

688

DIFFERENTIAL SHORTENING OF REPEATED CONTENT WORDS PRODUCED IN VARIOUS COMMUNICATIVE CONTEXTS*

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Three experiments examined the conditions under which repeated words undergo durational shortening in speech. Previous research (Fowler and Housum, 1987) showed that repeated content words are shortened in spontaneous speech. One experiment in the present series found no shortening when words are produced in lists. In a second experiment, reductions were observed for the same words produced in meaningful prose. Words preceded by homophones did not undergo shortening. The findings suggest that shortenings reflect talkers' exploitation of a word's redundancy in the context of a discourse. A final experiment found more shortening of content words produced in a communicative context than in the same discourse, transcribed and read into a microphone. Possibly, the tendency to shorten is increased by the presence of a listener; alternatively, it may reflect the slower speech rate characteristic of spontaneous as compared to read speech.

Key words: spontaneous speech, repetition, discourse, shortening

INTRODUCTION

Talkers shorten content words that they have uttered previously in a conversation (Fowler and Housum, 1987) even when they are not otherwise increasing their rate of speaking. The shortening does decrease the intelligibility of the words when they are excised from their contexts and presented in isolation to listeners for identification. However, in context the effect of reduction of the acoustic signal for a repeated word on the word's identifiability is offset at least partially by other factors that enhance its identifiability. In the discourse examined most thoroughly by Fowler and Housum, second occurrences of words were more predictable from their contexts than were first occurrences, so that, arguably, listeners could identify a second occurrence from a less adequate acoustic signal than was required for identification of first occurrences. In identifying words presented in isolation, listeners likewise benefited from a second hearing of a word type even if the earlier hearing was separated by many other words from the later one.

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In short, it seems that talkers can get away with producing reduced versions of words in situations in which listeners have other sources of information about the words' probable identity. Presumably this helps to explain why talkers exhibit elisions and other reductions in casual as compared to more formal styles of speech (e.g., Browman and Goldstein, in press; Brown, 1977; Zwicky, 1972). Casual speech is more likely in contexts where conversants are well-known to each other (Brown, 1977). In turn, well-acquainted conversants may share considerable knowledge, and this may obviate careful speech much of the time.

These findings may also relate to a host of other observations in the literature. Lieberman (1963; see also Hunnicutt, 1985) proposes that talkers shorten highly redundant words (as in "a stitch in time saves *nine*"). Chafe (1974) proposes that talkers attenuate productions of "given" information in discourse in order to accentuate "new" information. Long ago, Zipf (1935) pointed out a possible diachronic analog of this transient conversational shortening by noting that words that are phonologically long when they are coined, are often shortened when they become more commonplace (for example, "television" has become "TV", "airplane" "plane", and "telephone" "phone"). In addition to these findings of shortenings, Bolinger (1981) suggests an effect complementary to that described by Lieberman (1963) in which talkers lengthen unexpected words in an utterance. (In his example, of a person who has ridden his sit-down lawn mower cross country, of the return trip, it may be said: "He mowed home." In the sentence, according to Bolinger, "mowed" is lengthened as compared to its duration in a more commonplace utterance, such as "He mowed the lawn.")

All of this suggests a kind of interaction between talkers and listeners such that talkers provide less information to listeners the less listeners require. This account may be misleading in one, or possibly two, respects, however. First, it ascribes the shortening to a sort of least-effort principle deployed by talkers on their own behalf where possible. However, Chafe's proposal that talkers attenuate given information in order to accentuate new information puts the talkers' performances in a more altruistic light. From that perspective, talkers differentiate their productions of given and new information for the listeners' sake. Compatibly, Fowler and Housum (1987) found some evidence not only that listeners are not hurt by the talkers' reductions of repeated words, but that, in fact, the reductions help indicate to listeners that the reduced words refer back to earlier-presented information in the discourse.

A second respect in which our characterization of talkers' attenuations as systematic deployment of a least-effort principle may be misleading is that it presumes, without evidence, that the attenuations observed by Fowler and Housum are actively produced by talkers based on their on-line assessment of redundancy. Alternatively, they may simply be products of repetition. The literature reports a variety of "repetition effects" in perception (e.g., Kanwisher, 1987), memory (e.g., Jahnke, 1969) and motor production (e.g., Wing, Lewis, and Baddeley, 1979), in which close repetition reduces performance levels (detection levels in perception, recall in memory or rate of symbol production in handwriting, for example). In other instances, for example "repetition priming" (e.g., Scarborough, Cortese, and Scarborough, 1977; see also Morton, 1979), performance is improved. Possibly, the shortenings exhibited by talkers as words are repeated are, in

some way, unintended products of mere repetition itself – a decreased expenditure of effort over repetitions, perhaps, or a sort of facilitation of articulatory routines for a word.

The first experiment was designed to ask whether reductions of spoken words occur when they are repeated after some lag even when talkers simply read word lists. In addition, the experiment examined whether the shortening, if it occurs, has to do with communicative efficacy or else with the literal repetition of lexical forms. Accordingly, in one condition of the experiment, “target” words were preceded by themselves as “primes” in the word list, in another they were preceded by synonyms, and in a third by nonhomographic homophones of targets (e.g., “brake” – “break”). If mere repetition is important, then the first and third conditions should lead to shortening, while the second should not. If, on the other hand, redundancy of information is important, then the first and second conditions should yield shortening while the third should not.

EXPERIMENT 1

Method

Subjects. The talkers were 15 undergraduate students at Dartmouth College who participated for course credit. All were native speakers of English who reported having normal speech and hearing.

Materials. The materials consisted of 48 target words, each associated with three primes. The targets were commonplace words of English ranging from one to three syllables. One prime for each target was the word itself. For 24 targets (the synonym set), a second prime was a synonym of the target, while for the remaining 24 targets (the homonym set) it was a nonhomographic homophone. All synonyms were rated 5.96 or higher on a 1–7 scale in the listing of synonyms by Whitten, Suter, and Frank (1979). Of the 24 homophonic primes, 12 were real words of English while 12 were non-word letter sequences intended to have the same pronunciation as the target (e.g., “kreecher” – “creature”). The third prime was unrelated to the target in content, but similar in form to the synonym or homophone prime. Unrelated primes paired with nonword homophones were also nonwords that are homophonous with a word of English. Unrelated primes served largely as place holders; they ensured that targets occurred in the same serial position across lists and that talkers in different prime conditions had similar articulatory histories except in regard to manipulation of the independent variable of prime type. Primes and targets appear in the Appendix.

Primes and targets were used to produce three lists of 96 items. The final 48 items in every list were the 48 targets. The first 48 items were primes. In each list, 16 primes were identical to later-listed targets, eight were synonyms, eight were word and nonword homophones and 16 were unrelated to their targets. The lists of primes were constructed in such a way that primes for a given target occupied the same slot in the test order across all lists. For example, one list included “cellar” as item two in the list of primes; “cellar”

TABLE 1

Durations of targets preceded by themselves, by related primes (synonyms or homophones) or by unrelated primes in the isolated word lists of Experiment 1

<i>Stimulus set</i>	<i>Prime type</i>		
	identical	related	unrelated
synonym	506	508	507
homophone	545	558	554

is an identical prime for a later-occurring target. Another list included "seller" as the second (homophone) prime in the list, while the final list included "silly" as the second (unrelated) prime.

Primes and targets were ordered so as to vary the lag (that is, the number of intervening items) between prime and target over a large range. In particular, the order of items in the list of primes was the inverse of the order of items in the list of targets. (So, whereas the primes for "cellar" were second in the list of primes, the target "cellar" was penultimate in the list of targets.) This allowed the lags to range from 0 (the last prime was adjacent to its target) to 94. Primes of the three types were interleaved in the list so that their associated lags averaged to about the same value within a list. Because the three prime types of a target item occupied the same serial position across lists, lags were identical for the three prime types across lists.

Lists were typed double-spaced in a single column that covered four sheets of 8½ X 11 inch paper.

Procedure. Subjects were run individually. They sat before a microphone in a sound-attenuating room. They were given one of the three word lists and were instructed to read the list at a comfortable, steady rate. They were warned that some items in the list were nonwords and that they should try to pronounce those items as they were spelled. The sessions were recorded on cassette tape.

Measurements. Only targets and primes identical to targets were measured. Items were not measured if the talker stumbled over them or mispronounced them. Likewise, a target was not measured if an error occurred on its prime. Just one prime and 10 targets were eliminated from the analysis by these criteria. Of the 10 targets eliminated, five were eliminated because nonword primes ("ahnist", "kahledge" and "phunnie") had not been given the same pronunciation as their targets ("honest", "college" and "funny").

Items to be measured were filtered at 10 kHz and digitized at 20 kHz on input to a laboratory computer (New England Digital Company). Waveforms of the words were displayed on a computer-terminal screen, and the interval between the onset and the offset of visible energy was measured. I measured the whole set of targets and identical primes, and an undergraduate research assistant, naive to the purposes of the experiment, made independent measurements of a subset (20%) of the targets. The correlation between the two sets of corresponding measurements was 0.97.

Results and discussion

Table 1 shows mean durations of target items in the two sets across the various prime conditions. The differences across conditions are small and inconsistent in direction. Four analyses of variance were performed on the data, two analyses with subjects as the random factor and two with items as the random factor. In one pair of analyses, targets with synonym primes were examined, and in the other, targets with word and nonword homophone primes were examined. In no analysis did the effect of type of prime approach significance, nor, in the analysis of nonword and word homophones, did that effect interact with the lexicality of the prime.¹

A possible reason for the failure to find shortening overall is that, on average, time intervals or lags between prime and target were too long in the present experiment, so that priming had dissipated by the end of the experiment. However, there was no evidence of shortening even in the first quarter of the list of targets, where lags ranged from 0 to 22 items, averaging 11 items.

These findings offer no evidence that shortening is a consequence of repetition alone. However, it is premature to conclude that reductions of repeated words occur only in communicative settings. There are other differences between the study in which reductions were observed (Fowler and Housum, 1987) and the present experiment in which they were not.

One difference is that, necessarily, in spontaneous speech, a first occurrence (here "prime") precedes its second occurrence (here "target"), and in the earlier study we compared durations of first and second occurrences. In contrast, in the analyses just described, I compared *targets* in the same list position that had different primes earlier in the list. This eliminates the confounding between position in the utterance and identity of an item as first or second occurrence. Perhaps it also thereby eliminates the "repetition effect".

To determine whether that difference across studies is important, I compared durations of identical primes and targets. Overall, primes averaged 519 msec in duration,

¹ The analyses of variance were redone with durations changed to z scores. This was done because, in the subjects analysis, subjects' mean target durations across the different conditions of the experiment are based on different items, and different items have different average durations. Likewise, in the items analysis, means for different conditions are based on different subjects' productions, and different subjects spoke at different rates. Appropriate z transformations eliminate these sources of error. However, these analyses did not change the outcome of the original analyses.

while targets averaged 525 msec. The 6 msec of difference is not in the expected direction, and it does not approach significance.

One other possible difference between the present experiment and the original study was examined and dismissed. If talkers produced words at a faster rate in the word lists than the spontaneous speakers of Fowler and Housum, then possibly their productions had less room to shorten further on repetition. The opposite was the case, however.

It appears then that repeated-word shortening is special to a situation in which words occur in meaningful utterances, and possibly only in communicative settings. The next two experiments were designed to assess that possibility.

EXPERIMENT 2

In this experiment, I took one step away from a word list and towards a meaningful communicative setting by embedding primes and targets in paragraphs. As in Experiment 1, primes were identical to targets or else were synonymous, homophonous, or unrelated to them.

Method

Subjects. The subjects were 15 undergraduate students at Dartmouth College who participated for course credit. All reported having normal speech and hearing.

Materials. The materials were 24 paragraph triads. Within a triad, paragraphs were generally identical save for one word, the prime. In a few instances, a few words in the vicinity of the prime were also changed to preserve coherence. In all triads, there was one version of the paragraph in which the prime was the same as the target. In 12 paragraph triads, second versions had primes that were synonyms of the target. The targets and synonyms were 12 of the 24 synonym pairs used in Experiment 1 (those starred in the Appendix). They were selected at random from the set of 24. In 12 other paragraph triads, primes were homophonous with the target. They were the 12 real-word homophones used in Experiment 1. In the third version of each paragraph triad, the prime was unrelated to the target. These primes were not those used in Experiment 1, but rather were chosen to fit the content of the paragraph. A sample paragraph follows:

Vivian had never retained the services of a lawyer/attorney/detective before. However, the situation with her neighbor had gotten out of hand. She'd get the dirt on him then sue. The lawyer she had spoken to had been encouraging.

In the paragraphs, time-target lags ranged from 10 to 33 words and averaged 21 words overall.

Three lists of 24 paragraphs were created from the 24 paragraph triads. Each list included one member of each triad; members of a common triad occupied the same serial position across lists. In each list, 8 paragraphs included identical primes and targets,

8 included related primes and targets (4 synonyms, 4 homophones) and 8 included unrelated primes and targets.

Procedure. The procedure was the same as in Experiment 1.

Measurements. Measurements were made in the same way in Experiment 2 as in Experiment 1. No primes or targets were excluded due to subject error in this experiment. As in Experiment 1, an undergraduate assistant, naive to the purposes of the experiment, repeated a subset of the measurements independently. The correlation between his measurements and mine was 0.97.

Results and discussion

Table 2 presents average durations of targets in the various conditions of the experiment. On average, targets that are exact repetitions of primes were shorter than unprimed targets by 21 msec in the synonym condition and 19 msec in the homophone condition. Targets primed by synonyms were 13 msec shorter than unprimed targets, while targets primed by homophones were 12 msec longer. Two analyses of variance were performed on the data, one with subjects as a random factor and one with items as a random factor. The analyses had as factors prime type (identical, related, unrelated) and stimulus set (synonym, homophone). In the analyses, the effect of prime type was significant (subjects: $F [2, 28] = 3.22, p = 0.05$; items: $F [2, 44] = 7.37, p = 0.002$). The effect of stimulus set was significant in the subjects analysis only ($F [2, 28] = 14.01, p = 0.002$) and the interaction was significant in the items analysis only ($F [2, 44] = 3.32, p = 0.04$).

Planned comparisons were performed on the difference of primary interest, that between unprimed targets and targets primed by themselves. This difference was significant (subjects: $F [1, 28] = 8.29, p < 0.01$; items: $F [1, 44] = 9.18, p < 0.005$). *Post hoc* comparisons of the targets primed by synonyms against either the targets primed by themselves or by unrelated primes yielded nonsignificant outcomes. Accordingly, we

TABLE 2

Durations of targets preceded by themselves, by related words (synonyms or homophones) or by unrelated words in the paragraphs of Experiment 2

	identical	<i>Prime type</i> related	unrelated
<i>Stimulus set</i>			
synonym	311	319	332
homophone	323	354	342

can conclude that exact repetition of a target led to durational shortening, homophonous primes did not lead to shortening, while effects of synonymous primes are equivocal.

In this experiment, as contrasted with Experiment 1, shortening by repeated words was found. Accordingly, we can conclude tentatively that shortening only occurs when words are in meaningful prose. However, shortening was considerably smaller in magnitude than that observed in the study by Fowler and Housum. There, shortening averaged 72 msec for the talker on whom considerable data were available and 41 msec on average for five other talkers. This difference is not due to the direct comparison of identical primes and targets in the earlier study. When the same comparison is made in the present experiment, just 15 msec of shortening is found. This effect of repetition is only marginally significant (items: $t(23) = 1.57, p = 0.06$).

It may be worth asking then whether the stronger repetition effect seen by Fowler and Housum had to do with the fact that words were being repeated not only in meaningful prose in that study, but also in a real communicative setting. The final experiment sought to contrast repetition shortening for repeated words in prose produced in more and less natural communicative settings.

EXPERIMENT 3

Participation in a communicative interaction may enhance the tendency for talkers to distinguish first and second occurrences of a word for two reasons. Talkers may reduce productions of a word for their own benefit, because reduced versions of words are less effortful to produce than formal versions; the increasing redundancy over a communicative interaction (Fowler and Housum, 1987) creates increasing opportunities for reductions. In addition, however, the talker may produce shortenings for the listener's benefit, and so shortening may be more likely to occur when there is a listener present signaling his or her understanding of the talker's utterance (e.g., Krauss, 1987).

To ask whether the communicative setting affects reduction, I used a manipulation also used by other investigators to study special properties of spontaneous speech (Lieberman, Katz, Jongman, Zimmerman, and Miller, 1985; Remez, Rubin, and Ball, 1985). In particular, talkers were invited to speak spontaneously on a variety of topics. Their remarks, addressed to a research assistant, were recorded and transcribed. Subjects returned to the laboratory later and were recorded reading their transcribed remarks.

Method

Subjects. The subjects were 10 undergraduate students at Dartmouth College who participated for course credit. All were native speakers of English who reported normal speech and hearing.

Materials. An undergraduate research assistant compiled a list of topics that he considered of interest to students at the college. Topics included, among others, students' plans for Spring Break, their reasons for having chosen to attend Dartmouth, their home town or country, and their judgments of candidates for the presidential election of 1988.

TABLE 3

Durations of first and second occurrences of content words in spontaneous and read speech of Experiment 3

<i>Condition</i>	Occurrence	
	first	second
spontaneous	449	409
read	389	370

Procedure. Students were run individually. In the first session, the experimenter, an undergraduate, presented the student subject with a list of topics and asked him or her to select one or more on which to talk. Subjects were asked to talk for a total of five minutes to the experimenter on one or more of the topics. Their monologues were recorded on tape.

The monologues were transcribed and printed out on paper for reading. The students returned to the laboratory a minimum of one week after their first session and read their transcribed remarks into a microphone.

From each monologue, content words that occurred more than once were selected for measurement using criteria established by Fowler and Housum. The first and second occurrences of a content word in both spontaneous and read versions of the monologues were selected unless one or more productions occurred in a context in which they were subject to final lengthening, unless the talker produced a word disfluently, or unless the first and second occurrences spanned a change in topic. Across subjects, between 11 and 24 words were selected for analysis.

Measurements. Measurements were made as in Experiments 1 and 2. A research assistant, naive to the purposes of the experiment, repeated one quarter of the measurements independently ($r = 0.95$).

Results and discussion

Table 3 provides the means of first and second occurrences of the same words as spontaneous and read productions by the 10 talkers of the experiment. In spontaneous productions, all 10 talkers had numerically shorter second than first occurrences. Nine of the ten talkers also showed numerical shortening of second occurrences in read speech. All talkers read words faster than they spoke them spontaneously (see also Remez *et al.*, 1985). Nine talkers showed numerically more shortening in their spontaneous than their read speech.

In an analysis of variance, with factors occurrence (first or second) and condition (spontaneous versus read), the effect of occurrence was significant ($F [1, 9] = 29.69, p < 0.001$). So was the effect of condition ($F [1, 9] = 23.61, p < 0.001$), with spontaneous productions longer by 51 msec on average than read productions. The interaction was also significant ($F [1, 9] = 15.22, p = 0.004$). Whereas second occurrences of spontaneous productions were shorter by 40 msec than first occurrences, second occurrences of read productions were just 19 msec shorter than first occurrences. These differences respectively are very similar numerically to the differences between first and second occurring spontaneously-produced words found by Fowler and Housum (1987) and the differences between first and second occurring read words in Experiment 2 of the present study.

Two reasons for the significant interaction may be important. One is that, as I hypothesized earlier, the shortening may largely occur in settings in which talkers can estimate what quality of production listeners need to hear. Alternatively, however, the difference in shortening may reflect the longer durations of the spontaneously produced words. Possibly, read words are near their minimal durations, and talkers cannot reduce second read occurrences much more. To attempt to compensate for the different durations of spontaneous and read first productions, each talker's average amount of shortening of a second as compared to a first production was expressed as a percentage of the average duration of first occurring words, and a *t*-test compared shortening percentages in spontaneous and read speech. The difference was still significant ($t [9] = 2.80, p = 0.02$). Thus, talkers showed proportionately more shortening in the spontaneous-speech condition.

However, within that condition, there was a significant relation between shortening and duration of a first occurring word ($r = 0.64, p = 0.04$). The analogous correlation performed on read words was not significant ($r = 0.26$). This difference in the size of the correlation may reflect the overall short duration of first occurrences in the latter condition. The presence of a correlation in spontaneous speech and its reduction in read speech may be an indication that word durations are closer to a floor in read speech and cannot shorten even proportionately as much as spontaneously produced words. Thus, it is not possible to rule out a hypothesis that more shortening occurs in the spontaneous speech condition because durations of first occurring words are relatively long. That the different amounts of shortening across the conditions are due, at least in part, to different distances of first occurrences from their floors is hinted at also by a second finding. On average, talkers shortened 65% of their first occurring spontaneous productions on repetition and 63% of their first occurring read productions. Both percentages are significantly different from a chance value of 50% ($t [9] = 3.15, p = 0.01$ and $t [9] = 3.12, p = 0.01$, respectively), but, obviously they are not different from each other. It seems that talkers are not less likely to shorten repeated words in read rather than spontaneous speech; rather, they are likely to shorten repeated words less.

CONCLUSION

The findings of the present study are straightforward. Mere repetition of a word in a list, even at a short lag from its first occurrence, is not sufficient to yield the shortening observed when words are repeated in conversation. Rather, words must occur in meaningful prose. Compatibly, production of a homophone of a target is not sufficient, in meaningful prose, to yield shortening of a word even though the word's articulatory routine has recently been used. Apparently the shortening reflects the talker's estimate that a listener has other information available to help identify the word, and so the word need not be carefully produced.

Meaningful prose produced in a communicative setting (with a listener) yields more shortening than prose read into a microphone, although shortening is found in both settings. This latter finding may be mediated, however, by the slower rates of spontaneous as compared to read speech.

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APPENDIX

Synonym set

<i>related</i>	<i>unrelated</i>	<i>target/identical prime</i>
buy	guy	purchase
attorney	annuity	lawyer*
fall	ball	autumn
cent	went	penny*
car	star	auto
error	odor	mistake*
winner	sinner	victor*
teacher	feature	instructor*
remark	remake	comment
center	enter	middle
command	amend	order
jail	gale	prison*
bravery	average	courage
bunny	honey	rabbit
homicide	wayside	murder*
aviator	available	pilot*
couple	apple	pair
liberty	levity	freedom
sight	sigh	vision
baby	daily	infant*
obligation	refutation	duty*
film	firm	movie

journey
argument

jersey
alimony

trip*
quarrel*

*used in Experiment 2

Homophone set

homophone

unrelated

target/identical prime

seller

silly

cellar

raining

ruining

reigning

manner

banner

manor

trader

tardy

traitor

muscle

mutter

mussel

writing

writhing

righting

meddle

motor

metal

pedal

pecan

petal

loaner

label

loner

braking

barking

breaking

sonny

sonar

sunny

kneading

nodding

needing

kleener

kludder

cleaner

kreecher

kracker

creature

unoan

onner

unknown

dorphrame

dawter

doorframe

kahlidge

kardon

college

nayber

nayshun

neighbor

sirkus

sikkle

circus

murssy

muwdy

mercy

hansum

groosum

handsome

nooly

mydey

newly

phunny

phable

funny

ahnist

ardist

honest