Language and thought: **Does grammar makes us smart?**

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Many philosophers and psychologists believe that only people with rich language skills are capable of abstract reasoning. A man with a severe linguistic impairment poses a striking challenge to this view.

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There is an obvious relationship between being able to think and being able to talk. As Darwin noted [1], it could hardly be an accident that the animal with the most powerful reasoning ability is also the animal with the richest system of communication. And many philosophers and psychologists suggest that knowing a natural language such as English or Chinese is essential for complicated reasoning [2,3] — because such reasoning requires access to the sort of representational system that can only be provided though learning a natural language.

One way to explore this view is to study someone who has lost his language. Varley and Siegal [4] recently published in *Current Biology* a fascinating case-study of such an individual. As a result of a bacterial infection, S.A. developed a large lesion in his left hemisphere. This left him with a severe motor speech disorder (apraxia), as well as a severe language disorder (aphasia). Several tests show that S.A.'s language is severely impaired. His performance on sentence comprehension, both spoken and written, is at the chance level; he cannot comprehend verbs; and he cannot judge the grammaticality of sentences. But he has not lost the desire or ability to communicate. Because of the poor intelligibility of his speech, he prefers to express himself through writing. His written messages consist mostly of nouns, adjectives, and adverbs — verbs are absent. S.A. does not produce sentences; instead he strings together words in a random fashion. For instance, he might describe a scene as 'man the blue a orange' or 'woman a radio'. While many patients who are diagnosed as 'agrammatic aphasics' retain some residual grammatical capacities, S.A. has entirely lost this aspect of language.

What about the rest of S.A.'s mental life? When tested on the Wisconsin Card Sorting Task, a task that involves 'executive function', he scores in the top 10% of a normal sample matched for age and education. When tested on the WAIS Picture Arrangement Test, a standard test of non-verbal intelligence that involves arranging a series of cards to tell a sensible story, his performance was also better than normal. A third task probed his understanding of causal relationships — he had to pick out the likely cause of an event, understanding, for instance, that an alcoholic drink is likely to cause an automobile accident, while an axe and a helicopter are not. He was perfect at this task.

The most interesting result concerns S.A.'s ability to understand the mental states of other people. This is an aspect of social cognition, sometimes called 'theory of mind'. The particular task used by Varley and Siegal requires an understanding of false beliefs. To answer the questions correctly, S.A. needed to appreciate both a true state of affairs — for instance, that a pill bottle actually contains buttons — as well as a false mental state of another person — for instance, that the person believes that the pill bottle contains pills. Such a task poses serious problems for children under the age of four, and is also impaired in older individuals who suffer from autism [5]. S.A.'s performance, in contrast, was virtually perfect.

Despite his agrammatism, then, S.A. was able to reason in a sophisticated manner about the physical and social world. Varley and Siegal [4] note that this is consistent with 'modular' theories of language and cognition which propose that the neural and computational structures implicated in grammar are distinct from those involved in non-linguistic thought. Their results further suggest that the computational system necessary for understanding and computing social and causal relations is not derived from a learned natural language such as English, but instead exists as a universal 'mentalese' or 'language of thought' [6]. More generally, S.A.'s intact capacities are a challenge to the view that language is necessary for abstract thought.

This is not the first case-study of this type, of course. There have always been unfortunate individuals who lack language, through brain damage or through social deprivation. (In many cases, these were deaf children who were raised in a speaking community, and never provided with access to sign language.) The mental lives of such individuals have long been a matter of debate by scholars interested in the relationship between language and thought. In the 1800s, William James maintained that at least some of the language-less deaf were capable of 'abstract thought of a decidedly subtle kind, both scientific and moral'. But other commentators, including many contemporary scholars, argue that severe retardation will inevitably occur in such cases (see [7] for review). The evidence here is murky, mostly because what we know about these individuals tends to be anecdotal. Varley and Siegal's

study [4] is unusual in its careful empirical testing of the domains of both language and cognition.

Some objections to Varley and Siegal's conclusions come to mind. Perhaps S.A. still retained English — perhaps he was still able to *think* in English — but was unable to exploit this internal language in the course of production and comprehension. To put it differently, perhaps his problems have to do with linguistic performance, not with linguistic competence. This is conceivable, but not very plausible, given that his impairment was reflected in so many different ways, in production and comprehension, in speech and in writing.

Another reply is to concede that, although you do not need to currently know English in order to reason about the mental states of other people, you do need to have *once* known English. More generally, perhaps the learning of a language leads to the formation of certain cognitive abilities that non-linguistic creatures could not possess — but once language has been learned, it is no longer needed; just as one could throw out the blueprints once a building has been erected. Data from an adult such as S.A. cannot directly bear on this hypothesis, and Varley and Siegal [4] are appropriately careful to note that their conclusions apply only to '*mature* brain functioning'. What one would want to know, then, is whether an adult who had never learned language — such as the deaf man discussed by James — could solve the same tasks as S.A. For obvious reasons, such evidence is currently hard to come by (but see [8] for an intriguing exception).

If Varley and Siegal [4] are right, does this mean that grammar and thought have nothing to do with one another? Not at all. For one thing, a powerful communication system could only evolve in the context of a powerful system of non-linguistic thought — an animal would only evolve a recursive and hierarchical grammar, for instance, if it were capable of recursive and hierarchical thought [9]. Every species gets the syntax it deserves. Also, grammar allows for the efficient transmission of information, and hence an individual or group of individuals without grammar will find it difficult to learn from other people about important aspects of the social and physical world. (This is why intellectual deficits often accompany language loss in children, particularly when there is no attempt made to compensate for the child's language loss [7].) Finally, grammar *must* interact with abstract thought, simply because we use grammar to convey our ideas and understand those of others.

Nobody doubts there is some relationship between grammar and thought. The case of S.A. is fascinating because it demonstrates a way in which they are not related. At least in the mature human, abstract reasoning is not dependent on grammar; it is a distinct modular system.

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