13 Sweet nothings: Narrative speech in semantic dementia

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This chapter is rather different from most in this volume. First of all, with one small and rather amusing exception, it does not concern word recognition or reading. Second, unusually (though not uniquely; see the chapter by *Balota & Yap*), it concerns abnormal rather than normal language. Third (though again not quite uniquely; here, see chapters by *Andrews*, by *Pollatsek & Hyönä*, and by *Rayner, Reichle & Pollatsek*), it treats connected speech/language rather than single-word processing. Despite these deviations from the central tendency, the chapter should be germane to the themes of the book in the sense that it concerns issues of lexical retrieval, of the relationship between language and conceptual knowledge/processing, and of the modularity or otherwise of different aspects of language processing.

The specific focus of the chapter is the consequences for speech production of degraded conceptual knowledge, as seen in the neurodegenerative condition known as semantic dementia (SD) (Hodges, Patterson, Oxbury, & Funnell, 1992; Snowden, Goulding, & Neary, 1989). Almost every publication on SD describes the patients' speech as largely normal in phonology and syntax and notably abnormal only in the lexical component of language. That is, SD patients are said to speak fluently, in well-formed grammatical sentences consisting of correctly articulated words; they are just profoundly anomic, producing a limited number of lexical terms that are strongly biased toward high-frequency general words like "thing" and "do". Here, for example, is the attempt by a typical SD patient to describe his daughter's profession: "When people come into hospital, they take their clothes off and lie down, and someone does something to them; and that's what she does, she's the one who closes them off." Listening to this fluently produced utterance, one is struck only by the patient's failure to find the word *anaesthetist* and detects no phonological or syntactic abnormalities of note. In other words, at least at an impressionistic level, the standard characterization of SD speech is a completely adequate and accurate description. As a research topic begins to mature, however, its practitioners often wonder whether their

adequate impressionistic descriptions would still hold if the phenomena were subjected to more stringent scrutiny. Accordingly, the goal of this chapter is to ask whether SD speech is as phonologically and syntactically normal as it appears on informed but casual observation. Somewhat more challengingly, we can ask whether current understanding of language function should lead us to expect independence or interdependence of these different aspects of speech production.

There are reasons, both intuitive and from existing models of speech production, to anticipate both a degree of independence and a degree of interdependence between lexical and syntactic processes. For independence: more or less the same conceptual message can be expressed in the same syntactic frame with different lexical items (for example, "Mr B said to the doctor that he was having trouble talking" ≈ "Mr B told the neurologist that he was having difficulty speaking"). Likewise, more or less the same message can be expressed in a different syntactic frame using the same lexical items (for example, "The neurologist was told by Mr B about his speech difficulties"). By contrast, for interdependence: different lexical items, even within the same syntactic class, afford different syntactic structures. For example, both the verbs *give* and *donate* can be used equally well in the sentence, *The woman gave/donated her collection of teacups to the museum*; but if the sentence is uttered as a "double object" structure in which the recipient (the museum) precedes the thing being transferred (the teacups), then only *give* can be used, as in, *The woman gave the museum her collection of teacups*. Substituting *donate* for *give* here yields something that most English speakers do not consider acceptable English: *The woman donated the museum her collection of teacups*.

Thus, a key part of lexical knowledge concerns how particular words may be used in sentence structures; and this correlation between meaning and syntactic possibilities suggests that deficits in semantic knowledge should have consequences for syntactic production. If a person starts to express a conceptual message in a given syntactic frame that assumes the availability of a given lexical item that is then unavailable and is therefore replaced by one with a different structure, the resulting utterance will be at least syntactically odd if not frankly incorrect. Mr B above is, in fact, one of the SD patients seen recently in our clinic in Cambridge; when the neurologist (Professor John Hodges) asked him a question, Mr B replied, "I want to say you right now that this is what's wrong." We attribute this syntactic error to unavailability of Mr B's target verb (*tell*) which was then replaced by the word *say*, but used with the argument structure appropriate to the missing target *tell*.

These issues concerning the degree of independence of syntactic and semantic performance have previously been investigated in patients with probable Alzheimer's disease (AD), a group with well-known semantic deficits. Early investigations obtained no evidence for impaired syntactic abilities in AD patients, even those with significant semantic degradation (e.g. Kempler, Curtiss, & Jackson, 1987), which would argue for the independence

of syntactic and semantic knowledge. Several, more recent studies, however, have reported that when syntactic performance is scrutinized very carefully, AD patients do show abnormalities. Some of these studies found greater rates of syntactic speech errors in the patients than in controls (Altmann, Kempler, & Andersen, 2001), while others observed declines in the range of syntactic constructions produced. In particular, AD patients are less likely than controls to produce lower-frequency or more complex syntactic structures when discourse conditions demand them (Bates, Harris, Marchman, & Wulfeck, 1995; Kemper, LaBarge, Ferraro, Cheung, Cheung, & Storandt, 1993; Lyons, Kemper, LaBarge, Ferraro, Balota, & Storandt, 1994). Given the availability of several alternative syntactic structures to convey a message, the syntactic deficits in AD patients tend to appear as a general decrease in syntactic complexity and utterance length rather than in frank syntactic errors.

There is little experimental evidence on the issue of the phonological and syntactic status of SD speech. To the extent that researchers have examined the processing of connected speech, or even sentences, as opposed to single words in SD, they have concentrated almost entirely on comprehension rather than production (see Breedin & Saffran, 1999; Rochon, Kavé, Cupit, Jokel, & Winocur, 2004; Tyler, Moss, Patterson, & Hodges, 1997, for studies of SD comprehension beyond the single-word level). These studies therefore address syntactic but not phonological issues, and address only receptive language abilities. The few investigations of production beyond the single word have been largely in the domain of verbal working memory, in which patients are asked to perform immediate serial recall of strings of unrelated words (e.g. Jefferies, Patterson, Jones, Bateman, & Lambon Ralph, 2004; Knott, Patterson, & Hodges, 2000; Patterson, Graham, & Hodges, 1994; Warrington, 1975). These studies therefore address phonological, but not syntactic, issues.

We are aware of only two publications that investigated connected speech production in SD. One, a narrative picture description study (Bird, Lambon Ralph, Patterson, & Hodges, 2000), was concerned with the nature of the lexical deficit, in particular whether the patients produce normal ratios of nouns to verbs and how the items in these two major word classes differ in word frequency and imageability; the article scarcely mentions phonology or syntax. The other paper (Benedet, Patterson, Gomez-Pastor, & Garcia de la Rocha, 2006) did, in one experiment, have a specifically syntactic focus. An SD patient and some normal controls were asked to generate a sentence to describe each of 25 pictured events; across trials, the participants were instructed to use a variety of syntactic structures specified in terms of previously practised markers. For example, if a picture of a goat kicking a cow was to be described in passive rather than active form, both the goat and the cow were marked by arrows indicating that they must both be mentioned; and a dot by the cow further indicated that the participant should start by referring to the cow. Of considerable interest, the patient had impoverished ability to produce the required range of syntactic structures, especially the less typical ones.

The data to be considered here come from short samples of narrative

speech generated by SD patients and normal controls in a picture description task: the widely used cookie theft picture from Goodglass and Kaplan (1983), reproduced in Figure 13.1. This task, like any other that one might choose, has both advantages and drawbacks. As the test designers themselves noted, in spontaneous speech that is part of a free conversation, anomic patients are often skilled at avoiding difficult words; by contrast, picture description has the advantage that "The vocabulary constraints of the picture bring out word-finding difficulty more sharply" (Goodglass & Kaplan, 1983, p. 30). This is indeed a good feature, and it was part of our reason for choosing this task; but its disadvantages include the facts (1) that an adequate description of the picture does not require all that much speech; and, in particular, (2) that there is no demand to use anything other than present-tense, active-voice, single-clause declarative constructions. It is therefore not an ideal context in which to investigate the range of SD patients' productive syntax. But one must start somewhere.

The empirical component of the chapter is organized into three sections. First, we report on the lexical/semantic content of the patients' descriptions relative to those of normal speakers. In one sense, the outcome of this section is not news: the key feature of SD is semantic impairment, and its consequences for lexical production (i.e. anomia) have been pretty thoroughly documented. On the other hand, the impoverished nature of the patients'

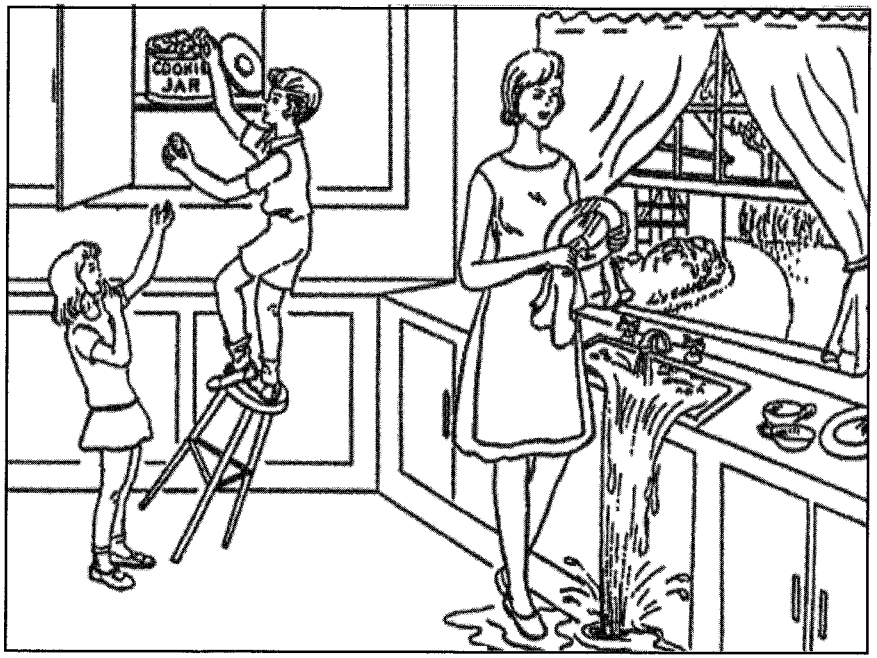

Figure 13.1 The cookie theft picture (reprinted from Goodglass & Kaplan, 1983).

lexical/semantic production (1) is too dramatic to ignore; (2) has never, to our knowledge, been analyzed in quite the fashion that we have used here; and (3) is responsible for the title of our chapter: the patients' descriptions of the cookie theft picture are so empty that "sweet nothings" seems a distressingly apt characterization. The remaining sections report our attempts to establish whether, on closer inspection, the SD patients' speech contains any phonological (section 2) or syntactic (section 3) abnormalities.

Methods

Participants

Two subgroups of SD patients and controls, n=21 each, participated in the experiment. Some of the basic characteristics of the patient sample are listed in Table 13.1, along with equivalent values/scores for normal speakers. The age mean/range of the controls in Table 13.1 is for the actual sample of control subjects whose cookie theft descriptions will be compared to those of the SD patients; but these subjects were not given the basic neuropsychological tests listed in Table 13.1. These test scores come from control participants in other studies of SD patients by the Cambridge research group (e.g. Bozeat, Lambon Ralph, Patterson, Garrard, & Hodges, 2000). Table 13.1 demonstrates that the SD cases included the entire spectrum from very mildly to severely impaired.

Procedure

Each patient or control, tested alone, was given the cookie theft picture and told, "Tell me everything that you can about what is happening in this

Table 13.1 Basic characteristics of patient and control samples. Age is self-explanatory. The MMSE (Mini-Mental State Examination) (Folstein et al., 1975) is the standard used worldwide to assess patients with dementia or other neurodegenerative conditions. The Addenbrooke Cognitive Examination (ACE) (Mathuranath et al., 2000), is an extended test designed to give more information about language and conceptual knowledge than the MMSE. PPT pictures is the all-picture version of a test to evaluate associative knowledge about objects. Both the WPM (Word-Picture Matching) and Naming tests come from the Cambridge semantic battery (see Bozeat et al., 2000)

	Patient mean	*Patient range*	*Control mean*	*Control* S.D.
Age	63.9	56–72	67.5	Range 57–75
MMSE (30)	22.8	12–26	29.1	0.8
ACE (100)	54.0	18–90	93.8	3.5
PPT pictures (52)	37.9	24–48	51.1	1.1
WPM (64)	42.8	8–64	63.7	0.5
Naming (64)	22.1	0–62	62.3	1.6

picture." No further instruction or assistance was provided; if a participant stopped after producing very little, the experimenter merely said, "Can you tell me any more?" or "Is there anything else happening?" The experimenter wrote a verbatim version of the speech output while the person was speaking; in most cases (19/21 SD patients, 12/21 controls), the descriptions were also tape-recorded for later checking of the transcription.

Results: Section 1

Table 13.2 presents information on number of words produced (both total and separately for content and function words), amount of time taken to produce the whole narrative, and rate of speaking for patients and controls. The number-of-words measures apply to all 21 participants in each group, but, because tape recordings were not available for every subject, the timed measures apply to only the specified Ns. The results in Table 13.2 support two conclusions. First of all, relative to normal language users, SD patients, on average, produced somewhat fewer words in their picture descriptions but also spoke for somewhat less total time, with the result that the rate of speech measure is very similar in the two groups. This result confirms the clinical impression that—apart from the inevitable occasions on which SD patients pause because of difficulty in word-finding—their speech emerges effortlessly and with reasonably normal fluency. Secondly, with respect to the word-class composition of speech, the two groups produced very similar numbers of function words; the fact that control narratives contained more words than those of the patients is entirely attributable to greater usage of content words in the control group. This result is not surprising given these patients' semantic deficit and anomia, and we next report on the nature of their sparse use of content words in describing specific events in the pictures.

As can be ascertained in Figure 13.1, there are two events in the cookie theft picture (and of course the oddity of the scene derives in large part from the lack of interaction between these two events). Table 13.3 lists the main content-word vocabulary that applies to each of the two events and gives the numbers of controls and patients who used each of these terms in their

Table 13.2 Quantity and rate of speech in the cookie theft narratives. Values for the first three rows (the number-of-words measures) are based on n=21 for each group; the last two rows (time/rate measures) are based on n=19 semantic dementia patients and n=12 controls

	Patients: mean [range]	*Controls: mean [range]*
Total number of words	93.9 [17–224]	107.9 [36–223]
Content words	38.3 [8–101]	51.8 [17–119]
Function words	55.4 [9–136]	56.7 [19–104]
Time taken (seconds)	69.6 [38–177]	90.8 [39–135]
Words/minute	88.0 [30–189]	83.9 [49–156]

Table 13.3 Numbers of controls and of semantic dementia patients (each out of 21) producing particular content words in describing each of the two events in the picture

	Controls	*Patients*
Cookie event		
Stool	19	0
Cookie/biscuit	19	5
Cupboard	13	3
Fall (off)	17	14
Steal/pinch/raid	9	1
Stand (on)	7	7
Sink event		
Sink	18	3
Plate(s) and/or cup(s)	17	6
Water	14	18
Floor	12	6
Feet	4	4
Overflow	17	2
Dry (up)	13	5
Wash (up)	12	9
Stand (in)	5	3

descriptions. Note that, for verbs, the table lists only the stem form (e.g. *fall*); numbers of instances indicated for each stem include any form of the verb used (e.g. the boy *is falling*, the boy is about *to fall*).

In describing the cookie event, most control subjects use at least three main nouns—*stool, cookies* (or *biscuits* as they are more typically called in the UK), and *cupboard*—and one main verb (*fall* or *fall off*); nearly half also use the verb *steal* or its equivalent. Of these lexical terms, only one, *fall*, was used as commonly by the patients as by the normal speakers. *Fall* is, by some substantial margin, the most frequent of these words, and its occurrence in the patients' narratives therefore fits with known facts about the massive impact of frequency on the availability of vocabulary in SD (Bird et al., 2000; Lambon Ralph, Graham, Ellis, & Hodges, 1998).

The sink event produces a slightly larger typical vocabulary, with more than half of the control speakers using four main nouns: *sink, plates* and/or *cups, water*, and *floor*, and three main verbs: *overflow, wash*, and *dry* (or the more typical UK alternatives for the last two when it is crockery/cutlery that is being washed/dried, namely, *wash up* and *dry up*). Only two of these terms, *water* and *wash(up)*, were common in the SD narratives: again, highly frequent words. Interestingly, *water* was the only substantive lexical term used more frequently by patients than controls; in addition to its high frequency, this may reflect the fact that normal speakers can—and almost always do—say that the *sink is overflowing*, rendering superfluous any explicit reference to *water*. Only a tiny minority of patients produced either *sink* or *overflow*, and

therefore—provided that they understood and were trying to convey what is actually happening in the sink event—there was reason to mention *water*.

Table 13.4 indicates the range of verbs used, and how commonly each was produced in describing the two main actions, that is, the water overflowing and the cookies being stolen. As can be seen, the patients managed to find a variety of alternatives, mostly of higher word frequency, with *coming out/down* the most common replacement for *overflow*, and *getting* the most common for *steal*. A few of their alternatives are rather odd (as in the water is *dropping off* or *overflooding*), though the term used by one control (*boiling over*) is also odd for an overflowing sink. Of more interest are the two phenomena in some patient descriptions that are truly abnormal: (1) 3/21 patients used no verb at all to refer to the movement of the water and 6/21 used no verb to describe the cookies being stolen or fetched; and (2) two patients incorrectly used the term *water* as a verb to describe what is happening at the sink (DV: "The water is running over, *watering*"; PF: "Mummy has done *watering*").

Finally in this section, we try to address in a limited way the issue of whether the patients' severe disorder of expressive (and for that matter, receptive) vocabulary is a lexical or a semantic deficit. Consider the fact that so few SD patients say that the boy is stealing cookies. This could arise because,

Table 13.4 Range of verbs used, and numbers of controls/patients producing each, to describe the two principal actions

	Controls	*Patients*
***Overflow* alternatives**		
Overflow	17	2
Come out/down	0	7
Run out/over	1	3
Flood/overflood	0	2
Pour out/down	1	1
Go out/down	1	0
Fall	0	1
Boil over	1	0
Drop off	0	1
Flush out	0	1
No verb	0	3
**Water*	0	2
***Steal* alternatives**		
Steal/pinch/raid/nick	9	1
Get	5	8
Take (out)	5	2
Pick up	0	3
Reach	2	0
Pull out	0	1
No verb	0	6

* Used as verb.

despite understanding that a cookie theft is taking place, they cannot retrieve the words to say so; or it could arise because they have degraded understanding of the event. To probe this issue a little, we devised something that we called a "cookie knowledge" (CK) score.

Of the 21 patients, five said some version of "He is getting cookies (biscuits)"; this seems to indicate good comprehension of the event, and we therefore assigned it a CK score = 4. Three patients said, "He is getting something to eat", which at least indicates some understanding of what cookies are for, and this was given a CK score = 3. Seven patients said only that "He is getting something"; since *eat* is such a common activity and word, it seems unlikely that patients would be completely unable to express this concept if they grasped it; so this was treated as CK = 2. The remaining six patients did not mention anyone getting anything: CK = 1. Even when a patient said (or rather read aloud) the term *cookie jar*, as 12/21 of them did, the rest of his or her comment on this aspect of the picture often failed to reflect much cookie knowledge. For example, TW: "He's pulling things out of the cookie jar", or AB: "The boy has got up to get some cookie jar." Sometimes a patient's narrative seemed explicitly to tell us that he or she did not understand the cookie theft event, as in RS: "He's picking up something; I don't know what these are." It is of course possible that "I don't know what these are" means "I don't know their name"; but, on the other hand, when anomic patients (including those with SD) feel that their difficulty is just in finding the word, they tend to say so, often with intense frustration: "I know what it is but I can't *say* it!" We are therefore more inclined to interpret RS's comment as genuinely meaning that he had no idea what the boy was picking up.

On the basis of this simple analysis, as well as much other research on SD over the last decade or so (e.g. Lambon Ralph, McClelland, Patterson, Galton, & Hodges, 2001), we postulate that the emptiness of the patients' speech reflects semantic degradation rather than a lexical deficit—or, if this seems a preferable formulation, a lexical deficit as a direct consequence of the semantic degradation. If this is so, then the CK score derived from the patients' speech should correlate with other measures of their semantic status. Figure 13.2 displays the relationship of each patient's CK score to his or her naming of the 64 common picture items in the Cambridge Semantic Battery naming test; Figure 13.3 does the same with respect to the patients' scores for name-to-picture matching on the same 64 items (means and ranges of scores on these two tests are listed in Table 13.1). The orderliness of these scatter plots seems to support our postulate. It is true that Figure 13.2 represents the relationship between two speech-production tasks, which might be expected to correlate; but they are very different tasks: the CK score is not a simple measure of object-name production. In both Figures 13.2 and 13.3, we claim that the basis of the correlation is the degree of deterioration of the patients' amodal conceptual knowledge.

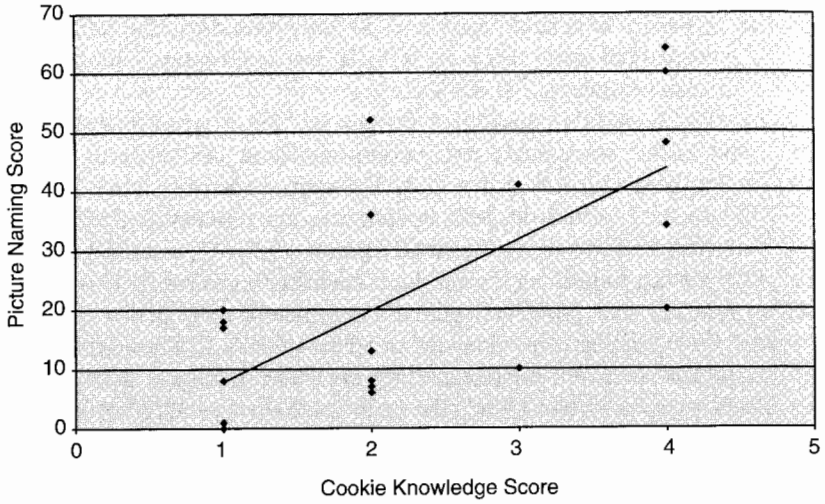

Figure 13.2 The relationship between each patient's cookie knowledge score and his or her score in naming 64 line drawings from the Cambridge Semantic Battery. Note that there are fewer than 21 data points because a few locations in the scatter plot are occupied by more than one patient.

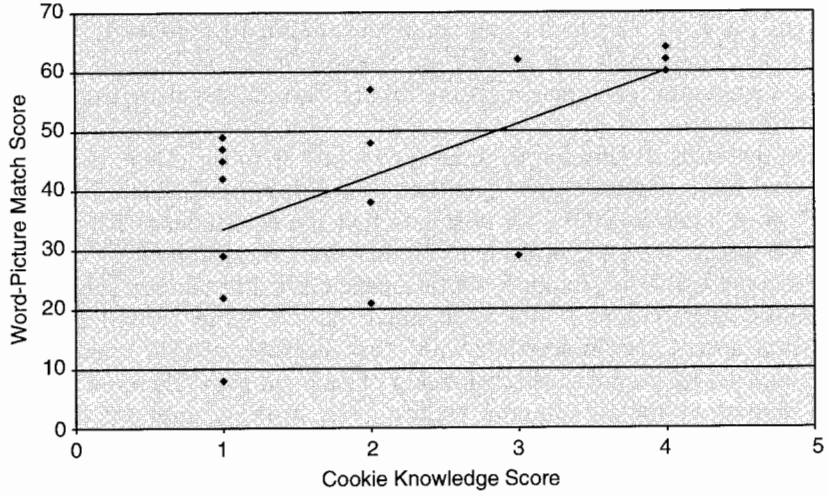

Figure 13.3 The relationship between each patient's cookie knowledge score and his or her score in comprehending 64 concrete concepts from the Cambridge Semantic Battery, as measured by name–picture matching. Note that there are fewer than 21 data points because a few locations in the scatter plot are occupied by more than one patient.

Results: Section 2

With 21 patients producing an average of about 100 words each in their narratives, we have a sample of upward of 2000 words to examine with respect to the question of whether self-generated SD speech is phonologically intact. The answer to this question is an unambiguous yes. Ignoring false starts (e.g. "She's tr——trying to clean"), of which there were a few examples in both control and patient narratives, we detected a total of three frank phonological errors in the 2000+ words produced by the 21 SD patients. Even more striking perhaps is the fact that all three of these errors, rather than suggesting any phonological disruption/distortion in self-generated speech, can be explained in terms of "external" factors. Two of the patients who read or attempted to read aloud the label on the cookie jar made a phonological error on the word "cookie" (recall that "cookie" is a low-frequency word in British English); this is the one small and amusing example in this chapter, mentioned in the introduction, that concerns word recognition/reading. And one patient produced a blend error of the sort that is common enough in normal speakers: AN said "What's that in her hand that she's trying to clean . . . a /kleit/" which is almost certainly a blend of *clean* and *plate*. Other research (e.g. Graham, Patterson, Powis, Drake, & Hodges, 2002; Graham, Patterson, Pratt, & Hodges, 1999; Jefferies et al., 2004; Majerus, Norris, & Patterson, 2006; Patterson et al., 1994) has established that SD patients make phonological errors, especially blends of phonological components of two words, at a much higher than normal rate when they are "reciting"—from short-term or longer-term rote memory—real words whose meanings are degraded for them. We interpret this as a consequence of reduced semantic (or again, lexical deriving from semantic) constraints on speech production when the speech is not generated on the basis of a conceptual message. Our analysis here, of the largest corpus of spontaneous (well, narrative) speech ever examined in SD, supports the view (1) that SD patients use very few lexical terms because of their semantic memory deficit, but (2) that whatever speech their conceptual knowledge does allow them to produce is phonologically intact.

Results: Section 3

We turn now to the main focus of this chapter: the putative interaction between lexical/semantic and syntactic processing in speech production. We began with a very simple approach: we selected any instance of syntactic abnormality that we could find in the 21 cookie theft descriptions by SD patients, and then asked whether or not there was a comparable oddity in a description produced by one of the 21 normal speakers. Examples of these are given in Table 13.5, and the conclusion was that this simple approach was insufficient to answer the question. Syntactically odd utterances were relatively rare in both groups, and some of these "errors", such as listing a series

Table 13.5 Examples of syntactic oddities in semantic dementia (SD) and control narratives

Type of oddity	*SD example*	*Control example*
List of nouns	"The woman, boy, a girl, the water coming out . . ."	"Two cups and a plate, house, bushes, path . . .
Omission of obligatory grammatical morpheme	"That looks like it [it's] falling down"	"Unfortunately, she [she's] not really with us"
Self-interruption to sentence structure	"Bubbles in the, no doubt she's using washing-up liquid"	"Outside of the window we can, which is open, we can see into the garden"
Conjunction of two unrelated clauses	"He's about to fall over and the window's open"	"Hopefully, his sister is going to get a cookie and there are two cups and a plate"

of objects without a verb, can plausibly be attributed to the particular discourse demands to describe a picture that is jointly viewed by the participant and the experimenter.

We next investigated whether the SD narratives were characterized by less complex syntax than the control narratives. We have already observed that the SD patients produced slightly fewer words; here we examine whether the two groups produced similar numbers of coherent clauses (essentially utterance units with both nouns and verbs) versus verb-less fragments. We chose "clause" as a unit of coherent speech, rather than "sentence", because it can be coded more objectively; sentence boundaries in spoken narratives are often subjective judgements of a transcriber. Table 13.6 shows little difference in clause and fragment usage in the two groups and a very low incidence of fragments overall. Within the clauses, we coded the number of simple clauses versus those that contain a clause embedded [shown here with brackets] inside another clause, as in the following statements by SD patients. AC said, "His sister is hoping [he'll give something to her]"; DV said, "The mother doesn't have many things [to wash and dry]." The table shows slightly more embedding in the control narratives than in the SD narratives. Overall, there is a low use of embedding by both groups, probably reflecting how little demand

Table 13.6 Clauses in semantic dementia and control narratives

	Patients: mean [range]	*Controls: mean [range]*
Verb-less fragments	0.88 [0–4]	1.24 [0–12]
Complete clauses	11.48 [0–25]	12.67 [5–23]
Simple clauses	9.57 [1–18]	10.33 [4–20]
Clauses with embedding	1.62 [0–5]	2.05 [0–6]
Noun phrases after verb	0.83 [0–3]	1.08 [0–7]

there is for such constructions in both this picture and this task. Similarly, the picture-description task does not encourage the use of passive structures or other lower-frequency syntactic constructions; and so a metric of variety of syntactic structures, on which AD patients and controls do differ (Bates et al., 1995; Kemper et al., 1993), cannot be sensibly applied here.

Given the limitations of our short narratives for examining syntactic variety and degree of embedding, we looked elsewhere for syntactic differences between the groups. Clauses can vary a great deal in the number of nouns following the verb, and we counted the number of nouns within the verb phrase as a measure of syntactic complexity and the amount of information conveyed in a clause. Because of the relatively small number of clauses available for analysis, we counted all nouns within the verb phrase equally and did not distinguish between direct objects, indirect objects, prepositional objects, and other forms. We also did not distinguish between informative nouns, such as "cookie", vague noun expressions such as "something", and pronouns such as "it". Thus, "giving the cookie to the girl" would be coded as having two nouns in the verb phrase (cookie and girl), as would "giving something to her" (something and her). Our coding therefore focused on the number of noun phrases of any sort in the verb phrase, independent of the richness of the semantics of these noun phrases. Table 13.6 shows the mean number of noun phrases per clause in each group. The overall numbers are not large, reflecting the fact that many events in the picture can be expressed very adequately without any noun phrases following the verb, as in "the sink's overflowing" and "she's washing up". The control narratives did, however, have more noun phrases following verbs than the SD narratives, $t(40) = 2.39$, $p < .05$. Thus, even when we ignore the semantic richness of the noun phrases, the controls produced more complex verb phrases than did the patients.

Correct pronoun usage requires integrating pragmatic knowledge (knowing when it is appropriate to use a pronoun versus a full noun phrase such as "the boy"), and morphosyntactic knowledge (knowing which syntactic positions require "he" versus "him" versus "his"). Pronoun usage is one area where it is reasonable to expect differences between SD patients and controls, as reduced ability to produce object names could lead to increased pronoun usage in the SD narratives, including vague uses such as *it* without establishing a clear referent. Table 13.7 shows slightly greater pronoun usage in the SD narratives than in the control narratives. We assigned each pronoun usage to one of two categories. Correct usages were those in which the pronoun

Table 13.7 Pronoun usage in semantic dementia and control narratives

	Patients: mean [range]	*Controls: mean [range]*
Total pronouns	8.23 [1–22]	7.38 [1–20]
Correct usage	5.19 [0–16]	7.05 [1–20]
Probable errors	3.64 [0–12]	0.33 [0–2]

referred to a noun or pronoun antecedent that had been recently mentioned and where there had been no topic shifts between mention of the antecedent and the pronoun (such intervening topic shifts would make pronoun usage infelicitous). Probable errors were those in which a pronoun was used with no prior mention of an antecedent, and those pronouns for which the antecedent was mentioned much earlier in the narrative, followed by topic shifts. We classified these usages as only "probable" but not certain errors, because in the context of picture description, it is possible for the participant to gesture to the picture and indicate the referent while saying only a pronoun. Table 13.7 shows that the control participants' pronouns were almost entirely correct; they virtually never used a pronoun without previously establishing its referent with a noun phrase such as "the woman", even though gesturing might have allowed them to do so. By contrast, nearly a third of the SD patients' pronoun usages were probable errors.

In sum, the SD narratives were less elaborate than control narratives in every metric of syntactic complexity that we could measure: They were shorter in number of words and number of clauses, had slightly fewer embedded clauses, had significantly fewer noun phrases following verbs, and contained considerably more vague pronoun references than control narratives. Some of these measures, such as pronoun usage, have a clear semantic and discourse component in addition to a syntactic component; but even the purely syntactic measure of number of noun phrases after the verb, independent of their semantic richness, distinguishes the two groups. This pattern of results is similar to that reported in AD patients: it appears that the syntactic consequences of both AD and SD, rather than being marked by frank grammatical errors, are mainly revealed in a decline in the length, variety, specificity, and complexity of the structures that are produced.

Concluding remarks

This chapter has addressed, in a modest fashion, the complex question of the modularity (or otherwise) of different aspects of language. In particular, we have tried to enquire whether a substantially degraded conceptual message has significant consequences for two aspects of the "carrier" of the message in narrative speech: its phonology and its syntax. Even bearing in mind the caveats regarding the relative paucity of data yielded by this simple picture description task, our analyses seem to provide relatively clear answers to these two questions: patients with SD, who have markedly impoverished lexical/semantic abilities, speak with normal phonology but with somewhat abnormal syntax. Both of these outcomes seem plausible if indeed not predictable.

First, with respect to phonology, it is perhaps worth specifying that we refer here not to prosody, which of course spans many words, and not to articulation, which can span at least two adjacent words due to phenomena like assimilation, but to phonological form; and the scope of this domain of

phonological form is essentially the single word. If a language deficit can truly be localized to impoverished semantic knowledge, with resulting unavailability of many substantive lexical choices, then it seems sensible that the sufferer from this deficit will produce a small range of content words but will pronounce them correctly. As mentioned in section 2 of the Results, SD patients make copious phonological errors in the task of immediate serial recall (ISR) of strings of words, particularly when the words have been selected as those with degraded meaning for the particular patients (e.g. Jefferies et al., 2004). Frequently, a patient's response on a given trial of this task will contain most if not every phonological segment of the stimulus string, but with the bits rearranged to form phonologically plausible neologisms (Patterson et al., 1994). This pattern of responding is more or less identical to what happens when normal speakers perform ISR on nonwords. And although we certainly do not claim that real words with degraded semantic representations have become the exact equivalent of nonwords to the patients (for example, their ISR success is characterized by "known" words > degraded words > nonwords), it is clear that the patients' ISR is achieved with little of the lexical/semantic support that aids word ISR in normal speakers (Jefferies, Frankish, & Lambon Ralph, 2006). By contrast, the words that SD patients produce in spontaneous or narrative speech are, of necessity, only words whose production begins with a conceptual representation sufficient to activate the corresponding phonology. The conceptual representation is often vague and general, resulting in many uses of words like *thing* instead of *stool*, or *getting* instead of *stealing*. But whatever information is available from the conceptual level appears to activate a set of essentially intact phonological forms for speech production.

Correct grammatical form has a very different scope from phonological form. Syntax must operate over at least two words (as in number agreement between adjacent noun and verb; for example, *the child steals* versus *the children steal*) and typically over whole clauses or sentences. In most accounts of sentence production, the choice of a syntactic structure, and the ease with which it is constructed, appear to be affected by two major factors. First, the process is guided by the speaker's intended conceptual message and the activated lexical items, and the resulting structure typically allows the most highly activated noun to appear first in the sentence (Bock & Levelt, 1994). Given a picture of a lightning bolt and a church, for example, someone who initially focused on the lightning in the picture might choose to describe it as "The lightning is striking the church", whereas someone who initially paid more attention to the church would tend to put that object first, saying, "The church is being struck by lightning" (Bock, 1986). Second, the syntactic operations that follow from a syntactic structure choice, such as assigning a particular noun to be the sentence subject and computing verb agreement with this subject noun, are influenced by frequency. Higher-frequency syntactic structures, such as simple active sentences, are developed more rapidly and easily than lower-frequency structures, such as passives (Bock & Griffin, 2000).

Both of these conceptual and structural frequency factors appear to affect syntactic production in SD. A spontaneous utterance by an SD patient is likely to be based on an impoverished conceptual representation, and the resulting utterance will tend to be short, as there is not much information to convey. To the extent that lexical items (even rather empty ones) become activated during sentence planning, however, they will often be sufficient to generate a simple grammatical sentence structure, because even minimal semantic information can usefully direct syntactic planning. For example, the semantic distinction between "thing" (or "person") and "event" is at the heart of the grammatical distinction between nouns and verbs; and even an SD patient with considerable degradation of the fine-grained semantic knowledge that distinguishes between similar sorts of things may still have sufficient information to drive the most basic syntactic planning.

In other words, a simple or vague message may often be produced in an utterance with correct grammatical form; but this is not to say that a semantic deficit has no impact on syntactic planning during production. In particular, different speaking situations stress the planning process to varying degrees. At one end of the spectrum, when patients are in free conversation and choose to speak about something for which they still have reasonable conceptual representations, the resulting sentences are likely to be well formed, though largely limited to common and simple syntactic structures. At the other end of the spectrum, if patients are participating in a language study in which the experimenter both selects the topic and constrains the syntactic structure, the patients would be expected to make errors when they are forced to use low-frequency syntactic structures, as reported in Benedet et al. (2006). The situation of picture description is intermediate between the previous two: The topic is specified for the patients, but they are free to determine their own speech structure. What we observed under these circumstances was (1) that the clauses produced by the SD patients were shorter and less complex than those of the normal speakers, and (2) that certain grammatical constraints which should operate over the scope of several clauses were violated by SD speakers. For example, to describe the little girl in the cookie theft picture by saying *she is hoping to get something* is not wrong; but as there are two "*she*"s in the picture (woman and girl), this utterance essentially demands that there will have been very recent mention of the *girl* as the antecedent for the pronoun *she*. The normal speakers in our sample hardly ever infringed this requirement, but SD patients often did. Anecdotally, we can report that this problem gets even worse with disease progression: Several of the very severely affected patients seen in our clinic have not only referred to people by pronoun without first mentioning them by name (e.g. *Bill*) or label (e.g. *my husband*), but have also used the wrong pronoun. Patient PP's husband Bill brought her to the interview room and then went back to the waiting room in the hospital; sometime later, PP asked us, "When is she coming back?"

It goes without saying that more evidence regarding the syntactic structure of SD speech would be valuable, particularly from tasks that either encourage

or indeed attempt to coerce the use of a much greater variety of syntactic structures than those generated in the cookie theft description. The data presented here, however, suggest that further evidence on this topic will uncover only more extensive syntactic abnormalities or at least limitations. At least as an interim conclusion, then, we suggest that syntactic ability in speech production is disrupted by semantic degradation.

Finally, it is worth just a brief mention that the least surprising aspect of our data remains the most dramatic, that is, the emptiness to which SD speech is reduced as a result of the patients' degraded knowledge of objects and actions and scenarios. Consider JT's narrative: *Water's coming out of the sink. Kid's going off that one he's on that's going down. He's getting something out of the jar there, and the little kid's looking*. This patient does seem to understand that water is overflowing, though she makes no comment on it (most controls comment on the oddity of the fact that the woman seems unaware of the flood that she is creating/allowing to happen). JT also seems to understand that the boy is falling off whatever it is he is on, and that he is getting something. There is no indication that she understands what he and his presumed sister are actually doing, nor that their mother is unaware not only of the flood but also of what they are up to. There are only four specific nouns in JT's narrative (*water*, *sink*, *kid*, and *jar*); *kid* is used to refer to both the boy and the girl without any differentiation; and recall that the *cookie jar* has a printed label on it, so that JT is probably reading rather than naming it. The only verbs (*coming out*, *going off*, *going down*, *getting*, and *looking*) are extremely general and high-frequency ones. In summary: what SD patients know and hence can say is sadly well characterized as sweet nothings.

Acknowledgements

This work is supported by an NIMH Interdisciplinary Behavioural Science Center grant (MH64445). We are grateful to John Hodges for permission to publish data from these cases, and to Sally Andrews and Anne Castles for comments on the first version of the chapter.

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