WHAT CAN A THEORY OF NORMAL SPEAKING CONTRIBUTE TO AAC?

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Theoretical models and issues

ABSTRACT
Our ability to speak depends entirely on the fluent cooperation among various processing components (for conceptual preparation, grammatical encoding, phonological encoding, articulation and self-monitoring). When a component breaks down, the whole system is in jeopardy and compensatory action may be required. I will sketch the organization of the normal speech generating system, component by component and mention some of the breakdown patterns. I will then discuss natural compensation in Broca patients and derive from it two principles of intervention. Finally I will discuss iconic and spelling systems from the point of view of these principles.

THE ARCHITECTURE OF NORMAL SPEECH GENERATION

The generation of fluent speech involves the cooperation of several specialized processing components, as reviewed in [1]. A first component deals with *conceptual preparation*. The speaker conceives of some communicative intention and will prepare an utterance that will hopefully make the intention recognizable by the interlocutor. In order to achieve this, the speaker will decide on *what* information to express given the estimated state of knowledge of the partner in speech. And the information is to be shaped in terms of *lexical concepts*, i.e., concepts for which there are words in the language. The product of conceptual preparation is called a *message,* which consists of lexical concepts. In *grammatical encoding* the speaker retrieves lexical items that can appropriately express these concepts, and these items are combined to produce a morpho-syntactic pattern. In *phonological encoding* the phonology of each lexical item (its segments, its metrical structure) is retrieved and used to compute the syllabic pattern of the utterance as a whole, with its prosody and intonation. In *phonetic encoding,* the articulatory gesture of each syllable is retrieved from a mental syllabary. In *articulation,* finally, these syllabic gestures are performed by the articulatory apparatus. Each component has its own processing resources, which makes it possible that they can function in a modular, automatic fashion and in parallel. The speaker's attention is largely spent on conceptual preparation; all the rest "comes for free".

Each component's functioning depends on specific neural substrates in the brain. Damage to these substrates will result in specific breakdown patterns, such as Broca's aphasia, anomia, dysarthria, etc. And when there is breakdown, the whole system is in jeopardy and compensatory action may be required. Is it possible to formulate any general principles of compensation?

NATURAL COMPENSATION IN BROCA'S APHASIA

Such principles may be at work in natural adaptations of patients to their defects. A well-studied case is the adaptation of Broca patients to their speech generating trouble. The Broca patient has special problems with the construction of morpho-syntactic structures. This is not due to a lack of syntactic knowledge, but to the relatively fast disintegration of syntactic patterns after they have been formed. There is not sufficient syntactic "span" for them to construct patterns of any larger size. Kolk and Heeschen [2] have shown that Broca patients usually adapt to that problem by a compensatory strategy. They resort to their elliptical register, a communicative register that we all share and that can serve to shorten and speed up communication. In order to use that register, one must produce *mini-messages* to express one's intentions. These mini-messages require very little syntactic span in grammatical encoding, and the result is often a well-formed elliptical utterance. This is an *option* for Broca patients. It depends on the task and the instruction whether they use this strategy of adaptation or not.

This compensatory strategy has two properties that can be formulated as (admittedly tentative) principles of intervention. The first principle is *Compensate as close as possible to the level of defect* (the patient's defect is at the level of grammatical encoding, and the compensation is "one step up", in the choice of register). The second principle is *Make maximal use of the intact system* (the patient makes use of an already existent register).

PRINCIPLES OF INTERVENTION AND AAC TECHNIQUES

The first principle, *Compensate as close as possible to the level of defect*, is often met in artificial intervention, for instance when an artificial larynx is used after laryngectomy. But there is a gray area that needs further scrutiny. There are patients with a primary motor impairment whose speech generating system is only locally damaged. They are the cases where it is largely or exclusively the articulatory component that is impaired. What happens linguistically and psychologically when such a patient is given an icon-based system such as MINSPEAK™?

It will be shown that, if this is done at all, it violates the first principle. Icon systems compensate at the level of conceptual preparation. Like is the case for a beginning second language learner, the user can only express a limited set of lexical concepts, namely those for which there exists an icon code. This is the *problem of semantic restriction*. Like a beginning second language user, the user will have a shrunken discourse world, and avoid to communicate about issues for which he has no vocabulary. One solution here would be to expand the vocabulary, just as a more proficient bilingual has done. Some icon systems, such as MINSPEAK™, allow for flexible extensions of their vocabulary. In MINSPEAK™ [3] this is achieved by what is called *semantic compaction*, a system of coding that is claimed to be based on the natural polysemy and metaphoric potential of word meanings. This should facilitate the construction and acquisition of new codes. But there is no way around the *encoding problem*. Whatever the codes, they have to be learned and that is a time consuming and tedious procedure.

This case is compared to providing the same patient with some sophisticated spelling system. Here the situation is not comparable to that of a second language learner. As long as the patient can spell any word, each and every lexical concept can be expressed. There is no problem of semantic restriction and no encoding problem. Providing this patient with a spelling system fully adheres to the first principle; phonetic output is replaced by spelled output.

Why would one consider using MINSPEAK™ in such a case? That has to do with a third problem, the *rate problem*. Spelling systems tend to be slow and MINSPEAK™ is claimed to be twice as fast or more. Certain types of communication, such as shopping, don't function if the rate is too low.

The second principle, *Make maximal use of the intact system*, will help our speller (but probably also the MINSPEAK™ user) to some extent. Like the Broca patient, the speller will spontaneously change register and use this intact system to generate mini-messages. This will shrink his output drastically.

What intact system can the MINSPEAK™ user employ to deal with *his* problem, the huge encoding problem? Here I will plead for a much freer use of mnemonics. I will argue that MINSPEAK™ is not the linguistic-semantic system it purports to be, but a potentially much richer system of mnemonic tricks - nothing to be ashamed about.

Finally, I suggest that there may be ways of using the speller's intact syllabary or his intact speech comprehension system to facilitate lexical choices. This may, in particular, work when the vocabulary is fairly small. And I plead for the use of hybrid systems that are iconic (and relatively fast) when the domain of discourse is restricted (like in shopping), but spelling-based when discourse is semantically unrestricted and rate-tolerant (like in letter writing).

REFERENCES

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[3] Baker, B.R. (1986). Using images to generate speech. *Byte*, 160-168.