Stroke victims illuminate brain's grammar

Two women who suffered brain-damaging strokes in 1985 have given scientists a glimpse at apparently different mechanisms by which the brain handles written and spoken words belonging to the same grammatical class, such as nouns or verbs.

In fact, the women provide the first clear evidence that different brain systems – devoted either to speaking or writing words – distinguish grammar categories separately, assert neuropsychologists Alfonso Caramazza of Johns Hopkins University and Argye E. Hillis of HealthSouth Rehabilitation Corp., both in Baltimore. Previous studies of brain-impaired people suggested that the brain separately processes nouns by a variety of categories, such as fruits and vegetables, animals, inanimate objects and proper nouns (SN: 8/10/85, p.85).

One of the study participants, a 62-year-old right-handed former salesperson referred to as H.W., experienced a stroke near the back of her brain's left hemisphere. The other woman, a 48-year-old right-handed librarian dubbed S.J.D., sustained stroke-induced damage toward the front of her left hemisphere.

The researchers asked each woman to read aloud and to write from dictation a list of 296 nouns and verbs, and then to orally name and write 60 pictured objects and actions. Both women made a significant number of errors, but only with verbs, not nouns. Where H.W. had trouble pronouncing verbs, S.J.D. displayed problems only in writing verbs, Caramazza and Hillis report in the Feb. 28 NATURE.

Further testing with homonyms – words that assume different meanings as a noun or verb while maintaining the same written or spoken form – indicates that the womens' language deficits involve the processing of words when used as verbs, not an impairment in producing specific words regardless of their grammatical affiliation, the investigators say.

In written homonym tests, experimenters read the women a sentence and then asked them to write an emphasized word in the blank space of a typed sentence. For example, for the noun form of the word "crack," the women heard "There's a *crack* in the mirror; write 'crack,'" and then filled in the partial sentence "There's a _____ in the mirror." For the verb form, the women heard "Don't *crack* the nuts in here; write 'crack'" and again filled in the blank in an incomplete sentence.

The reading test required the participants to read a sentence silently, and then to pronounce an underlined word in that sentence – such as the word "crack" in the two sentences above.

H.W. displayed marked difficulty only with reading aloud homonym verb forms, while S.J.D. performed poorly only when asked to write homonym verb forms, the researchers observe.

These findings suggest that a word's grammatical identification gains representation "separately and redundantly" in brain systems that process either written or oral vocabulary, Caramazza and Hillis contend. Such a precise divvying up of brain functions concerned with word meanings poses a challenge to recent theories (based on work with "neural network" computers) that reject the need for rule-based language systems in the brain, the researchers add. These theories assume instead that different patterns of activation among large numbers of brain cells associate words with their meanings. *– B. Bower*

Fresh smoke lowers nitrous oxide estimate

Biomass burning – the combustion of organic matter in forest fires, wood stoves and "slash and burn" land clearing – may contribute far less nitrous oxide to the atmosphere than previously thought, a team of U.S. and Canadian scientists reports. Atmospheric concentrations of this gas – which not only contribute to the greenhouse effect but also destroy stratospheric ozone – have been growing in recent years. If confirmed, the new findings would seem to indicate that major sources of this worrisome air pollutant have either been seriously underestimated or ignored.

Wesley R. Cofer III of NASA's Langley Research Center in Hampton, Va., and his colleagues sampled air from above a forest fire near Morley Lake in Ontario, Canada. Cofer not only analyzed combustion-gas levels in the air during the fire – using a new helicopter-mounted gas chromatograph he developed – but also collected additional air samples in bottles for periodic analysis over the next 21 days. And in the Feb. 21 NATURE, these researchers report finding that chemical reactions within the stored samples generated nitrous oxide (N_2O). Quantifiable changes, first detected within 4 to 8 hours, reached significant increases – on the order of 20 percent – within 10 to 21 days.

Because chemists have traditionally regarded nitrous oxide as inert in collection jars and because it often takes hours or days to transport samples from a burn site to a laboratory, pollutant-assaying delays commonly occur, observes Joel S. Levine, an atmospheric scientist at Langley and co-author of the study. The new data now suggest that previous estimates of nitrous-oxide emissions – largely based on such delayed analyses – have seriously exaggerated biomass burning's role in growing atmospheric levels of this pollutant, Levine says.

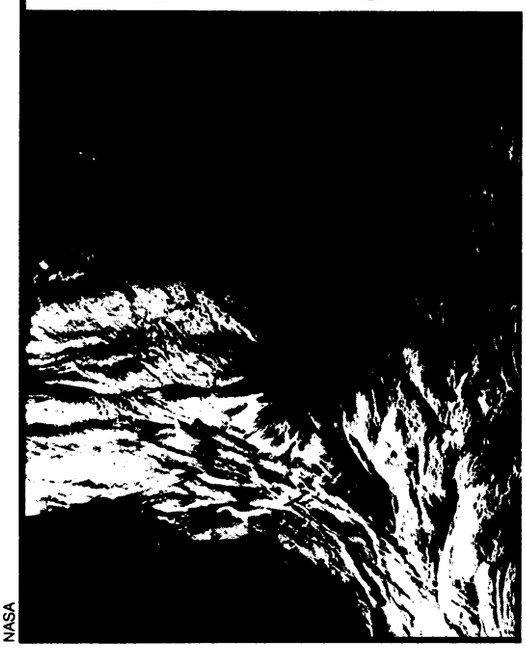
The new biomass-burning data parallel findings two years ago showing that fossil-fuel combustion gases can react within collection jars to form additional nitrous oxide (SN: 11/26/88, p.340).

Previously, researchers have estimated that combustion of biomass and fossil fuel together account for 40 to 50 percent of the annual atmospheric increase of nitrous oxide. Levine now estimates that biomass burning yields no more than 7 percent of the global production of nitrous oxide. As a result, he says, these new estimates fail to account for about 30 percent of the nitrous oxide emitted worldwide.

Scientists should confirm Cofer's results by performing equivalent experiments in the tropics, the site of most large-scale biomass fires, says F. Sherwood Rowland, an atmospheric chemist at the University of California, Irvine. The new results should also prompt scientists to "look even harder for other new sources of nitrous oxide," and to re-examine each known source of the gas in order to "balance the nitrous-oxide equation," says Mark H. Thiemens, a chemist at the University of California, San Diego.

Thiemens and his San Diego colleague, William C. Trogler, recently reported that the production of nylon may account for up to 10 percent of the annual increase in nitrous oxide levels (SN: 2/23/91, p.117). Recent studies by Levine indicate that soil bacteria feeding on ammonium compounds in the ash of biomass fires may also excrete significant amounts of nitrous oxide. *– T. Walker*

New penetrating radar



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