Agrammatism

Agrammatism is a disorder that leads to difficulties with sentences. These difficulties can relate both to the correct comprehension and the correct production of sentences. That these difficulties occur at the sentence level is evident from the fact that word comprehension and production can be relatively spared.

Agrammatism occurs in many clinical populations. In patients with Wernicke's aphasia, for instance, agrammatism has been established both for comprehension (Lukatela, Schankweiler, and Crain, 1995) and for production (Haarmann and Kolk, 1992). Agrammatic comprehension has been demonstrated in patients with Parkinson's disease (Grossman et al., 2000), Alzheimer's disease (Waters, Caplan, and Rochon, 1995), and in children with specific language disorders (Van-der-Lely and Dewart, 1986). Agrammatic comprehension has even been demonstrated in normal subjects processing under stressfull conditions (Dick et al., 2001). However, agrammatism has been studied most systematically in patients with Broca's aphasia, and it is this group this review will focus on.

Symptoms of agrammatic comprehension are typically assessed by presenting a sentence to the subject and asking the subject to pick from a number of pictures the one depicting the proper interpretation of the sentence. Another procedure is to ask subjects to act out the meaning of the sentence with the help of toy figures. The main symptoms thus established are the following: (1) Sentences in which the two thematic roles can be reversed (e.g., "The cat is chasing the dog") are substantially harder to understand than their nonreversible counterparts ("The cat is drinking milk") (Caramazza and Zurif, 1976; Kolk and Friederici, 1985). Roughly speaking, thematic roles specify who is doing what to whom. (2) Sentences with noncanonical ordering of thematic roles around the verb are harder to comprehend than ones with canonical ordering. In English, the order of the active sentence is considered to be canonical: agent-action-patient (or subject-verb-object). Sentences with a word order deviating from this pattern are relatively difficult to understand. Thus, passive constructions are harder to understand than active ones (Schwartz, Saffran, and Marin, 1980; Kolk and van Grunsven 1985), and object relative sentences ("The boy whom the girl pushed was tall") are harder than subject relative sentences ("The boy who pushed the girl was tall") (Lukatela, Schankweiler, and Crain, 1995; Grodzinsky, 1999), to mention the most frequently studied contrasts. (3) Sentences with a complex—more deeply branched—phrase structure are harder to understand than their simple counterparts, even if they have canonical word order. For instance, a locative construction (e.g., "The letter is on the book") is harder to understand than a simple active construction ("The sailor is kissing the girl"), even if subjects are able to comprehend the locative proposition as such (Schwartz, Saffran, and Marin, 1980; Kolk and van Grunsven, 1985). Furthermore, sentences with embedded clauses ("The man greeted by his wife was smoking a pipe") are harder to comprehend than sentences with two conjoined sentences ("The man was greeted by his wife and he was smoking a pipe") (Goodglass et al., 1979; Caplan and Hildebrandt, 1988).

Agrammatic production has attracted much less attention than agrammatic comprehension. Symptoms of agrammatic production have traditionally been assessed by analyzing spontaneous speech (Goodglass and Kaplan, 1983; Rochon, Saffran, Berndt, and Schwartz, 2000). Four types of symptoms of spontaneous speech have been established. (1) Reduced variety of grammatical form. If sentences are produced at all, they have little subordination or phrasal elaboration. (2) Omission of function words (articles, pronouns, auxiliaries, prepositions, and the like) and inflections. (3) Omission of main verbs. (4) A slow rate of speech. Whereas these symptoms have been established in English-speaking subjects, similar symptoms occur in many other languages (Menn and Obler, 1990). A number of studies have attempted to elicit production of grammatical morphology and word order in agrammatic patients. A complicating factor is that there are systematic differences between spontaneous speech and elicited speech. In particular, function word omission is less frequent in elicited speech and function word substitution is more frequent (Hofstede and Kolk, 1994). The following symptoms have been observed on elicitation tests. (1) Grammatical word order is impaired (Saffran, Schwartz, and Marin, 1980). (2) It is more impaired in embedded clauses than in main clauses (Kolk and van Grunsven, 1985). (3) Inflection for tense is harder than inflection for agreement (Friedmann and Grodzinsky, 1997). (4) Sentences with noncanonical ordering of thematic roles appear harder to produce than their canonical counterparts (Caplan and Hanna, 1998; Bastiaanse and van Zonneveld, 1998; but see also Kolk and van Grunsven, 1985).

The localization of agrammatism is variable. With respect to both production and comprehension, agrammatism is associated with lesions across the entire left perisylvian cortex.

Theories of agrammatism abound. Some researchers claim that differences between patients are so great that a unitary theory will not be possible (Miceli et al., 1989). Extant theories pertain either to comprehension or to production. This is justified by the fact that agrammatic production and comprehension can be dissociated (Miceli et al., 1983). The most important approaches are the following. The TRACE DELETION HYPOTHESIS about agrammatic comprehension holds that traces, or empty elements resulting from movement transformations according to generative linguistic theories, are lacking (Grodzinsky, 2000). The mapping hypothesis maintains that it is not a defect in the structural representation that is responsible for these difficulties but a defect in the procedures by which these representations are employed to derive thematic roles (Linebarger, Schwartz, and Saffran, 1983). Finally, a number of hypotheses claim a processing limitation to be the bottleneck. The limitation may relate to working memory capacity (Caplan

and Waters, 1999), altered weights or increased noise in a distributed neural network (Dick et al., 2001), or a slowdown in syntactic processing (Kolk and van Grunsven, 1985). With respect to production, the tree truncation hypothesis maintains that damage to a particular node in the syntactic tree leads to the impossibility of processing any structure higher than the damaged node (Friedmann and Grodzinsky, 1997). Finally, the adaptation theory of agrammatic speech (Kolk and van Grunsven, 1985) maintains that the underlying deficit is a slowing down of the syntactic processor. A second claim is that the actual slow, telegraphic output results from the way patients adapt to this deficit.

Treatment programs for agrammatism vary from theoretically neutral syntax training programs (Helms-Estabrooks, Fitzpatrick, and Barresi, 1981), to programs motivated by the mapping hypothesis (Schwartz et al., 1994) or by the trace deletion hypothesis (Thompson et al., 1996). The reduced syntax therapy proposed by Springer and Huber (2000) takes a compensatory approach to treatment and fits well with the adaptation theory.

—Herman Kolk

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Agraphia

Agraphia (or dysgraphia) is the term used to describe an acquired impairment of writing. The impairment may result from damage to any of the cognitive, linguistic, or sensorimotor processes that normally support the ability to spell and write. These procedures can be conceptualized within the framework of a cognitive model of language processing such as that shown in Figure 1 (Ellis, 1988; Shallice, 1988; Rapcsak and Beeson, 2000). According to the model, the writing process can be divided into central and peripheral components. The central components are linguistic in nature and are responsible for the retrieval of appropriate words and provision of information about their correct spelling. Peripheral procedures serve to translate spelling knowledge into handwriting, and to guide the motor control for appropriate movements of the hand.

When the system is working normally and an individual wants to write a familiar word, the relevant concepts in the semantic system activate representations in the memory store for learned spellings (i.e., the orthographic output lexicon). Access to this lexicon via the semantic system is referred to as the lexical-semantic spelling route. In contrast, when the individual attempts to spell unfamiliar words or pronounceable nonwords (such as *flig*), reliance on knowledge of sound-to-letter correspondences allows the assembly of plausible spellings by a process referred to as phoneme-grapheme conversion. This alternative means of spelling is depicted in Figure 1 by the arrow from the phonological buffer (where phonological information is held) to the graphemic buffer (where the assembled spelling is held). Spelling in this manner is considered a nonlexical process, because spellings are not retrieved as whole words from the lexicon. Spellings generated by the lexical-semantic and nonlexical spelling routes are subsequently processed in the graphemic buffer. This buffer serves as an interface between central spelling processes and the