Executive Functions and Theory of Mind in Aging

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Social cognition is essential for maintaining relationships throughout life, with Theory of Mind (ToM) as its central component. ToM encompasses both cognitive and affective processes, enabling individuals to decipher concealed social cues and make moral judgments within various social contexts. ToM is a current topic of interest investigated in diverse age-related conditions, such as Mild Cognitive Impairment (MCI), a transitional stage between healthy and pathological aging. Recognizing ToM difficulties is crucial, as they can significantly impact decision-making and social interactions while also serving as valuable indicators for tracking disease progression. However, assessing ToM poses challenges, given the variety of available tests and the ongoing debate about its connection with other cognitive abilities. Existing literature suggests that executive functions (EF) can influence ToM performance, but only a few studies have delved into this aspect deeply. Improving the understanding of the dynamics of ToM, its interaction with age-related changes, and its possible variations in MCI is critical to promoting social well-being and cognitive health in older people.

MCI working memory executive functions social cognition

1. Introduction

Social cognition encompasses a range of skills that are necessary for maintaining harmony in both personal and social connections throughout a lifetime [1][2]. The Theory of Mind (ToM), also known as mentalizing or mindreading, is a fundamental component of social cognition [3]. It involves the ability to comprehend and anticipate behavior by meta-representing one's own and other people's mental states [4].

ToM involves cognitive (referred to as "cold") and emotive (referred to as "hot") sub-processes [5]: Cognitive ToM implicates deducing others' cognitive aspects like beliefs, thoughts, intentions, and motivations, while affective ToM entails understanding their emotions and affective states [6]. These attributes allow to identify cognitive and emotional states in others through concealed social cues like eye-gaze expressions, irony, metaphors, and implied speech meanings [7][8][9]. The growing interest in the study of ToM's skills is due to its relevance for effective social functioning, enabling moral judgments that integrate ToM information with knowledge about the potential consequences of actions or beliefs. This allows people to discern what is right or wrong in a social context [10]by permitting them to manage complex social dynamics [11].

2. Exploring the Debate: ToM Integrity and Age-Related Changes

A debate exists on ToM's association with age [2][12]. Happé and colleagues [13] found that older adults excel in ToM tasks. This superiority in understanding the thoughts and feelings (reported in a unit score) of characters in the provided stories for ToM assessment suggests the potential influence of accumulated life experience [2]. However, recent studies contradict these findings, revealing an age-related ToM decline [12][14][15]. Maylor and colleagues [15] and Sullivan and Ruffman [16] conducted studies that replicated Happé et al.'s research and noted divergent results. The outcomes revealed that ToM performance decreases as individuals grow older, a conclusion that has been further refined with time, detailing poorer performance mainly in the cognitive subcomponent of ToM [17]. These results appear to be in line with evidence of the cognitive decline that occurs with age [18]. Cognitive aging, a natural process of change over the years, can lead to a reduction in specific skills' performance [14]. In particular, skills that rely on previously acquired information (i.e., crystallized abilities) are less impacted by aging compared to abilities that need more mental effort, novelty, and information complexity (i.e., fluid abilities) [19].

Executive Functions (EFs) are defined as control processes responsible for planning, assembling, coordinating, sequencing, and monitoring other cognitive operations. EFs encompass abilities such as inhibition, working memory (WM), and attention, all of which are affected by cognitive aging [20]. These abilities are closely connected to the performance at ToM tasks. Indeed, some studies have shown that a decline in EFs is the underlying cause of reduced ToM ability: while EFs decrease, the underlying ToM skills are preserved. In other words, it has been suggested that EFs appear to be the primary sources of age-related deterioration in ToM [21][22].

In particular, the role of WM (as a component of EFs) has been extensively studied in relation to ToM performance [23][24][25]. WM refers to the process of temporarily retaining or storing information and perceived stimuli for brief periods -typically lasting between 3 and 10 seconds [26]- while also actively manipulating them [27]. WM can be useful for acquiring and expressing ToM knowledge, allowing individuals to hold conflicting perspectives in their minds [23][28][29]. Therefore, it is possible that difficulties in the WM may partially explain their challenges in ToM tasks [30].

3. The Importance of ToM Evaluation in MCI

Social cognition challenges, including those tied to ToM skills, are commonly reported among older individuals, potentially affecting their well-being, social engagement, and feelings of isolation [31]. These issues become more pronounced as aging coincides with the development of neurological and behavioral disorders due to various pathologies, which tend to become more prevalent with advancing age, including conditions like Alzheimer's disease (AD) and Mild Cognitive Impairment (MCI) [32][33].

MCI is a transitional stage between healthy and pathological neurocognitive aging, characterized by a slight, yet measurable, decline in cognitive abilities beyond the expected range for one's age and education [34][35][36].

Although deficits in various cognitive domains can be identified through neuropsychological assessment, they usually do not significantly disrupt daily activities [37][38][39].

Identifying deficits is crucial for categorizing MCI types based on memory and impaired domains [40][41]. MCI's cognitive deficits do not always progress to dementia; efforts focus on monitoring and enhancing well-being and social engagement to mitigate decline. In particular, it has been suggested that participating in social activities is associated with a decreased risk of further cognitive decline among those with MCI [42]. From this perspective, it is evident that difficulties related to the social cognition domain can be associated with pathological development and are worth evaluating. Specifically, assessing ToM ability is important for tracking disease progression [43][44]. However, there is a wide variety of tests currently used to investigate ToM, and this heterogeneity can pose a limitation to the field, potentially leading to ambiguous results: The affective and cognitive aspects are often assessed separately, using different instruments, and not all studies examine both components [45].

Moreover, despite various studies examining ToM challenges in older adults [46] or cognitive disorders, the underlying mechanisms remain debated [9]. It is unclear whether deficits in ToM are linked to other cognitive functions. Thus, the impairment might result from poor performance in other skills like EFs, or these factors may be unrelated. Indeed, while EFs are presumed to impact ToM performance, some findings suggest that impaired ToM can manifest independently of other cognitive difficulties [47][48]. Several results indicate that EFs do not significantly correlate with ToM performance, sparking an ongoing debate that the literature has not addressed sufficiently [6][49][50].

Recently, a new perspective has emerged, shedding light on the potential link between EFs and ToM in the performance of healthy elderly subjects, while revealing a discrepancy in those with MCI. This suggests that, despite the presence of a decline in cognitive performance, the pathology could impact these abilities differently [1].

The debate surrounding ToM and its relationship with other cognitive functions remains complex and ongoing, but improving understanding of the dynamics of ToM, its interaction with age-related changes, and its possible variations in MCI, can exert a substantial influence on the overall welfare of the elderly individuals and it is critical to promoting social well-being and cognitive health in older people.

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