# "I forgot what you thought" : theory of mind abilities in Alzheimer's disease

“Theory of mind” or ToM is a critical aspect of what is called social cognition, a set of neurocognitive processes allowing us to have normal social interactions. Named because humans are assumed to make “theory” on other’s mind, ToM generally refers to our ability to infer others’ thoughts. Since actual mind reading is only possible in fantastic movies or books, ToM is a particularly crucial tool in our social life as it allows us to make very accurate inferences about other’s thoughts, feelings, beliefs or intentions. This is of course tremendously useful on a daily basis: when following a conversation, anticipating others’ actions or reactions, understanding our relatives or being empathetic toward them. In fact, we use this implicit cognitive mechanism so frequently that we don’t even notice it.

Neurosciences and, more specifically, neuropsychology – the science investigating the cognitive functioning and its relationship with the brain – has shown that some developmental disorders such as Autism as well as some neurodegenerative diseases such as Frontotemporal Degeneration could involve ToM difficulties. Recently, some scientists suggested that patients suffering from Alzheimer’s disease (AD) may also present with ToM difficulties. Other scientists did not agree and suggested that this function was intact in AD. In sum, ToM in AD was at a center of a typical debate within the neuroscientific community and data was needed to bring some answers. We were about to bring interesting ones.

What is also typical in neuropsychology research are comparisons and correlations. Both statistical methods are frequently used in the field and indeed incredibly useful to bring results helping to understand how the mind & brain work. However, as any methods, they have limits. In particular, they are not optimal to document complex relationships within a large set of data. My colleagues and I believe that the complex nature of the human mind requires neuroscientists to use the full spectrum of tools available in modern statistics and therefore opted for a different approach. Data mining methods consider all the data available, without any a priori hypothesis. They rely on algorithms identifying complex relationship between the variables – some that cannot be assumed a first sight. We decided to use these methods to investigate ToM in a group of patients with AD. As we wanted our findings to be as accurate as possible, we included a second independent group of patients with AD, as well as a group of patients suffering from Frontotemporal Degeneration – in which ToM deficits are well documented.

Our results were striking. Basically, our study did show that, in contrary to what was observed in Frontotemporal Degeneration (where a direct and independent impairment was observed), ToM abilities in AD were decreased only because other cognitive dysfunctions impacted them negatively. In sum, memory impairments – characteristic of AD – attention dysfunctions and abstraction difficulties drastically influenced ToM performance and therefore negatively impacted the ability of the patients to infer what others could think, feel or believe.

Such results have important consequences. First, they do show that free of hypotheses exploratory data-mining methods could bring critical results helping our understanding of human brain functioning. Data is knowledge, not hypotheses. Such technics should be increasingly used in the near future to understand, describe and predict neurological diseases. Secondly, it shows that although patients with AD do not have a primary ToM deficit, they do have an indirect impairment of this ability, which in turn, negatively impact social interactions. Finally, such results have important implications for the patients and their family as they explain why these patients have trouble to understand others and to adapt themselves to their social circles.

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## Publication

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