Agrammatism

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Microworld for Aphasia

Introduction

Stroke is a major health care and social problem estimated to consume 5% of total NHS resources. For survivors and their carers the commonest long term effects of stroke are physical disability and language dysfunction or aphasia. Aphasia can take many forms, affecting some subsystems of language more than others. Assessments using contemporary cognitive neuropsychological models of language are capable of yielding highly specific accounts of the spared and impaired processes (Ellis and Young, 1988). Damage to Broca's area immediately above the Sylvian fissure in the frontal lobe of the brain (Gazzaniga, 1989) leads to a form of aphasia called Broca's aphasia or agrammatism.

Agrammatism

Agrammatism is a relatively common component of aphasia and has been the subject of research since the late 1970s (Caramazza & Zurif, 1976) with a noticeable concentration of interest in the recent literature (e.g. Caplan, 1995; Marshall, 1995; Mitchum, Haendiges & Berndt, 1995 and others). The distinctive features of agrammatism are typically laboured speech (possibly due to damage in the motor-control strip adjacent to Broca's area which controls the jaws, tongue, lips etc) and a lack of use of grammar in speech production and comprehension (though not all patients who present with agrammatic production necessarily also have agrammatic comprehension (Berndt, 1987; Kolk, Van Grunsven & Keyser, 1985)). Agrammatic production is characterised by a "telegraphic" form of speech with function words and inflections omitted, leading to simple one- or two-word sentences. The following extract from Goodglass (1976) is a typical example. The patient is explaining that he has returned to hospital for work on his gums:

"Ah...Monday...ah, Dad and Paul Haney [himself] and Dad...hospital. Two...ah, doctors..., and ah...thirty minutes...and yes...ah...hospital. And, er, Wednesday...nine o'clock. And er Thursday, ten o'clock...doctors. Two doctors...and ah...teeth. Yeah,...fine."

Agrammatic (or asyntactic) comprehension is characterised by good single word comprehension and intact semantic knowledge, yet poor ability to interpret sentences (e.g. determine who is the 'do-er' and who is the 'done-to' in sentence contexts). Asyntactic comprehension is best detected by the use of 'reversible' sentences (i.e. those where the subject and object can be interchanged equi-plausibly, e.g. The boy kicked the horse / The horse kicked the boy; The man was kissed by the woman / The woman was kissed by the man) since the intended meaning of such sentences can only be inferred from syntactic cues (such as word order or closed class items).

Mapping Hypothesis

One of the most widely investigated hypotheses for asyntactic comprehension is the mapping hypothesis (Linebarger et al, 1983; Linebarger 1990) which holds that (at least one aspect of) these patients' deficit is an inability to map grammatical (surface structure) functions such as subject, object etc onto thematic (deep structure) roles such as agent or patient. Currently there
are many versions of the mapping hypothesis which differ mainly in their claims about the exact cause of the interpretive mapping deficit, e.g:

- loss of (or impaired access to) verb-specific information such as the theta grid (lexical mapping hypothesis).
- loss of (or impaired access to) specific mapping rules, e.g. object -> Patient (procedural mapping hypothesis).
- impairment to a general mapping mechanism.
- An attentional mapping deficit.

Other accounts of asyntactic comprehension tend to fall into one of two categories. Chain disruption accounts hypothesise impairment to the transmission of theta roles from an element’s base-generated (d-structure) position to its moved (s-structure) position via a chain of traces (Chomsky, 1981). An example of this type of account is the Trace-Deletion Hypothesis (Grodzinsky, 1995a; Grodzinsky 1995b). Trade-off accounts claim that the observed linguistic deficits arise out of damage to shared cognitive resources (such as short-term memory) and resulting impairment to general cognitive processing (e.g. Miyake et al, 1994; Miyake et al 1995). For a comparison of all three accounts see Linebarger (1995). Of these theories only the mapping hypothesis leads to a specific (restorative) therapeutic approach, namely mapping therapy (Marshall, 1995). This therapy has two main aims: firstly, to train the patient to identify the grammatical functions in a sentence and to associate them with their corresponding thematic roles and, secondly, to discourage pathological heuristics or non-linguistic strategies (Chatterjee et al, 1995). This general approach has been implemented in various ways, for example: Byng (1988); Byng, Nickels and Black (1994); Schwartz, Saffran et al. (1994); Weinrich, McCall and Weber (1995); Mitchum, Haendiges and Berndt (1995).

**Rehabilitation**

Until recently neurological opinion held that no further improvement in cognitive function could be expected beyond the spontaneous recovery period of 3-6 months post-onset. Evidence is emerging, however, to show that well-targeted language therapy can produce statistically significant and durable treatment effects even many years post-onset (Crerar & Ellis, 1995; Crerar, Ellis & Dean, 1996). Currently, stroke victims with language disorders are referred for a relatively short period of speech and language therapy. Thereafter, in most cases, therapy ceases. The need has been recognised for more systematic research to determine factors that make some patients, and not others, susceptible to worthwhile improvement (Ellis, Franklin & Crerar, 1994). This has motivated the development of therapy "modules" which target specific psycholinguistic processes vulnerable to disruption in aphasia whilst attempting to achieve as much generality of effect as possible. Mapping therapy has been proposed as one such module (Schwartz, Fink & Saffran, 1995) and there is evidence that such treatment does generalise to untreated language functions (Byng, 1988; Schwartz et al, 1994). Moreover, the use of computer technology in clinical assessment can provide a level of diagnostic detail on response times, error patterns and interaction history not previously feasible using manual recording techniques (Bradley, Welch & skilbeck, 1993; Katz, 1995) whilst increasing the amount of supervised therapy clinicians can give to patients and opening-up the possibility of patients administering their own therapy (with the help of trained carers). The Microworld for Aphasia project attempts to combine computer technology with theoretically-motivated approaches to treatment such as mapping therapy.
References


