

# Imitation of complex syntactic constructions by elderly adults

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## ABSTRACT

Elderly adults (70 to 89 years) and young adults (30 to 49 years) were asked to imitate complex sentences involving embedded gerunds, *wh*-clauses, *that*-clauses, and relative clauses. The young adults were able to imitate accurately or correctly paraphrase the sentences regardless of the length, position, or type of embedded clause. The elderly adults could accurately imitate or paraphrase short constructions. The elderly adults were unable to imitate or paraphrase correctly long constructions, especially those in which the embedded clause was sentence-initial. The pattern of results demonstrates an age-related decline in syntactic processing abilities due, perhaps, to the increased processing demands of the long or sentence-initial constructions.

The linguistic abilities of normal, healthy elderly adults are generally assumed to be comparable to those of younger adults. There appears to be little deterioration of language skills with age; however, this conclusion is based on limited research (Cohen, 1981; Davis, 1984). There are few life-span decrements in the performance of normal, healthy adults on aphasic test batteries (Borod, Goodglass, & Kaplan, 1980; Duffy, Keith, Shane, & Podraza, 1967; Schuell, 1973; Schuell, Jenkins, & Jimenez-Pabon, 1964). These norms rarely provide information about elderly adults' processing of specific linguistic structures or include normative information about the performance of adults in their 70s and 80s. Experimental studies of the linguistic skills of elderly adults are not numerous. Comprehension of complex syntactic constructions does decline in the 60s and 70s (Walsh & Baldwin, 1977; Feier & Gerstman, 1980) and inference making declines (Belmore, 1981; Cohen, 1979; Cohen & Faulkner, 1981; Taub, 1969); however, few life-span decrements in sentence production have been observed (Nebes & Andrews-Kulis, 1976; Walker, Hardiman, Hedrick, & Holbrook, 1981; Yorkston & Beukelman, 1980).

Kynette and Kemper (1986) have carefully examined the production of a wide range of grammatical and syntactic constructions in the spontaneous speech of adults between 50 and 90 years of age. With the effects of education statistically removed, there were age-related declines in the variability and accuracy of the adults' use of grammatical form classes and syntactic structures. The 70- and 80-year-olds did not use gerunds, reflexive pronouns, modal auxiliary verbs, and

participles; the elderly adults did not use complex constructions involving sentence-initial relative clauses or noun phrase complements, and structures with multiple embedded clauses. The 70- and 80-year-olds also made more errors in the use of obligatory grammatical morphemes than did the 50- and 60-year-olds.

This research suggests that elderly adults have difficulty spontaneously producing syntactic structures that impose high memory demands. Age-related deficits in memory have been well documented (Botwinick, 1977; Botwinick & Storandt, 1974; Craik, 1977; Kausler, 1982; Smith, 1980). Kynette and Kemper (1986) have suggested that "left-branching" grammatical structures may be more difficult for elderly adults to process than "right-branching" structures because the embedded clause precedes and interrupts the processing of the main clause (for a discussion of psycholinguistic studies of such structures, see Fodor, Bever, & Garrett, 1974). For example, a sentence-initial noun phrase complement, like that in (1), must be processed before the main clause can be understood, and the structure and content of the complement must be retained during the processing of the rest of the sentence. Processing a sentence-final complement, as in (2), imposes fewer memory demands as the structure and content of the complement need only be concatenated with those of the main clause.

- (1) That I would be a doctor was assumed.
- (2) I always thought that I would be a doctor.

Research on adults' comprehension of such complex syntactic structures is highly limited; methodological problems further reduce the interpretability of these studies. Feier and Gertsman (1980) compared adults' comprehension of sentence-initial and sentence-final relative clauses. They noted a decline in comprehension in the 60s and a further decline in the 70s; however, they reported no interaction between sentence type and age. The comprehension test required the adults to act out the sentences by manipulating animal figures. The artificiality of this task may have obscured any effects of sentence type. The poor performance of the elderly adults may reflect other considerations, such as the appropriateness of this task, which was designed for use with young children.

The Token Test (DeRenzi & Vignolo, 1962) requires adults to execute complex instructions involving tokens of different color, size, and shape. Some of the most complex constructions involve left-branching constructions and sentence-initial embedded clauses. Noll and Randolph (1978) compared the performance of 25 normal adults between 29 and 76 years on this test. No age-related decline in performance was apparent across this age range; however, few 70-year-olds and no 80-year-olds were tested. Further, the task is highly artificial.

The present research was undertaken to provide converging evidence for the hypothesis of Kynette and Kemper (1986). The performance of elderly adults between 70 and 89 years of age was compared to the performance of younger adults between 30 and 49 years. A sentence-imitation task was used; the adults were asked to imitate either grammatical or ungrammatical stimulus sentences with embedded clauses. The adults were encouraged to correct any sentences that they judged to be ungrammatical. The task was designed specifically to acknowledge individual differences in grammatical judgments, hence, overall performance.

It was hypothesized that the elderly adults would have difficulty imitating sentences in sentence-initial embedded clauses whereas they would be able to imitate sentences with sentence-final embedded clauses. The younger adults were expected to be able to imitate both types of sentences. Such an interaction between age and clause position would support the hypothesis that there is an age-related decrement in syntactic processing. Further, the interaction between sentence type and age was expected to be contingent upon the length of the embedded clauses. It was assumed that elderly adults would be less likely to imitate long, sentence-initial embeddings than short ones, whereas clause length was not expected to affect the performance of the younger adults. Such an interaction of age and clause position with clause length would imply that attentional or memory limitations reduce the syntactic processing abilities of elderly adults.

## EXPERIMENTAL METHOD

### *Subjects*

Sixteen healthy adults (12 women) between the ages of 70 and 89 years ( $\bar{x} = 79$  years) volunteered to participate. All were living independently or with spouses or other relatives in a middle-class neighborhood of a midwestern town.

A second group of 16 adults (9 women) between the ages of 30 and 49 ( $\bar{x} = 43$  years) was recruited from among relatives and neighbors of the elderly adults. These adults were also living independently or with spouses or other relatives in the same middle-class neighborhood as the elderly adults.

Each adult filled out a 25-item health and activities report. None of the adults reported any significant impairments of visual or auditory acuity; 14 of the elderly adults had participated in health and hearing screenings offered by community groups within three months of testing. None had any record of chronic or debilitating medical problems, including mobility impairments or cardiovascular limitations.

All 32 subjects reported that English was their native language and the predominate language spoken at home when they were children. Three of the elderly adults and one of the younger adults reported that, during their childhoods, their parents spoke a language other than English. None was able to recall more than a few words or phrases from this language. The sixteen elderly adults had completed high school whereas all of the younger ones had completed high school. Eight of the elderly adults had completed four or more years of college; 11 of the younger adults had completed four or more years of college. The groups were matched in terms of the mean number of years of schooling completed (elderly: mean = 13.8, range = 10–19 years; younger adults: mean = 13.7, range = 12–20;  $t(34) < 1.0$ ,  $p > .05$ ).

### *Materials*

Four sets of sentence prompts were prepared. Each sentence included both a main or matrix clause and an embedded clause. The 32 sentences in each set

varied in grammatical correctness, length of the embedded clause, position of the embedded clause, and type of embedded clause. Grammatically incorrect sentences were used as half the stimuli in order to provide a rationale for the imitation task. The elderly adults were expected to succeed at detecting and correcting most errors, thus enabling them to succeed on the task, despite any sentence-imitation limitations. The embedded clauses varied in length so as to examine the role of attentional or memory limitations. Four types of embedded clauses were used to investigate the generality of the results across different constructions.

The four sentence sets varied in topic. Four different topics were used: baking cookies, working in a hardware store, watching the Olympics, growing flowers.

Ungrammatical sentences were created in one of four ways: (1) the copula verb *is* was added to a past tense main clause verb, for example, "Baking is tired me out"; (2) subject-verb number agreement was violated, for example, "I believe the cookies is brown"; (3) an extraneous preposition was added to the sentence, for example, "The cookies that I baked in were brown"; or (4) an extraneous *have* or *did* was added to the sentence, for example, "They watched what I have took out of the oven."

The embedded clauses were either one to five words in length (short clauses) or six to nine words in length (long clauses). The long clauses were formed by expanding the predicates or by adding adjectives or prepositional phrases to the short clauses. For example, the short sentence "I like baking" was expanded to "I like baking ginger cookies for my grandchildren."

The sentences were written so that each embedded clause could occur sentence-initially as part of the subject of the main clause (e.g., "What I took out of the oven interested my grandchildren") or sentence-finally as part of the predicate (e.g., My grandchildren watched what I took out of the oven").

Finally, four types of embedded clauses were used: (1) gerunds, for example, "Baking tires me out"; (2) *wh*-clauses, for example, "What I did interested my grandchildren"; (3) *that*-clauses, for example, "That the cookies were brown surprised me"; and (4) relative clauses, for example, "My grandchildren enjoyed the cookies that I baked." These clause types represent a range of syntactic constructions. They were assumed to vary in their processing demands. A complete set of 32 sentences is given in Table 1.

Stimulus booklets were generated for each subject. Each booklet included eight sentences from each of four sentence sets. Each subject was tested with four sentences of each combination of correctness, length, position, and clause type. The sentences were randomly arranged with the constraints that two sentences from the same set or two sentences of the same form were not consecutive.

### *Procedure*

Each adult was tested individually at home by the author. The experiment was described as part of a study of grammatical judgments. Each adult was asked to repeat a series of sentences. They were instructed that some of the sentences may be "grammatically incorrect" and violate the rules of "good English." The

Table 1. *Complete set of 32 sentences varying in grammatical correctness, length, position, and type of embedded clause*

Grammatical		Ungrammatical
<i>Gerund</i>		
<i>Sentence-initial</i>		
Short	Baking tires me out.	Baking am tires me out.
Long	Baking ginger cookies for my grandchildren tires me out.	Baking ginger cookies for my grandchildren am tires me out.
<i>Sentence-final</i>		
Short	I like baking.	I am like baking.
Long	I like baking ginger cookies for my grandchildren.	I am like baking ginger cookies for my grandchildren.
<i>Wh-clause</i>		
<i>Sentence-initial</i>		
Short	What I did interested my grandchildren.	What I have did interested my grandchildren.
Long	What I took out of the oven interested my grandchildren.	What I have took out of the oven interested my grandchildren.
<i>Sentence-final</i>		
Short	My grandchildren watched what I did.	My grandchildren watched what I have did.
Long	My grandchildren watched what I took out of the oven.	My grandchildren watched what I have took out of the oven.
<i>That-clause</i>		
<i>Sentence-initial</i>		
Short	That the cookies were brown surprised me.	That the cookies was brown surprised me.
Long	That the ginger cookies were golden brown surprised me.	That the ginger cookies was golden brown surprised me.
<i>Sentence-final</i>		
Short	I believed that the cookies were brown.	I believed that the cookies was brown.
Long	I believed that the ginger cookies were golden brown.	I believed that the ginger cookies was golden brown.
<i>Relative clause</i>		
<i>Sentence-initial</i>		
Short	The cookies that I baked were delicious.	The cookies that I baked in were delicious.
Long	The cookies that I baked yesterday for my grandchildren were delicious.	The cookies that I baked in yesterday for my grandchildren were delicious.
<i>Sentence-final</i>		
Short	My grandchildren enjoyed the cookies that I baked.	My grandchildren enjoyed the cookies that I baked in.
Long	My grandchildren enjoyed the cookies that I baked yesterday for them.	My grandchildren enjoyed the cookies that I baked in yesterday for them.

Table 2. *Examples of the four categories of responses to the stimulus sentences (the first example sentence is ungrammatical)*

Stimulus sentence:	
My grandchildren enjoyed the cookies that I did baked.	That the ginger cookies were golden brown surprised me.
Grammatical imitation:	
My grandchildren enjoyed the cookies that I baked.	That the ginger cookies were golden brown surprised me.
Grammatical paraphrases:	
I baked the cookies that my grandkids enjoyed.	I was surprised that the ginger cookies were golden brown.
I baked some cookies and my grandchildren enjoyed them.	The ginger cookies were golden brown. This surprised me.
My grandchildren liked the ginger cookies I made.	The cookies, ginger ones, surprised me by being golden brown.
Grammatical abridgment:	
My grandchildren enjoyed the cookies.	The cookies were brown.
I baked some cookies.	The cookies surprised me.
I baked cookies for my grandchildren.	I baked ginger cookies.
Other:	
My grandchildren baked me some cookies.	I didn't like them.
I have six grandchildren.	The cookies were burnt.

adults were advised that "acceptable speech may vary over time" and examples from 18th- and 19th-century English were given. The adults were asked to repeat each sentence as "exactly as possible" but they were told to correct any ungrammatical or unacceptable sentences. Four single-clause sentences, two grammatically correct and two grammatically incorrect, were used as practice sentences to ensure that the adults understood the instructions.

The 32 sentences were individually read to the adults; the interviewer marked each stimulus booklet to indicate whether the sentence was imitated correctly or whether the repetition changed or distorted the sentence. A short break was taken after 16 sentences; the entire procedure required approximately 30 minutes.

Each interview was audio recorded and the adults' sentence imitations were transcribed. For accuracy, these transcriptions were checked against the interviewer's notes in the stimulus booklets. A second judge verified 20% of the transcripts and scoring decisions, agreeing 100% with the interviewer's decisions.

Four scoring categories were used: (1) verbatim repetitions of grammatical stimuli as well as revisions of ungrammatical stimulus sentences that corrected the grammatical rule violation yet preserved the semantic content and syntactic form, (2) grammatically correct paraphrases that preserved the semantic content but altered the syntactic form of the original, (3) grammatically correct sentences that abridged the semantic content of the original sentence by omitting a clause or one or more phrases, and (4) other types of changes that altered the syntactic form and semantic content of the original. Most paraphrases (93%) were created

by syntactic changes that replaced the two-clause sentence with two single-clause sentences. Of the abridgments, 85 (74%) resulted from the deletion of either the embedded or the main clause. The category of "other responses" include 5 instances (14%) in which an ungrammatical stimulus sentence was imitated verbatim with the grammatical rule violation preserved. Other grammatical errors accounted for another 3 instances (9%). Examples of the four categories of responses are given in Table 2.

## RESULTS

The frequency of responding was a function of six factors: response type (grammatical repetitions, paraphrases, abridgments, and other responses), age of the subjects (elderly adults versus younger adults), grammatical correctness of the stimulus sentence (grammatical versus ungrammatical), length of the embedded clause (short versus long), position of the embedded clause (sentence-initial versus sentence-final), and type of clause (gerund versus *wh*-clause versus *that*-clause versus relative clause).

Log-linear analysis of categorical data was used to test whether each factor or combination of factors affected the frequency of responding. The fit of different models of subsets of the  $n$  factors was compared to that of the fully saturated model of all  $n$  factors and combinations of 1 to  $n-1$  factors. The likelihood-ratio  $G^2$  statistic is computed. The best-fitting model with the fewest factors and combinations of factors minimizes  $G^2$  indicating that the model does not differ significantly from the data.

The fully saturated model has one parameter: the six-way association of response, age, correctness, length, position, and clause type. This model also includes all the component associations of one to five factors. The log-linear analysis yielded a best-fitting model with one parameter: the five-way association between response, age, correctness, length, and position. For this model,  $G^2(192) = 83.28$ ,  $p = 1.0$ . The one-factor model of the four-way association between response, correctness, length, and position,  $G^2(32) = 266.13$ , provides a significantly worse fit to the data. Note that both young and elderly adults responded alike to gerunds, *that*-clauses, *wh*-clauses, and relative clauses. This task was not sensitive to the differential processing demands of the four types of embeddings. Table 3 reports the frequency of each type of response for elderly and younger adults.

Overall, the frequency of each type of response varied as a function of the stimulus sentences' correctness and the length and position of the embedded clauses. Grammatically correct imitations were the most frequent responses to either grammatical or ungrammatical sentences with short embedded clauses; abridgments were the most frequent responses to grammatical sentences with long embedded clauses; other types of responses were common only for ungrammatical sentences with long, sentence-initial embedded clauses.

The younger adults usually produced grammatically correct imitations of the stimulus sentences. The younger adults' responses were not affected by the correctness, length, or position of the embedded clauses. In contrast, the elderly adults produced many paraphrases, abridgments, and other types of responses

**Table 3. Frequency of each type of response by elderly and younger adults to stimulus sentences varying in grammatical correctness, length, and position of the embedded clause**

	Grammatical imitations		Grammatical paraphrases		Grammatical abridgments		Other responses	
	Elderly	Younger	Elderly	Younger	Elderly	Younger	Elderly	Younger
<i>Sentence-initial</i>								
Short								
Grammatical	55	56	9	8	0	0	0	0
Ungrammatical	48	55	10	9	6	0	0	0
Long								
Grammatical	7	54	11	7	37	3	9	0
Ungrammatical	1	52	4	8	32	4	26	0
<i>Sentence-final</i>								
Short								
Grammatical	54	59	10	5	0	0	0	0
Ungrammatical	52	57	11	7	1	0	0	0
Long								
Grammatical	27	55	28	7	9	2	0	0
Ungrammatical	27	53	18	9	19	2	0	0

and the elderly adults, unlike the younger adults, responded differently to grammatical and ungrammatical stimulus sentences, to long versus short embedded clauses, and sentence-initial versus sentence-final embedded clauses.

Compared to the younger adults, the elderly adults had more difficulty responding to the ungrammatical sentences. They produced fewer paraphrases (43 versus 58), more abridgments (58 versus 46), and other types of responses (26 versus 9) when they were confronted with ungrammatical sentences.

The elderly adults also had more difficulty correctly imitating the sentences with long embedded clauses. They gave more paraphrases (61 versus 40), abridgments (97 versus 7), and other types of responses (26 versus 9) to the sentences with long embedded clauses. Finally, the position of the embedded clause affected how accurately the elderly adults could imitate the sentences. Fewer paraphrases (34 versus 67), more abridgments (75 versus 29), and more other types of responses (35 versus 0) were produced for the sentence-initial embedded clauses than for the sentence-final ones.

Long, sentence-initial embeddings posed special problems for the elderly. They typically abridged these constructions by omitting one clause. When the stimulus sentence was ungrammatical as well as involving a long, sentence-initial embedding, the elderly adults were likely to respond with ungrammatical sentences (31%) or with evaluative judgments (25%) or personal associations (44%).

The abridgments of the sentence-initial and sentence-final clauses also differed; 69 of the 75 abridgments of the sentence-initial embeddings (92%) consisted of deletions of the embedded clause and 3 (4%) were deletions of the main clause. In contrast, 5 of the 29 abridgments of the sentence-final embeddings

(17%) consisted of deletions of the main clause and 3 (11%) involved deletions of the embedded clause.

There appeared to be little variability across subjects in how the elderly adults responded to the stimulus sentences. For ungrammatical stimuli, 13 of the 16 elderly subjects most commonly responded with abridgments, although paraphrases were the most common responses for 3 of the elderly subjects; all 16 elderly subjects most commonly repeated verbatim the grammatical stimuli. For all 16, abridgments were more common than paraphrases or grammatical repetitions for the long embedded clauses, yet grammatical repetitions predominated for short embedded clauses. All 16 elderly subjects most frequently abridged the sentence-initial embeddings while 15 elderly subjects most frequently paraphrased the sentence-final embeddings.

The total number of nonparaphrases and "other" responses was correlated with the subjects' ages and the number of years of schooling each had completed. Age was positively correlated with the number of nonparaphrases and "other" responses,  $r(32) = +.87$  when the effects of education are statistically controlled,  $p < .01$ . This indicates that the older subjects made more errors than did the younger subjects. Schooling was not correlated with nonparaphrases and "other" responses,  $r(32) = +.18$  when age is controlled,  $p > .05$ . This indicates that education had little effect on how accurately the subjects could imitate the stimulus sentences.

Childhood exposure to a language other than English was not related to any apparent pattern of responding. The three elderly adults reared in bilingual families were somewhat more likely to produce grammatical imitations than the other elderly subjects (60% versus 51%). Ungrammatical responses, including verbatim repetitions of ungrammatical stimulus sentences, were produced by 14 different elderly subjects, including 2 from bilingual homes.

## CONCLUSIONS

The results support the hypothesis that elderly adults have an impairment of syntactic processing. Sentence-initial gerunds, *wh*-clauses, *that*-clauses, and relative clauses produce "left-branching" syntactic structures in which the embedded clause precedes or interrupts the main clause. The structure and content of the embedded clauses must be processed and retained in memory while the main clause is processed. In contrast, sentence-final gerunds, *wh*-clauses, *that*-clauses, and relative clauses are "right-branching" structures; the embedded clause occurs at the end of the main clause. The structure and content of the sentence-final embedded clauses must only be concatenated with the main clause information. The elderly adults had difficulty imitating or paraphrasing sentences with long, sentence-initial embedded clauses; they accurately imitated or paraphrased sentences with short, sentence-final embedded clauses.

In conjunction with the results of Kynette and Kemper (1986), this study demonstrates a pattern of linguistic deterioration in healthy adults over 70 years of age. Not only is there a reduction in the number of different grammatical forms, syntactic structures, and verb tenses spontaneously produced by elderly

adults (Kynette & Kemper, 1986) but there is a loss in the ability of elderly adults to imitate and paraphrase complex syntactic structures. The effects of age on both production and imitation may be attributable to memory limitations (Craik, 1977; Kausler, 1982) of 70- and 80-year-olds that affect sentence processing. Further research is required to directly examine the role of memory limitations on elderly adults' sentence processing abilities.

Previous research has demonstrated few age-related declines in the linguistic abilities of healthy elderly adults. The failure to find normative evidence for age-related language impairments, such as those reported here, may reflect two methodological considerations. First, aphasia test norms, such as those of Schuell (Schuell, 1973; Schuell, Jenkins, & Jimenez-Pabon, 1964), *Boston Diagnostic Aphasia Examination* (Borod, Goodglass, & Kaplan, 1980), and Porch (Duffy, 1967), pool together the results of a wide range of tests of auditory comprehension, reading, speaking, and writing. Thus, impairments of specific syntactic structures may not be apparent. Second, the norms typically compare the performance of aphasic adults to age-matched normal adults. Thus, the normative data may be biased toward the performance of 50- and 60-year-olds, rather than 70- and 80-year-olds as in the present study. Experimental studies of specific language processes are also limited by methodological considerations. First, tendencies to respond idiosyncratically and evaluatively, attentional deficits, distractibility, or overall slowing of cognitive processes may obscure or qualify specific syntactic deficits. Further, the use of inappropriate and artificial tasks may impede the performance of elderly adults or limit the power of the tasks to discriminate subtle differences in the processing of specific syntactic structures.

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