Information theorists maintain that typical English-language text is approximately 75 per cent predictable; for example, in a text-reconstruction experiment carried out by Claude Shannon, a subject presented with various incomplete sentences was able to guess the next letter correctly in 79 out of 102 attempts. However, if one attempts to retain the sense of a sentence after weeding out letters according to some predetermined rule (such as all the vowels), one cannot achieve such an extreme limit; in fact, the removal of even half the text is likely to introduce severe difficulties. Although Shannon cites an experiment in which six subjects restored an average 93 per cent of the 50-per-cent-deleted FCTSSTRNGRTHNFCTN, surely the triteness of the phrase made it more easily recognizable than unfamiliar text would have been. It is the purpose of this article to shed light on the question of just how much can be trimmed from text without losing the meaning.

Of course this has been attempted before, most frequently by speedwriting systems designed to aid the part-time stenographer who does not want to take the time to master a non-literal shorthand system such as Pitman or Gregg. Most of these systems are tailored to a "business English" vocabulary and assume that the stenographer is the only reader of the compressed text; they are often rather cryptic in appearance to the untrained reader. The rules of compression are elaborate, involving both literal and phonetic properties; furthermore, 100 or more high-frequency words are encoded by single letters, making guessing especially hard for the outsider if the word is long (l for 'letter', s for 'sincerely', p for 'price'). In short, if the reader of compressed text is not the writer of it as well, he has a better chance of recovering the original if he knows the rules used for compression, so that he can if necessary reconstruct the set of words corresponding to a particular shortened form.

In this article, I propose three sets of literal (not phonetic) rules for compressing words -- low, medium and high. These rules have been kept reasonably simple, but try to leave the most informative letters of each word in view. Of course, there is a great deal of ambiguity present in individual shortened forms (the letter t can stand for 'the', 'to', 'it' and 'at' in high-compression text, for example), but often this can be overcome by considering the sentence as a whole. Following the rules and a discussion of their characteristics, I give various examples of compressed text for the reader to try deciphering.
Low-compression Rule

1. create a reduced word by replacing doubled letters with single ones (as 'bookkeeper' to 'bokeper')
2. compress the reduced word as follows:
   - put down the first letter (b)
   - put down consonants in order of appearance (bk, bkp, bkpr)
   - insert vowels in order of appearance (bokpr, bokepr, bokeper)
3. write down reduced words of five letters or less without compression; compress reduced words of six letters or more to five

For instance, 'we should elect only able representatives' becomes 'we shld elc onl abl rprsn', a reduction of 36 letters to 25.

Medium-compression Rule

1. same as above
2. same as above
3. if the reduced word is i letters long, compress it to n letters
   
   | i | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8+ |
   | n | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |

The above-mentioned sentence becomes 'we shld elc onl abl rprsn', a reduction of 36 letters to 20.

High-compression Rule

1. create a reduced word by replacing doubled letters with single ones and omitting h after t (as 'three' to 'tre')
2. same as before
3. if the reduced word is i letters long, compress it to n letters
   
   | i | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10+ |
   | n | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |

The above-mentioned sentence becomes 'w shl elc on ab rprsn', a reduction of 36 letters to 16.

How much compression of text does each rule achieve on the average? Using the Kucera and Francis corpus of a million words taken from English-language writings of 1961, one can easily calculate the average reduction due to steps 2 and 3: low, medium, and high compression reduces text to 0.79, 0.64 and 0.52 of its original length. It is somewhat harder to estimate the additional compression achieved by eliminating doubled letters and h following t, but the effect is relatively small. For example, there are about 84,000 occurrences of h following t in 3-letter, 5-letter, 8-letter and 10-letter words occurring 100 or more times in Kucera and Francis. Since words occurring more than 100 times use up nearly 70 per cent of the total corpus of 4.7 million alphabetic letters, one can use a simple extrapolation to predict a total of \((10/7)(84000) = 120,000\) occurrences of h following t in the entire corpus -- a leap for doubled letters per cent. This was to shorten word, 69,971 better distinct 'them', then common words.

Obviously, the most baffling letter, and I sth

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a: a
b: be, bee, b

d: do, odd
f: of, if, off,
g: go, egg
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Among two-let

true, three, the turn -- all occur highly-ambiguous (fire, farm, fa step, still, sta sit, stuff, stop)

The follow

agreement, medium-her each repre agree, I think, sing is extremely easy. A final party game, we determine the sure hunt or do give instruction

```
w shld elc on

d te mk lw
tm? ts an
gvrmn

we shld elc

do thr wrk

ot th lws a
of spcl cn

177 letter

we shld elc
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corpus -- a letter-reduction of only 2.5 per cent. A similar argument for doubled letters predicts an even smaller reduction -- perhaps 0.5 per cent. The principal reason for introducing the h-following-t rule was to shorten the word 'the' (occurring more often than any other word, 69,971 times in the corpus) to a single letter, and to permit better distinction among the two-letter versions of 'this', 'that', 'them', 'then', 'than' and 'they' -- all occurring among the 71 most common words.

Obviously, there is much ambiguity in the high-compression rule. The most baffling words are those that have been reduced to a single letter, and I summarize the common alternatives below:

- a: a
- b: be, bee, by, ebb
- d: do, odd
- f: of, if, off, fee
- g: go, egg
- h: he
- i: I
- l: all, ill
- m: me, my, am
- n: an, in, on, no
- p: up
- r: or
- s: as, is, us, so, see
- t: the, too, to, is, it, tee
- w: wo, we
- y: you

Among two-letter compressed words, tr is probably the most ambiguous, representing there, their, tree, trees, tare, trap, trip, try, true, three, third, truth, trim, torn, tour, tire, threw, throw and turn -- all occurring 20 or more times in Kucera and Francis. Other highly-ambiguous combinations include fr (for, from, far, fear, firm, fire, farm, fair, four, forth, form, ford, free, Fred), st (stem, step, still, staff, south, star, stay, stiff, steel, set, sat, seat, site, sit, stuff, stop) and ts (this, these, those).

The following paragraph is written according to the high-compression, medium-compression and low-compression rules; try and decipher each representation before moving on to the next. Most people will agree, I think, that full recovery of a message with half the letters missing is extremely difficult, but with only one quarter missing it is quite easy. A final thought: compressed text might be used as the basis of a party game, with individuals or teams competing against each other to determine the sense most quickly. (It might be combined with a treasure hunt or dictionary rally, in which a series of decoded messages give instructions to do something.)

with single
bkp, bkpr kepr, bokep

more to five
's becomes
rs to 25.

with single ones
abl rprsn',

letters

rprsn',

the average
take comma-
high compre-
h. It is
relatively
h following
100 or
more than
million
dict a total
the entire
As a matter of interest, here is another paragraph, first written in Carter Briefhand (a form of speedwriting developed in 1957 by Theodore H. Carter) and then according to the high-compression rule. Which is more understandable?

in a representative democracy, the people govern themselves by entrusting the entire administration of the state to their representatives, whom they choose by ballot. the founders decided that our government should be that of a republic or representative democracy, they recognized that a pure democracy is neither practical nor enduring. in a pure democracy, of course, management of public affairs remains in the hands of the people themselves, so that they make laws, levy taxes, and determine all matters (passage quoted from Carter Briefhand)

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