JNNP Online First, published on November 24, 2015 as 10.1136/jnnp-2015-312568

The relationship between Executive Functions and Theory of Mind: a Long and Winding Road

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The term Theory of Mind (ToM) refers to the ability to infer others' mental states, and it has been related to frontal functioning. This brain area is also supposed to support Executive Functions (EF), broadly considered as processes that control and organise cognition and behaviour. Besides depending on closely related brain circuits, both ToM and EF jointly develop during infancy. Also, certain executive processes—such as inhibitory control or cognitive flexibility—are clearly needed to understand what other people might be feeling or thinking.

All of the above has led to the question of independence or mutual dependence between EF and ToM, an issue that has been in the centre of a long, yet inconclusive, debate. From initial studies showing some independence between both functions to later investigations indicating the opposite,[1 2] multiple efforts have been made to clarify the relationship between these processes. The discordancy of reported results could be partly attributed to the fact that most studies neglected to explore important variables, such as the different subdimensions of ToM itself or the differential relationship between ToM and EF, with more general frontal functions such as fluid intelligence.

The relationship between EF and ToM is particularly relevant to clinical pathologies with frontal involvement, in which a dysexcutive syndrome is sometimes accompanied by multiple neuropsychiatric and behavioural symptoms whose origins are still not clearly understood. Bertoux *et al*,[3] address this issue in the context of the behavioural variant of frontotemporal dementia (bvFTD), a neurodegenerative disease characterised by progressive frontal and anterior temporal lobe atrophy that results in deep changes in behaviour and associated personality. Authors used cluster analysis to evaluate data on a large sample of patients with bvFTD, overcoming the limitations of previous studies that mainly used binomial correlation analysis and one-way analysis of variance. Overall, results showed that EF measures—such as the Wisconsin Card Sorting Test (WCST), verbal fluency, many Frontal Assessment Battery (FAB) subcomponents and the Digit Forward and Backward test—were clustered separately from the Faux Pas tests of ToM, arguing in favour of the independence between ToM and EF. These results are in line with those of previous studies investigating the differential relationship between ToM and EF in regards to fluid intelligence performed with bvFTD.[4] It was shown that EF measures strongly depend on fluid intelligence, while the Faux Pas test of ToM exceeds the fluid intelligence loss shown by these patients.

In a second line of exploration, Bertoux performed a post hoc analysis to investigate the relationship between EF and different ToM subcomponents. In this regard, ToM can be understood as a complex construct, in which different subprocesses, dependent on different neural substrates, are involved. As an example, differential deficits have been described in FTD when cognitive and affective ToM are considered[5]—affective ToM deficits are initially demonstrated and cognitive ToM becomes impaired only later as the disease progresses. This second line of analysis indicates a more complex relationship because mixed EF-ToM clusters were evident, in addition to the independent and pure clusters of EF and ToM seen previously. Even though this second analysis was performed with a smaller sample size, it highlights the need to further explore the relationship between EF and different ToM subdimensions.

As mentioned above, the study by Bertoux *et al* overcomes methodological and theoretical limitations of previous investigations. Their findings also provide clear directions to further explore the relationships between ToM and EF in clinical pathologies such as FTD.

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Competing interests None declared.

Provenance and peer review Commissioned; internally peer reviewed.

To cite Roca M. *J Neurol Neurosurg Psychiatry* Published Online First: [*please include* Day Month Year] doi:10.1136/jnnp-2015-312568

Received 27 October 2015
Accepted 3 November 2015

► http://dx.doi.org/10.1136/jnnp-2015-311643

J Neurol Neurosurg Psychiatry 2015;**0**:1. doi:10.1136/jnnp-2015-312568

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