

Actions versus objects: The role of the motor system

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Amyotrophic lateral sclerosis (ALS) is a very severe disease that mainly affects the motor system. Recently the focus of public attention thanks to a viral campaign (remember last summer's ALS Ice Bucket Challenge?), ALS leads to progressive paralysis and ultimately death. Among the lesser known symptoms of the disease are cognitive impairments, which may even involve full-blown dementia. One of them is a selective difficulty in understanding and using verbs denoting actions, which these patients find much more challenging to process compared to nouns denoting objects. Scientists hypothesize that the difficulty with this word class depends on the damage to their motor system, which influences the semantic encoding of these words. However, a new study, carried out with the participation of investigators from the International School for Advanced Studies (SISSA) in Trieste, fails to find evidence to support this hypothesis.

"Our idea was to test the performance of ALS patients - and healthy controls - on action-verbs in comparison with nouns denoting objects involved in the same actions as the verbs (e.g., "brush your teeth" and "toothbrush"), rather than nouns denoting any object. And this had not been done before as previous studies had used verbs and objects that were completely unrelated", explains Liuba Papeo, neuroscientist at the CIMEC in Trento and first author of the paper, who started on this research project for her PhD at SISSA.

If the problem with verbs reflected a deterioration of the motor centres, then the tests should also reveal difficulties with the names of objects

that imply some action. "In our tests we found better performance on noun processing compared to verb processing. This suggests that the motor deficits and the difficulty with verbs are two distinct aspects, and that there is no direct causal relationship between the two", says Raffaella Rumiati, the SISSA neuroscientist who coordinated the research.

So what causes the language impairment? "It should be stressed that this type of difficulty is most probably not specific to ALS patients. It may be more pronounced in ALS, but it reflects a general tendency of the healthy population, as do most of the neurological syndromes that involve cognitive function. In practice, verbs are more difficult than nouns", continues Papeo. "Our test results show that there is a connection with 'executive function' - that is, the cognitive function involved, amongst others, in the difficulty of tasks".

Executive function in our brain coordinates and plans the execution of complex actions: in addition to purely motor deficits, ALS patients also experience this type of problem. "Our tests revealed that ALS patients fail to retrieve the logical/functional sequence of motor events that make up a complex, purposeful action". And this is precisely the type of disorder that may underlie the language deficit seen in ALS patients. "We now need further investigations to better understand both the executive dysfunction of ALS patients and the role this function has in the semantic encoding of action [verbs](#)", concludes Rumiati.

"Cognitive research into ALS may have a real clinical impact," explains Papeo. "The cognitive impairments often manifest before the motor deficits and could therefore be helpful for an early diagnosis, so as to improve as far as possible the quality of life of these [patients](#). Then, should research lead to advances in the treatment of this, so far incurable, disease an [early diagnosis](#) could become absolutely critical".

The research is published in the journal *Cortex*.

Provided by International School of Advanced Studies (SISSA)

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