SAGE reference

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Recursion

Recursion is a mathematical principle that involves repeating an algorithm (a sequence of mathematical operations) any number of times. There is no limit to the number, and infinite repetition is possible. In other words, the mechanism can be used to describe infinite objects using only a finite description.

Recursion is an important principle in the theory of computation, a branch of mathematics that demonstrates whether something is computable and how. This led to the creation of computer science. Furthermore, recursion is a fundamental principle that is found in all cognitive sciences. The principle of recursion was used in linguistics by Noam Chomsky to explain how it is possible for a human being to generate an infinite number of sentences from a limited number of rules and words. Recursion is supposedly one of the basic principles that allows human brains to implement language.

There are several types of recursion in language. The most complex one is *centrally embedded recursion*. For example:

- [The man filed a complaint]
- [The man [the boy hit] filed a complaint]
- [The man [the boy [the girl kissed] hit] filed a complaint]

In the last two sentences above, the central clause reproduces the grammatical structure of the main clause. It would be possible to add more clauses within the last sentence, but the resulting sentence would be very difficult to understand. This difficulty is explained by memory limitation because processing many embedded clauses implies having the whole sentence in mind. This limitation led Chomsky to separate the principle of competence (the theoretical knowledge of grammar) from the principle of performance (the actual production of language within the limits of the actual biological brain). For Chomsky, the principle of recursion belongs to competence and is nonlimited, which explains why language is potentially infinite.

Real examples of multiple embedded clauses in language exist although they are infrequent. Often the memory load is lighter than in the example above because the elements to be memorized are clearly different from one another. For example:

- [The fact [that the teenager [who John dates] was pretty] annoyed Suzie]

Some linguists have argued against the necessity of recursion in language, explaining that recursive embedding is not the only solution used to express embedding in human languages. This seems to be the case for the Pirahã language. Although recursion is found in almost all languages in the world, it might not be a defining condition of human language.

Language Acquisition

Children demonstrate early knowledge of the structural properties of language. In the case of lexical recursive structures, as for example in "red rats eater," children make the difference between grouping "red rats" to mean "eater of red rats" (the correct interpretation) and grouping "rats eater" to mean "red rats-eater" (an incorrect and ungrammatical interpretation, although based on a much more frequent grammatical construction). However, the acquisition of complex structures and especially compound sentences is slow, and the first compound sentences acquired are based on specific grammatical structures (clefts) and not recursive structures.

Language Impairment

One of the few studies to have explicitly tested the existence of recursion in children with specific language

impairment (SLI) found poorer performances on recursion measures in children with SLI when compared with age-matched normally developing children. This is not surprising, as children with SLI are known to have difficulties with complex processing. Although recursion should not be reduced to complexity, it does call for simultaneous processing; hence, processing limitations might impair recursive processing in children with SLI.

See also Clauses and Phrases; Syntax and Grammar

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Further Readings

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