Essay

An assessment of the differences in linguistic nature of patients with Broca's and Wernicke's aphasia

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Abstract

Aphasia is a disorder of language and speech caused by a brain lesion. After the lesion, usually caused by an accident or stroke, the patient typically has some residual language left, indicating that knowledge of language can be selectively impaired by the location of the lesion. The linguistic properties of words and morphemes lost by aphasics are explored in this assessment, as well as the differences in speech production and comprehension between those who have suffered injury to either Broca's or Wernicke's area.

Keywords: Aphasia; language disorder; linguistic.

Aphasia as an impairment language

Aphasia affects the production or comprehension of speech and the ability to read or write. Caused by injury to the brain, it most commonly occurs after a stroke in older individuals, but brain injuries resulting in aphasia may also arise from head trauma, brain tumours, or infections. It may affect a single aspect of language use, such as the ability to retrieve the names of objects, the ability to put words together into sentences, or being able to read. Aphasia can be as severe as to make communication with the patient almost impossible. More commonly, multiple aspects of communication are impaired, but some channels remain accessible for a limited exchange of information. Goodglass and Kaplan (1983) suggested that subdivisions of aphasia syndrome are

based on language output. Fluent aphasics have normal articulation, rhythm of speech, phoneme selection, sequencing and syntax, but sentences are deficient in meaning. Comprehension is typically poor with fluent aphasics, but variables such as the presence of auditory receptive impairments and of impaired repetition exist, depending on the exact site of lesion (Kaplan and Sadock, 2007). Imaging techniques such as magnetoencephalography (MEG) and functional magnetic resonance imaging (fMRI) provide images of the brain 'at work' and have led to the growth in knowledge about physiological mechanisms underlying language. For example, Posner and Raichle (1994) set participants tasks of increasing complexity and used positron emission tomography (PET) to monitor the way in which blood flow changed in their brains. It was found that hearing a rapid sequence of words, shadowing and association all activated different parts of the brain, but were not exclusive to just one area. This suggests that the brain areas dealing with grammar are not all in Broca's area and areas involving semantics are not all in Wernicke's, and that each of the different components in the language system (phonology, syntax, semantics etc.) consist of subparts which are localised in different parts of the brain (Benson and Zaidel, 1985).

The origins and localisation of aphasia variations

In 1861 a French neurologist, Paul Broca, described a patient who had suffered a stroke leaving him with the ability to say only one word. After the patient's death, Broca studied his brain and discovered a large lesion in the frontal lobe of the left hemisphere. He concluded that this was the area of the brain responsible for controlling the production of speech, which has since come to be known as Broca's area.

Carl Wernicke, a German neurologist, studied a second group of aphasic patients in the 1870s who had considerable difficulty in understanding language. In many cases, such patients appeared to produce language reasonably fluently but close examination revealed they often spoke in a 'garbled' fashion. This pattern of deficit is referred to as Wernicke's aphasia, and occurs when there is damage to another area of the left hemisphere, Wernicke's area.

DOI: https://doi.org/10.5526/esj90

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Patterns of speech impairment following damage to Broca's area

Non-fluent aphasic speech (Broca's aphasia) is slow and laboured with short utterance length (McCaffrey, 2001). The flow of speech is more or less impaired, with the finding and sequencing of articulatory movements and the production of grammatical sequences proving difficult to grasp. Speech is also choppy, interrupted, and awkwardly articulated. According to further research by Goodglass et al. (2001), the speech of the non-fluent aphasic is laborious and there are usually less than three or four words in a breath group. Both comprehension and production of language are affected by non-fluent aphasia, but comprehension appeared to be performed marginally better by patients studied by McCaffey (2001). These results were to be expected; similar to learning a foreign language, it is easier to understand another speaker by inferring key words than to produce comprehensible sentences yourself. The speech of a Broca's aphasic is telegraphic, meaning that articles, conjunctions, pre-positions, auxiliary verbs, pronouns and morphological inflections (e.g. plurals, past tense) are omitted. In addition, output may also be restricted to noun-verb combinations.

Only the most basic and overlearned grammatical forms are produced (often limited to nouns and verbs) showing how syntax and morphology are affected. Speech is laboured and slow, melodic contour is flat. Articulatory agility is impaired and potential problems include simplification of consonant clusters (e.g. t/st, p/spl) and distortion of consonants. Patients frequently have low frustration tolerance as they are aware of errors and occasionally respond to them with distraught reactions. Studies on other languages led to the general conclusion that agrammatics respect the word structure properties of their native language, the categorical features of bound morphemes, and inflectional paradigms.

Sentences Broca's aphasics produce in spontaneous speech are characterised by their simplicity or reduced syntactic complexity. These sentences are often incomplete, with functional elements (including grammatical inflections) being omitted. These problems usually occur in writing as well, whereas sentence comprehension is said to be more or less unaffected (Radford, 2009). When Broca's patients attempt to produce simple English sentences (italicised words in examples are those omitted) such as, 'He *'s* going *on the* bus', the head tense position of a tense phrase (a linguistic phrase with a subject: doer, and a predicate: action) is left empty instead of being filled with auxiliary *is*, and the determiner *the* is omitted from the head position of the target determiner

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phrase *the bus*, the preposition *on* is omitted from the target prepositional phrase *on the bus.* '*I* only passed my test *in the* afternoon', shows how determiner *the* is omitted from the target prepositional phrase *in the* afternoon. We can paraphrase the deviant or simplified utterances produced by Broca's aphasics as using normal English sentences which differ only minimally from the actual realisations. In all cases, the realisations are less complex than the target reconstructions, and omissions and simplifications typically affect functional projections.

Research in linguistics has shown that Broca's aphasics have problems in comprehending functional categories as well as in producing them. Sentence comprehension in Broca's aphasia can be studied only through structured experiments. Aphasiologists (Heilman and Scholes, 1976) have adapted various psycholinguistic techniques, such as linguistic judgement tasks, lexical decision experiments and reaction time techniques in order to assess knowledge of grammar.

The sentences, (a) The man showed her baby the pictures, and (b) The man showed her the baby pictures, were used. Two further pictures (both incorrect) were included to test for lexical comprehension, examples being pictures for sentences such as (c) The man showed her girls the hats, and (d) The man showed her the girl's hats.

The results of this experiment demonstrated that agrammatics made few lexical errors; for instance, they hardly ever chose pictures appropriate to (c) and (d) when the sentence presented was (a), but in nearly half of the trials they picked the comprehension pictures when asked to choose the picture appropriate for (b). The agrammatic patients appeared to treat (a) and (b) as ambiguous, an interpretation which is consistent with them failing to process the definite article *the* and thus treating both sentences as if they were 'The man showed her baby pictures'. Given that the comprehension disorder found in this experiment is parallel to the syntactic errors that occur in agrammatic production (in that both involve errors with function words) we may conclude that agrammatism is a fundamental disorder of the linguistic representational system (i.e. the grammar), rather than a peripheral impairment to one specific modality only.

Patterns of speech impairment following damage to Wernicke's area

Wernicke's aphasics can exhibit dissociation between the sounds of sight words and their meanings. Although the form of language may be relatively unimpaired, speech may be essentially

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meaningless in the most severe cases. Fitzgerald (1997) found that repetition and augmentation (adding words due to auditory comprehension deficits) are common and patients may use paraphasias (less than half of the utterance is correct), which could be due to problems with word finding. A phenomenon called press of speech also characterises Wernicke's aphasics, patients speak rapidly and interrupt others for sense of closure as they communicated what they intended (Goodglass and Kaplan, 1983). Unlike Broca's, Wernicke's aphasics tend to have a lack of awareness of their communication problems (David, 1983). This lack of concern possibly indicates the more severe cognitive problems that give Wernicke's patients a worse prognosis than Broca's.

In regards to how paraphasia patients produce errors when using content words, performance of Wernicke's aphasics on content words is affected by the frequency of the word in the vocabulary: infrequent words take longer to retrieve and are more often inaccurately retrieved than frequent words (Rosch, 1975; Rosch et al., 1976). Secondly, and more importantly, the typical error patterns that occur in paraphasias can be explained in terms of the structures which characterise the mental lexicon.

In object-naming experiments by Rosch (1975; 1976), subjects were presented with a picture of an object, and asked to name it. For example, when a target picture of a shark was shown, subresponses from the participants included fish, trout, guitar and rainbow trout. Fish and Trout represent the common types; it is possible for patients to distinguish between categorisation in taxonomies: superordinate (fish, musical instrument, fruit etc.) and the subordinate level (rainbow trout, great white shark, bass guitar). These notions, as well as being significant in understanding acquisition of words, have proved important in the study of how visually presented objects are categorised by normal adult subjects. Such subjects typically categorise an object, e.g. by naming it, at the basic object level, despite the fact that logically it could be categorised as a variety of other levels. In object naming experiments with Wernicke's aphasics by contrast, the subjects' typical naming response to the picture of a shark is either the superordinate level term or a prototypical element from a basic set (trout). Wild paraphasic misnaming such as guitar occurs only in severely impaired subjects, rainbow trout is pretty much a non-existent response.

When tested with a target word of chair, the subjects' choices were chair, stair, table and apple. The role of phonetic and semantic similarity in aphasics' perception of category names had been tested. Aphasics were asked to match a picture of an object from a set of multiple choice pictures to a test

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word presented orally by the experimenter. When the aphasics produced errors in this experiment, it was typically an error of type (table), i.e. an exchange based on the semantic similarity between the test word (chair) and name of depicted object (table) – in this case, co-hyponyms. Errors such as stair are based on phonological similarity, specifically on rhyme. These were much less frequent, and wild paraphasias, such as apple, were produced only by severely impaired subjects.

These findings indicate that the meanings of words and their associative links in the mental lexicon are accessible to Wernicke's aphasics, and that only in severe cases of vocabulary deficit the associative processes begin to break down. Effects that have been found in content word paraphasias from aphasics include frequency effects, which show that low frequency content words yield more paraphasias than high frequency words. Categorisation level effects involve hyponym exchanges (sparrow – owl), the use of superordinates (sparrow – bird), similarity effects, semantic exchanges (hair – comb), and pragmatic exchanges such as flower – visit, those which are associated in everyday life.

Conclusions

From the results of mentioned experiments, we can see how patients with Broca's aphasia typically have difficulty with function words, while patients with Wernicke's aphasia may have problems with content. Function words are those such as prepositions (of, at), pronouns (he, anybody), determiners (the, that), conjunctions (and, when), auxiliary verbs (have, do) and particles (no, as). Content words are classified as nouns (room, answer), adjectives (happy, new), full verbs (search, have) and adverbs (completely, enough). Damage to Broca's area often leads to agrammatic or telegraphic speech where most of the function words have gone missing. Those with Wernicke's aphasia may speak in long sentences that have no meaning, add unnecessary words and even create made up words. There is typically better recovery of language in Broca's area than any other and more research is being conducted every day to further define the patterns of impairment and improve upon the quality of therapy to aid patients to recover.

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