the questions asked. Instead they produced frequent confabulations or semantically totally unrelated re-

sponses. Wernicke's aphasics, on the other hand, were predominantly characterized by partly fulfilling answers, especially fragmentary ones, which nearly always resulted from severe word finding blockages which hindered the aphasic in giving a complete answer. Partly fulfilling responses also occurred with the demented patients but in far lower frequency and in a more equal distribution of fragmentary, vague, and evasive reactions. The aphasics also produced non-related responses, but these were restricted to two patients with the most severe auditory perceptive disorders. Indeed, we do not want to rule out disorders of perception as an explanatory ground for the frequent occurrence of non-related responses for both patient groups. Thus, these utterances may possibly not reflect disturbances within the language production system but may be caused by the inability to perceptually follow the informational flow of discourse. In addition, the fact that the demented patients often used check-back questions might reflect receptive problems, especially when having to switch from one topic to another. With respect to "other" forms of response behaviour the groups revealed some clear yes/no distributions: Nil- and echolalic reactions were restricted to demented patients, metacommunicative responses (e.g., "I know it but I can't say it") were only found with the Wernicke's aphasics and seem to indicate a noticed conflict between the underlying communicative intentions and the difficulties of expressing them verbally.

Table 12. *Types of responding behaviour (totals and percent)*

Responding behaviour	SDAT	Wernicke's
Fulfilling:	42.8 (77)	40.0 (26)
Partly-fulfilling:		
Fragmentary	5.0 (9)	27.7 (18)
Vague	3.9 (7)	3.1 (2)
Evasive	5.0 (5)	1.5 (1)
Non-fulfilling:		
Confabulated	13.3 (24)	1.5 (1)
Non-related	13.9 (25)	12.3 (8)
Don't know	4.4 (8)	1.5 (1)
Others:		
Nil-reactions	2.2 (4)	– (–)
Echolalic	4.4 (8)	– (–)
Check-backs	7.2 (13)	3.1 (2)
Metacommunicative	– (–)	9.2 (6)

Discussion

The most important findings concerning the spontaneous speech of demented patients and Wernicke's aphasics can be summarized as follows:

(a) Both groups exhibited a tendency towards short and simple syntactic sentence organization but were able to produce complex and long sentence frames, too. Wernicke's aphasics, but not the moderately demented subjects, frequently produced sentence fragments and anacolutha. Additionally, unlike the aphasics, the demented patients made only a negligible number of errors of inflection and in the selection of closed class items. In all, there was no evidence for a systematic disturbance of syntactic and morphosyntactic operations in moderate SDAT patients.

(b) Both patient groups showed a quantitative reduction in the use of nouns, but not of other content words. Simultaneously, the frequency of adverbs in the word class usage of the SDAT subjects was increased in comparison to the healthy elderly group.

(c) The frequency of word finding problems of the demented patients was much lower than that of the Wernicke's aphasics and differed only slightly from elderly controls. The qualitative analysis revealed that the moderately impaired seniles in most instances used strategies of delay and search whereas the Wernicke's aphasics tended to give up.

(d) With respect to responding behaviour, Wernicke's aphasics revealed themselves as being relatively selectively characterized by fragmentary responses due to word finding blocks and only in cases of severe auditory perceptive disturbances by non-related replies. Their metacommunicative utterances in the answer's position demonstrate the conflict between the speakers' intentions and their restricted abilities of verbalization. On the other hand, the demented seniles exhibited, with the exception of metacommunicative responses, the full range of our taxonomy of aberrant responding reactions, indicating a more general deficit underlying their verbal behaviour than in the aphasics.

It has frequently been stated that demented subjects show spontaneous language behaviour similar to that of fluent aphasics of the Wernicke type. There are indeed some common features in language production of both syndromes, such as an easy accessibility of the closed class vocabulary, a decrease of nouns, and a stronger reliance on verbs and adjectives, the latter ones especially in predicative position. But these present similarities of their language-related symptomatology cannot conceal the simultaneous marked differences that render the assumption of a common underlying deficit questionable. In respect to morphosyntax, the use of closed class words in demented subjects is not characterized by frequent errors of selection as is typical

for Wernicke's aphasics. Furthermore, they did not produce an abnormal number of sentence fragments and anacolutha compared with the elderly controls. In addition, note the total lack of agrammatic symptoms in the SDAT group as they are constitutive for Broca's aphasia, an observation which is in accordance with earlier studies on this topic. Indeed, except for cases of additionally acquired aphasia, the present authors do not know one single case of Broca's aphasia in SDAT patients, either in their own observations or in those of a published report. Thus, on the basis of the proposed model of language production (see Figure 1), we must conclude that in moderate SDAT the linguistic functions of the grammaticalization component including the linearization of the sentence constituents and the insertion of closed class items are not disturbed in a paragrammatic or agrammatic way such as is known of aphasic speech.

The question is now whether SDAT subjects suffer from an impairment of the lexicalization component as is supposed to be present in Wernicke's aphasics. We believe that the infrequent occurrence of anomic situations is an important argument in favour of our model driven hypothesis. The results presented can show that even for nouns the mechanisms of word access are functionally quite intact with respect to spontaneous speech. Wernicke's aphasics, on the other hand, clearly suffer from lexical access disorders resulting in frequent word finding blocks. Specifically, their frequent absence of lexical search indicates a deficit that is situated at a very early stage of lexicalization, at a level of whole-word retrieval or already in accessing lexical meanings.

The problem remains as to whether the use of content words in spontaneous speech is appropriate in the demented subjects. For both patient groups we found a striking tendency to repeat content words already used. Perusal of the transcripts shows that the repetitions of the demented seniles cannot be classified as continuous or recurrent (intruding) perseverations (Sandson & Albert, 1984; Shindler, Caplan, & Hier, 1984) because the repeated elements were used in a semantically overwhelmingly appropriate manner. In addition, there are no indications that the repetitions are due to difficulties in the retrieval of anaphora (e.g., pronouns), which were well accessible, better than content words (see Table 6). In the aphasics their drastic word finding problems seem to be involved in their repetitive use of content words. Their struggle for words often forces them to go back to the words once used. For the demented seniles we cannot rule out that the more "soft" type of "stuck-in-set perseverations", often related to frontal lobe damage (Sandson & Albert, 1984), underlies their verbal behaviour, leading to an impairment of switching from one lexical entry to another or from one semantic category to another. On the other hand, even more mysterious "intentional" deficits

could cause a repetitive use of words and a slower progression of discourse. Thus, demented seniles speak but they do not have much to say and therefore become repetitive. For methodological reasons it is very difficult to identify misnamings and verbal paraphasias in conversational speech as the underlying intention is often unclear. We gained the impression that the spontaneous speech was characterized rather by imprecision than by frequent paraphasic misnamings. However, although vagueness and emptiness of linguistic expression are the dominant features, verbal paraphasias may also occur in discourse. For instance, when asked for his earlier profession, a patient replied "groom". In a confrontation naming task (see above) all demented subjects of this study suffered from marked deficits and produced unambiguous verbal paraphasias which were almost exclusively semantically and/or visually related to the target. Thus language in moderate dementia reveals the potential dissociation of rather intact mechanisms of mere word access and appropriate and precise word selection, whereas aphasic patients exhibit deficits on both levels.

Why is the average length of simple sentences reduced in both patient groups although they are sometimes able to produce long and complex syntactic frames, in our SDAT patients even longer ones than in the controls? In qualification, we must add that complex sentences occurred relatively less frequently than in the elderly controls. While in the aphasics problems of lexicalization appear to be a plausible cause for the shortening of sentences, word access difficulties, as already shown, cannot explain the decrease of sentence length in the demented seniles. For the SDAT subjects we assume that deficits of the prelinguistic formation of conceptual structures, which controls sentence formulation, lead to the reduced length of their utterances.

Indeed, language production in dementia, in spite of the potential absence of frank aphasic symptoms, is not inconspicuous or even intact. The language behaviour of demented seniles is characterized by many pathological features which appear markedly at the semantic and pragmatic level of language control. The analysis of their responding behaviour revealed striking deficits on the discourse level of dialogic exchange of verbal information.

Taken together, we suggest that the deficits of language production of our senile subjects result from higher level disturbances within the pragmatic-conceptual apparatus. It is assumed that the demented speakers of this study are weakened or impaired in their ability to form prelinguistic conceptual structures of speech act-like representations. This kind of representation is presumed to determine and control the content-related decisions of sentence production including the selection of content words in accordance with the speaker's intentions.

We believe that the absence of aphasic language disorders in the spontane-

ous speech of our moderately impaired SDAT patients provides strong evidence for the dissociability of the pragmatic-conceptual and the formulation apparatus. All data presented here are in accordance with the hypotheses H1 and H2 stated above, thus supporting our most general hypothesis H3, that is, that the pragmatic-conceptual apparatus and the formulation apparatus are autonomous processors of language production.

The question remains whether we are justified in generalizing from our data to the clinical syndrome of SDAT. In a strict sense we are certainly not. In a pilot investigation we saw 3 patients (2 with mixed etiologies, 1 SDAT) who demonstrated clear-cut aphasic symptoms like marked word access disturbances, phonemic paraphasias, and in one case fluent phonemic neologisms strongly reminiscent of fluent aphasics of the Wernicke type, which suggests that the symptoms of fluent aphasia may occur in a subgroup of demented patients.

Our results are based on the analysis of spontaneous speech samples and focus on the largely preserved ability of language formulation of our SDAT subjects in an approximately natural setting. Therefore our argumentation is negative in nature, submitting that primary aphasic symptoms are absent in our SDAT group. Our present data do not allow further elaboration of the internal processing characteristics of the hypothesized pragmatic-conceptual apparatus. We only want to claim at present that there is indeed a natural line of demarcation between linguistic formulation and higher planning procedures of verbal behaviour, and that linguistic deviations in our SDAT group result from higher level deficits and not from aphasic disruptions of linguistic formulation.

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Résumé

Nous avons analysé des phrases produites spontanément au cours d'interviews semi-standardisées par dix patients souffrant d'une démence sénile modérée de type Alzheimer, cinq aphasiques de Wernicke et cinq sujets contrôles âgés mais sans atteinte cérébrale. L'analyse a révélé chez les deux groupes de patients une réduction de la longueur des phrases, mais l'absence de symptomes paragrammaticaux systématiques chez les déments séniles. Dans les productions des deux types de patients, l'usage des noms était dénoncée de façon relativement sélective, alors que la capacité de trouver les mots était étonnamment préservée chez les Alzheimer. Les deux groupes ont montré des déficits marqués, mais des comportements pathologiques différents, dans

leurs réponses aux questions de l'examinateur. Les résultats sont interprétés dans le cadre d'un modèle neurolinguistique de production du langage. Nous pensons que le processus de formulation peut être préservé chez les déments séniles, mais qu'il est atteint dans l'aphasie. Les désordres du langage observés chez les déments séniles résulteraient de troubles pré-linguistiques dans la formation de la structure conceptuelle de l'acte de parole.