

## METAMEMORY IN ALZHEIMER'S DISEASE

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### ABSTRACT

Alois Alzheimer's first publication describes his patient's inability to be aware of her condition. One hundred years later, whether or not Alzheimer's disease (AD) patients show impaired awareness of their memory deficits is still of debate. This review makes a novel contribution, arguing that the ideal empirical tool to assess this question is the metamemory framework. The fact that the metamemory framework offers models of healthy memory and metamemory function and ready-developed measures mapped onto theoretical constructs, means that it is a useful paradigm to explore the question of memory awareness. The review focuses on two as yet separate approaches: the neuropsychological models of anosognosia as well as the metamemory framework. Metamemory constructs and measures are used to evaluate Alzheimer's patients' awareness of their memory difficulties by relating the main findings to the existing neuropsychological model of anosognosia. With this approach, only very specific deficits in awareness are found: a failure to update self-beliefs, and a deficit in monitoring episodic memory, possibly related to a deficit in effortful, conscious control processes. This review also considers how the exploration of the neural correlates of metamemory can help to draw novel hypotheses on the brain regions implicated in anosognosia in AD.

Key words: metamemory, anosognosia, Alzheimer's disease

*“Bei der Unfähigkeit, eine situation zu begreifen, greift sie jedesmal in lautes Schreien, sobald man eine Untersuchung and ihr vornehmen”* (Alöis Alzheimer, 1907, p. 5) (‘With her inability to understand her situation, she bursts into loud screams each time she is approached to be examined’)

Alöis Alzheimer's (1907) first publication places a strong emphasis on his patient's inability to be aware of her difficulties. This reflective ability, and the lack of it, has been of major interest in psychology since William James (1890/1891). It is referred to as “self-awareness”. In clinical populations, self-awareness is of interest because unaware patients with, for example, head injuries, lack motivation for treatment, and fail to benefit from rehabilitation (Prigatano, 2005).

As with head injury cases, Alzheimer's observation suggests that people with Alzheimer's disease (AD) are unaware of their difficulties and this quite clearly has implications for our understanding of the disease. Interestingly, in the same report, Alzheimer also wrote that the patient “*remarks that she does not understand anything and is at her wit's end*”, showing frustration arising from some facet of awareness and hinting at the complexity of this issue.

A hundred years after this report, whether or not AD patients show impaired awareness of their deficits (in particular, memory) is still of debate (see Cosentino and Stern, 2005; Ekklund-Johnson and Torres, 2005). This review considers impairments of self-awareness on AD. Because

memory represents the major impairment in AD, the main aim of this review is to try to shed some light on awareness of memory dysfunction in AD. In particular, this review focuses on the concept of *metamemory* as one form of memory awareness.

Different terms have been used to refer to awareness of memory abilities or the lack of it, such as *denial of deficits*, *anosognosia*, *unawareness of deficits*, or *metamemory*, leading to apparently contradictory results. The terms, *denial of illness* or *denial of deficit* are encountered frequently, and signify that patients might be “aware” of their deficits but are unwilling to confront them. The frequently used term *anosognosia* (Babinski, 1914) refers to a condition where patients are unaware of a neurological or cognitive impairment, and many articles in the literature on AD focus on the use of this term, literally “a lack of awareness”. Often, the term *metamemory* has been used synonymously with memory awareness in neurological populations to refer to patients' ability to reflect on their memory performance. This has led to a certain level of imprecision in these terms, and a failure to consider the relevant theoretical and empirical constructs related to either memory awareness or “metamemory”.

These terms correspond to different theoretical framework. For example, neuropsychological models of *anosognosia* were developed on the basis of clinical observations to explain disorders of awareness (Agnew and Morris model – Agnew and Morris, 1998; DICE model – McGlynn and Schacter, 1989). Thus, the *anosognosia* literature has been developed with a focus on deficit and

assessing the absence of awareness without reference to normal patterns of self-awareness. On the other hand, the metamemory framework (Nelson and Narens, 1990) has been developed using normal populations and it explains the normal function of awareness and reflective abilities in memory function. Applied to clinical populations, the key focus of the metamemory framework (Nelson and Narens, 1990) is observing patients' ability to estimate their memory proficiency while performing a specific task. This empirical focus, and the fact that the metamemory framework produces models of healthy memory and metamemory function and standard measures mapped onto theoretical constructs, means that it is a useful paradigm to explore the question of memory awareness.

It should, therefore, be able to bring new insight into disorders of memory self-awareness in clinical population and especially in dementia. Furthermore, an understanding of current theories of disorders of self-awareness within the metamemory framework may give rise to a powerful theoretical framework in which to understand both normal and abnormal self awareness. Finally, an additional advantage of the metamemory approach is the ability to converge on the neurological regions implicated in anosognosia, since again, the metamemory framework has been explored in some detail in this regard. Indeed, explorations of various neurological patients and neuroimaging studies using metamemory measures have permitted us to shed some light on the neural correlates involved in awareness of memory.

In AD, one hypothesis, then, is that these patients suffer a deficit in a reflective memory awareness process and this deficit can be termed *anosognosia*. This review makes a novel contribution to this field by reviewing the utility of the existing neuropsychological models of awareness and *anosognosia* in AD (e.g., Agnew and Morris, 1998; McGlynn and Schacter, 1989), with reference to the considerable, but somewhat diffuse, literature on metamemory in AD. In fact, the metamemory approach applied to neuropsychological populations has rarely used these models in designing and interpreting its results. Throughout discussion, metamemory constructs and measures are used to evaluate the idea expressed in Alzheimer's quote; that people with AD are unaware of their deficits, that they are anosognosic. Because the metamemory literature in normal populations provides a means of determining the cognitive processes utilised in predicting or estimating memory performance, a neuropsychological approach to metamemory should increase our understanding of the cognitive processes underlying the anosognosia of memory disorders in AD. This review, then, presents the cognitive neuropsychology of metamemory as applied to AD.

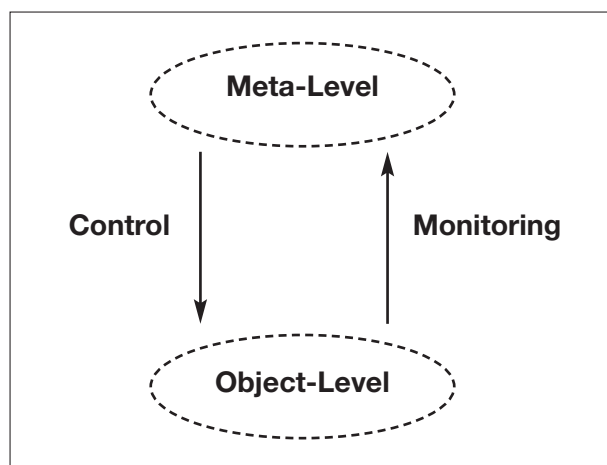


Fig. 1 – Metamemory model. From Nelson and Narens (1990).

The metamemory framework and the neuropsychological models of anosognosia are considered first. Findings from the study of metamemory in AD are presented subsequently. A final section reviews brain regions thought to be related to awareness and memory abilities in AD.

#### THE METAMEMORY FRAMEWORK

Metamemory refers to the higher order cognitive processes involved in memory function, and encapsulates beliefs, attitudes, sensations and knowledge about memory function (e.g., Flavell, 1979). In the context of the framework proposed by Nelson and Narens (1990), metamemory is defined as one's own knowledge and control of memory and consists of two main metamemory processes: *monitoring* and *control*, as illustrated in Figure 1. Monitoring is the collation of information about one's own knowledge and performance, while control refers to the self-regulation process of one's own behaviour. These two processes operate in a feedback loop: through memory monitoring, we can control our memory function. For example, the self-regulation of one's own behavior such as the implementation of memory strategies (*control*) is based on metamemory judgments (*monitoring*) that can be used to estimate the learning level (Nelson, 1996). This conviction has been conceptualized in terms of a causal link between metamemory monitoring and metamemory control: the *monitoring-affects-control hypothesis* (Nelson, 1996). Metamemory is a major construct related to memory. Indeed, proficient memory relies on metamemory (Dunlosky and Connor, 1997; Nelson and Narens, 1990). In other words, proficient memory functioning implies proficient metamemory functioning.

Studies of metamemory typically ask people to predict their memory performance on a task. The accuracy of these predictions, when compared to actual memory performance, forms an indication of

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