

## Analysis of the Mental Images in Episodic Memory with Comparison between the patients with Dementia of Alzheimer Type and Healthy Elderly People

KyungHun, Han<sup>†</sup>

Ernst, Pöppel

München Institute for Medical Psychology Munich University Goethestr

Episodic memory, i.e. memorization of information within a spatiotemporal environment, is affected Alzheimer's disease (AD), but its impairment may also be occurred in the normal aging process. The purpose of this study is to analyze and evaluate memory in with Dementia of Alzheimer Type by examining their cognitive skills in episodic memory using the technique. This new method involves assessing the mental images the subject's own past in the mind like projected and movies. Three patients in the early stage of Dementia of Alzheimer Type, one with mild depression, and 2 healthy controls for comparison were asked to retrieve their episodic memory of the previous day, week, month, and a day testing day. The answers were then analyzed with regards to their specific features as emotional state, color, and time order. In the following day, the subjects were tasked to recall again the images they reproduced in the day's test order to observe of memory. Results showed that all 3 patients failed to arrange the retrieved images in time order and their images of the previous day were unclear in color and were stationary like photographs, even when they reproduced the mental images at much quantity as controls. patients could not remember particular events of yesterday, and only recalled the general occurrences of every day life. These results suggest that in the early stage of Dementia of Alzheimer Type, difficulties in the retrieval of recent episodic memory begin to primarily occur, and qualitative impairment happens earlier than quantitative.

*Keywords : Episodic memory, Autobiographical memory, Alzheimer's disease, The mental image*

---

<sup>†</sup> Corresponding author. Institut für Medizinische Psychologie der Ludwig-Maximilians-Universität München  
Institute for Medical Psychology Munich University Goethestr. 31 / I D-80336 München, Germany,  
Tel: 010-9890-5111, E-mail: franzhan@yahoo.co.kr

## Introduction

As the developed world's population ages, interest in Alzheimer's disease has reached mainstream discourse. Studies regarding AD have progressed accordingly with the aging trend. Despite this, the exact cause of AD still remains a mystery and a definitive cure is not in sight. Detecting AD in the early stage becomes crucial in dealing with and man aging it as well as possible. Its diagnosis in the early stage, however, is not easy, with the only symptom being a mild forgetfulness, common enough in everyday life. While such a symptom may register as a minor annoyance, they rarely cause concern, as it is common enough in normal-aging people.

Numerous studies demonstrate that the decline of episodic memory is a major expression of cognitive impairment in the early stage of AD, and the brain regions known to regulate episodic memory actually coincides with those regions of which activities typically decrease in AD patients. Consequently, discovering the mechanisms of the decline of episodic memory caused by defective brain regions such as in the case of this neuro-degenerative disease is important not only for better elucidating the process of AD but also for that of normal aging. The finding that episodic memory deficits in early stages of AD are widespread is consistent with certain histopathological [1] and morphological evidence that imply some of the earliest brain changes in AD occur in the hippocampus and related structures [2-4]. These regions have been strongly implicated in episodic memory in both lesion [5] and brain imaging studies [4, 6]. Episodic memory (i.e. memory of events within a spatiotemporal frame) is affected in AD, but may also occur in the normal aging process. Episodic memory involves conscious retrieval of information acquired at a particular place and time [7]. Some authors suggest autobiographical memory to be subsumed under episodic memory [8-10]. According to [9], autobiographical memory refers, characteristically, to a person's recollection of past incidents and events, which occurred at a specific time and place. Episodic memory, on the other hand, is a somewhat broader term, encompassing autobiographical memories as well as performance on certain learning

tasks, such as the recall of a word-list. However, the term “autobiographical” and “episodic” are often used interchangeably. [10]’s concept of autobiographical memory retains some features previously associated with episodic memory, but also includes some novel ideas, such as the temporal duration of episodic memory (short) and autobiographical memory (long) and different kinds of recollective experience (i.e., recollection and familiarity in episodic, and feelings of ‘knowing’ in autobiographical memory). In the present study, episodic memory and autobiographical memory are not differentiated, because the definition of episodic memory in the present literature includes both forms of memory.

In the laboratory, episodic memory is typically assessed by having subjects recall and recognize specific information encountered in an experimental setting. Anterograde memory loss appears to be due to defective encoding and storage of new information, which increases sensitivity to pro-active interference and accelerates rates of forgetting [11-13]. Remote memory by contrast has been investigated much less extensively. Although there is no doubt that patients with AD show impairment on a range of remote memory tests including naming and identifying famous faces or famous scenes [14], a number of clinical and theoretical questions concerning the efficacy of these tests on episodic memory remain unanswered.

The first question is how to assess temporal order with these methods. The question of temporal order has been previously studied in patients with alcoholic Korsakoff’s syndrome [15, 16]. The same decline of this particular functional component can be observed in AD patients, as episodic events are by definition related to specific temporal and spatial contexts. In general, the majority of AD patients have well-established remote memory with respect to recent memory. Experimental settings can assess remote episodic memory quantitatively, but it is necessary to evaluate it qualitatively as well, because as mentioned above, remote memory in patients in the early stages of Dementia of Alzheimer Type (DAT) is not impaired in quantity but quality. The final question concerns the identification of famous people itself, as recalling the name of a famous person or object seems to be more of a mechanical

task related to general loss of semantic memory. Also with regard to stimulus or cues, they tend to be more semantic and synthetic in their detection than that of episodic memory, as episodic memory is related to one's personal past and their relative emotions evoked through visual images. A person can recognize that he/she experienced a particular event from a picture or video of the occasion. Introspectively, visual mental images appear to embody spatial and temporal properties of objects and scene. These patterns are activated from episodic memory, not from the eye. Recollective experience is the sense or experience of the self in the past and is induced by images, feelings and other memory details that come to mind during the act of remembering [10]. As mentioned above, an episodic memory is not about encoding and retrieving simple information, but about remembering one's own past event in its integrative detail. In other words, an individual recalls not only an occurred (past) event, but also the particular objects, emotions or feelings, thoughts, and senses related to that event.

In fact, in the clinical setting it is critical to distinguish memory impairment typical of early stage AD from simple forgetfulness or false - dementia caused by depression. In clinical practice, neuropsychological tests and neuro-imaging techniques such as MRI and PET are commonly used to diagnose AD. However, MRI and PET are used to clinically ascertain that patients have no brain infarction or extensive white matter hyperintensities or other types of dementia such as stroke. Brain atrophy observed on the scan imply that the disease is moderated. Neuropsychological tests are useful tools in the diagnosis of AD, but their effectiveness is confounded by the influence of individual variables like education or intelligence, making their implementation somewhat limited for detecting AD in its early stage. There are also difficulties in distinguishing AD from false dementia caused often by depression because the only observable symptom for AD in its early stages is simple memory impairment.

In this study, the test of episodic memory is conducted with early-stage Dementia of Alzheimer Type patients. Through a comparison of the retrieval process of episodic memory in both healthy elderly people and patients with DAT, the current study aims to understand the differences and characteristics of 'normal' and 'impaired'

episodic memory. This study therefore tries also to discover differences and characteristics of the encoding and retrieval process of episodic memory between healthy elderly people and patients with DAT.

As noted, the retrieval of episodic memory is a complex process expressed through various dimensions of psychological behavior such as emotion as well as with diverse types of the images retrieved.

From the clinical perspective, findings from this study will contribute not only to establish better criteria or instruments for an early detection of AD in its early phase, but also towards the understanding of the normal evolution of episodic memory in normal aging. From the research perspective, these results may serve as more comprehensive and rigorous parameters to assess episodic memory in experimental settings.

## Method

### Design

In this study, free recall of one's own past was assessed on each measurement occasion in order to determine their relative importance in identifying persons at early stages of DAT. This study is designed to evaluate the effect and the process of normal and pathological aging on cognitive skills in episodic memory using the technique of introspection. The present study will pay particular attention to observing the mental images of episodic memory, the recall of an event and/or a thing with a mental image. Mental images of episodic memory emerged during retrieving tasks of memories of a day before, a week ago (previous week), a month ago (previous month), and the remote past will each be quantified and compared between groups. The features of the retrieval of episodic memory will be assessed and analyzed by investigating retrieved emotions, the color, and the form of the mental image such as

movie and pictures, the images related to the event, and time order and details of the retrieved images. In the following day, subjects were tasked to recall all the contexts which they recalled in the interview.

## Subjects

In the current study, 6 cases of episodic memory in healthy elderly people and in patients with DAT have been reported and described. One female and two male outpatients in mild stages of Dementia of Alzheimer Type were selected from KyungHee Medical Centre of Oriental Medicine. The diagnosis of probable AD was made by a neurologist on basis of a neurological examination and a neuropsychological assessment in concordance with NINCDS-ADRDA and DSM-IV criteria. In the healthy elderly group, one male and two females were selected, with one of them having light symptoms of mild depression. All subjects were between the ages of 55 and 70. All subjects were administered the neuropsychological tests K-DRS and MMSE-K. All patients were examined by a neurologist and psychiatrist before entry into study and underwent MRI scanning. The test was held at KyungHee University Medical Centre, and all subjects provided informed consent for study participation.

## Procedure

The subjects were informed about the procedure of the test. The experimenter explained how to recall an event with the prepared picture and a short film and what the subjects are asked during the test. Pictures of a wedding, the war, and the birthday party, and a daily photo of no significance and the short film containing the sounds and the movement of a child were shown to explain the mental image of a retrieved event. Both color and black and white photos were shown. The subjects were then asked to retrieve his/her first memory of the previous day and/or week without any cues (free recall), then instructed to record by themselves the entire context of the

interview and were informed that they are asked to retrieve it the following day. An MP3 player recorded verbal response during the test. The experimenter asked them to tell everything that they remember about/in an image according questions, which were designed for measuring diverse categories of memory retrieval (for the question list, see appendix). For example, "Did you smell or hear something?", "How did you feel when you smelled that?" and/or "How were you?" The subjects are then asked to retrieve other memories in the same way. On the following day, subjects were tasked to recall all contexts that they were able to remember in a telephone interview. The content of the response were interpreted by category, time order and number of image, congruence etc. and could be marked for frequency for each category on the prepared table. Questions were constructed toward checking out all elements of episodic memory, and this helped the experimenter for performing the test.

### **Case description**

#### **Case 1: Patient HEC (P-HEC)**

##### Case description

P-HEC was aged 53 years old at time of testing and is a right-handed woman with 12 years of formal education. She is a housewife living with her husband and has two daughters, also living with her. She was referred to our service because of increasing difficulties in calculation, forgetfulness, depression and a mild personality change. There was no history of dementia or neurological disease in the family and the husband mentioned no previous head trauma or psychiatric disorder from alcohol abuse. She was visited by a neurologist a year ago, when she and her husband first suspected she had problems. At that time she was diagnosed as depressed, and was prescribed antidepressants for one year. Despite this she developed memory impairment

that increasingly became more serious. One day she was shocked when she realized that a street she went to everyday was unfamiliar to her. However, she has no difficulty talking to her daughters or keeping house. Only social contacts and activities were reduced after the shock and she is accompanied by her husband every time she goes out.

### Clinical notes

The subject had some difficulty understanding the procedure of the test. Her face expressed perplexity because the questions of the test concerned her own life. She was calm and spoke with a low voice. She was worried and stressed about her disease. However, no neuro-clinical symptoms such as slowing of behavioral or verbal ability were observed.

### Psychopathological assessment

The subject showed symptoms of depression when thinking about her disease. She was anxious for her family, believing she was going to be a burden to them, in particular to her two daughters. Her husband reported that she cried often from fears of onset. Aside from unwillingness to go out and reduced social contact, she did not show substantial changes in personality.

### Case 2: Patient CJC (P-CJC)

#### Case description

P-CJC is a 63 years old right-handed man with 16 years of education. He lives with his wife in a small city in eastern Korea. At the time of the testing he was retired, but up to a couple of years ago he worked as teacher in a high school. He



came to the hospital because of difficulty remembering recent events. He sometimes forgot appointments with colleagues and also had trouble recognizing them. However, his daily life was not yet greatly affected by memory decline. He was able to talk and write, to drive his car and to recognize friends and relatives, and had no problem finding his way around. According to him, there was no history of dementia or neurological disease in his family and his wife mentioned no previous head trauma, psychiatric disorders or alcohol abuse. He seemed to be depressed at the time of testing. His wife mentioned that he became depressed since recognizing his memory problem. In all probability it was caused by several episodes of memory loss.

### Clinical notes

He had no great difficulty understanding questions during intervention. However, the questions had to be repeated many times. He also needed time to answer simple questions. He spoke with notable slowness. He had no other pathological behavior such as slow movement or trembling hands.

### Psychopathological assessment

Since the onset of his symptoms, P-CJC's wife had noted that he had a tendency to become more anxious and depressed compared to his previous self. Also during testing, he became more anxious when he failed or could not respond properly. Deterioration of social activity or changes in attitude was not observed, but his speaking speed slowed.

**Case 3: PatientHGB (P-HGB)**

Case description

Mr. P-HGB was a 69 year-old retired high school teacher attending medical care for Dementia of Alzheimer Type. He lives with his wife in Seoul. He came to the hospital after forgetting an important appointment which he made and couldn't remember making. However, he had no problems recognizing friends and familiar relatives or going to hospital sessions or driving. He still goes out alone without company and never loses his way. Reviewing his clinical history, there was no history of dementia or neurological disease in his family and no head trauma, psychiatric disorder or alcohol abuse. He was very active in therapy, and looked cheerful. A year ago he had a surgical operation for prostatitis.

Clinical notes

The subject had a good understanding of the questions, and gave clear responses. No other pathological behaviors such as slow speech and movement or trembling of hands were observed. He became anxious once he found some difficulties chronologically ordering retrieved events.

Psychopathological assessment

P-HGB's wife said he had no great mood changes since the onset of the disease, considering that he has had problems before retrieving memory events chronologically. No symptoms pertaining to depression or anxiety disorder were observed during the rest, nor was there deterioration of social activity or changes in attitude.

#### **Case 4: Control KYJ (C-KYJ)**

##### Case description

C-KYJ, a 65-year-old right-handed woman with 9 years of formal education, participated in this study as a volunteer. The subject lives with her husband and daughter in one of Korea's major cities, and is a housewife. There was no history of dementia or neurological disease in the family and no previous head injury, psychiatric disorder or alcohol abuse.

##### Clinical notes

At the examination, certain difficulty in understanding and performing the test of episodic memory retrieval was observed. During the test, the subject was inactive, cynical and spoke in a low voice. Her expression was dark and she was inattentive.

##### Psychopathological assessment

She reported that she had a tendency to become more depressive, anxious, irritable and overall apathetic. Her sleeping time increased, and at the same time she saw reductions in speech, social contact and appetite.

#### **Case 5: Control KJM (C-KJM)**

##### Case description

At the time of the test, the subject was a 61-year-old man living with his wife and has two married sons. One of them is living in another city. He had graduated university, and works in the industrial sector. He actively volunteers at his local Catholic

church. In testing he was very active and reacted positively. He does not smoke and is only a social drinker. He was never hospitalized long-term and has never had any kind of operation or any neurological or psychiatric disorder including head injury.

### Clinical notes

During the test the subject did not exhibit any particular clinical symptoms which might be related to mental disease. The tone and speed of his voice and speech were well-adapted. He had a good understating of the procedure of the test. There were no observed symptoms relating to dementia or memory disorder.

### Psychopathological assessment

He was relaxed, and not under stress. He was able to express emotions easily. He wished to maintain his content life and good health. He seemed to be successful overall in coping with stressful situations. He had no problems sleeping. His appetite was normal. His social contacts and other activities were also normal.

### Case 6: Control HKJ (C-HKJ)

#### Case description

The subject is 61 years-old and female. She has been single all of her life and lived alone for a long time. She graduated a French university majoring in architecture. She works as an architect. She volunteered for this research in order to examine her cognitive abilities. She is a non-smoker and does not drink alcohol. She was actively attentive during examination. There were no long-term diseases such as hypertension or diabetes in her clinical history. The subject has never undergone surgical operation or therapy in neurology or psychiatry.

## Clinical notes

This was her first psychological assessment, and she participated actively. She had the best understanding of the procedure out of all the subjects. She expressed her emotions easily and had no difficulties retrieving her own past. No clinical symptoms related to dementia of memory or cognitive ability was observed during the test.

## Psychopathological assessment

Recently, she was stressed by an excessive workload and problems with personal relationships connected to work, but has adapted well in coping with such situations. Also recently, her sleeping time has increased and she began to easily tire. She does not avoid social contact. No symptoms of nervousness, depression or anxiety were observed during the interview.

## Results

### Neuropsychological assessment

Formal neuropsychological tests, namely the Mini-Mental State Examination Korean version (MMSE-K) and a standard dementia test, K-DRS (Korean-Dementia Rating Scale), devised to explore attention, initiation preservation, construction, categorization and memory, were administrated. P-HEC's MMSE-K score was 23 and her K-DRS score was 106. Results of both tests indicated that she has some problems of cognitive ability and that she is a typical dementia patient. P-CJC's MMSE-K score was 24 and K-DRS score was 130. He obtained a very low score in memory and attention of K-DRS, but the other subscales's scores were perfect. P-HGB's MMSE-K score was 29/30 and total KDRS score was 137. These results indicate that P-HGB showed no

sign of general mental impairment or of dementia. Moreover, he obtained high scores in both neuropsychological tests compared to the healthy subjects' scores. C-KYJ was tasked in two formal neuropsychological tests with one test evaluating depression. Her MMSE-K score was 28 and K-DRS score 135. She is at normal levels on both tests. However her attentions score is lower than average. Depression was suspected, leading to the administration of a BDI (Back's Depression Inventory). As expected, her score in BDI was over 17. C-KJM's (MMSE-K 28, K-DRS 140) and C-HKJ's (MMSE-K 29, K-DRS 133) scores of both tests both came out on normal levels. All subcategories of K-DRS were also shown to be normal. There were no pathological results suspecting depression or dementia.

### Episodic memory retrieval

The amount of the retrieved episodic images of the subjects is demonstrated in Fig1-A. P-HEC recalled the episodic image slowly with a long interval between each image. The subject P-CJC used relatively slow speech, but his speed matched controls when he reproduced episodic images from remote memory. P-HGB reacted quickly to memory of yesterday, and had no trouble remembering, but he took more time retrieving remote memory

On the following day after the test, he could not recall all the images he reported on testing day and confused the interview test with the neuropsychological test done previously. The number of the recalled episodic images by controls is reported on Fig.1-B.

P-HEC had no great difficulty in retrieving the episodic events concretely, but she was confused when asked to remember the events in time order and could not reproduce the events coherently or systematically. She also could not recall details of the event which happened a month ago, even though she retrieved the event itself (Tab.1). P-HEC seemed to be suffering from depression as well, expressing anxiety of her disease during the interview. She recalled episodic images in as much quantity as

healthy elderly people. However, her recalled episodic images in her memory of yesterday were like photographs, while controls reported images that were like short movies.

P-CJC could not distinguish between the images of yesterday and some days ago, implying some overlapping. P-CJC seemed tense and unstable when reporting images of yesterday, week and month ago memory, but returned to a comfortable state when remembering his remote past. His quantity of the recalled episodic images for each category is described in Fig.1-A. P-CJC reported that all of his reported images had no colors, and images flashed by like a slide show rather than a moving film. This patient also could not remember particular events of yesterday, only their general occurrence. P-CJC could not arrange the events in order of occurrence or reproduce any concrete emotion at the time (see Tab.1). While recalling an image of a week ago without much trouble, P-HGB realized for himself that the image he was describing happened a month ago. P-HGB could not retrieve the exact place of the event, and he needed a long time to recall the related images between events. As with the other patients, P-HGB recalled the remote memory events well.

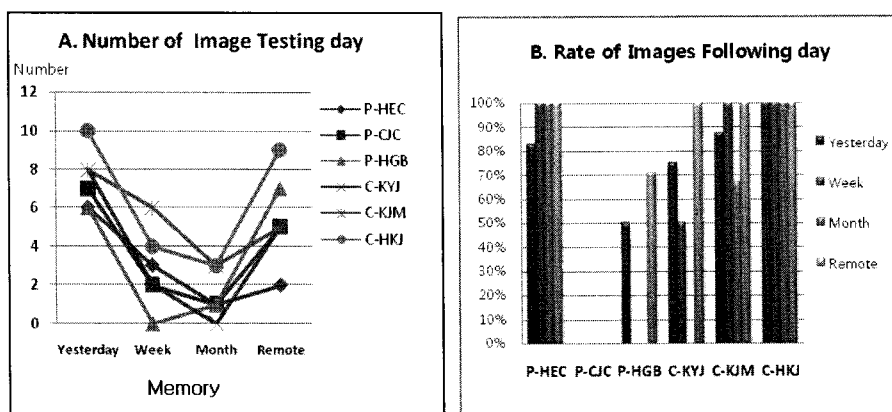


Figure 1. A. Number of the retrieved episodic image on the testing day  
B. Rate of images on following day

Table 1. Analysis of the retrieved episodic memory images

		Emotion	Colorful/ B&W	Moving/ Stationary	Event related	Detail	Time Order
Yester Day	P-HEC	H, F	Color	Stationary	Both	Failed	Failed
	P-CJC	None	Unclear	Stationary	Related	Failed	Failed
	P-HGB	H,D,F	B&W	Moving	Both	Failed	Failed
	C-KYJ	H	Color	Both	Both	Pass	Pass
	C-KJM	F,A	Color	Moving	Both	Pass	Pass
	C-HKJ	H	Color	Moving	Both	Pass	Pass
Week	P-HEC	H, F	Color	Stationary	Related	Pass	Unavailable
	P-CJC	H	B&W	Stationary	Related	Failed	
	P-HGB	-	-	-	-	-	
	C-KYJ	None	Color	Both	Related	Pass	
	C-KJM	H, F	Color	Moving	Both	Pass	
	C-HKJ	H, F	Color	Moving	Related	Pass	
Month	P-HEC	F	Rejected	Rejected	Related	Failed	Unavailable
	P-CJC	None	B&W	Stationary	Related	Failed	
	P-HGB	H	B&W	Stationary	Related	Failed	
	C-KYJ	-	-	-	-	-	
	C-KJM	H	Color	Stationary	Related	Pass	
	C-HKJ	H	Color	Moving	Related	Pass	
Rem ote	P-HEC	S	Color	Moving	Both	Pass	Unavailable
	P-CJC	F, S	Both	Both	Related	Pass	
	P-HGB	H,S,F	Both	Both	Related	Pass	
	C-KYJ	H,S	Both	Both	Related	Pass	
	C-KJM	H, F, Su	Both	Both	Related	Pass	
	C-HKJ	H, F, S	Color	Moving	Related	Pass	

A=Anger, D=Delusion, F=Fear, H=Happiness, S=Sadness, Su=Surprising.

'-' means that subject did not recall any episodic memory image



## General discussion

This study considers the effects of AD vs. normal aging on autobiographical images. In this chapter, three subjects with DAT, one mild depression subject, and two healthy elderly subjects reported autobiographical images, which were further analyzed qualitatively and in detail. The early stage Dementia of Alzheimer Type and depression subjects were compared with the two healthy control subjects in order to determine the neuropsychological mechanisms of episodic memory disruption.

## Emotion

All three patients had deficit of retrieval concerning anterograde memory, such as memory of a week and a month. P-CJC was not emotional when recalling an event that happened a month ago, but he reproduced clear episodic images from retrograde memory of events taken place before the onset of the disease. His emotions were also engaged to the same level as health controls when he re-experienced them. This fact was also identified by diverse studies [17-19]. Interestingly, P-CJC was not emotionalized when they retrieved remote episodic memory, describing the event as if reporting a historic fact. Considering this finding, we can suspect that decline of emotional expression in the early stage of Dementia of Alzheimer Type can bring about impairment in episodic memory.

[20]investigated whether neural systems known to be involved in episodic memory retrieval also subserve retrieval of emotional episodic memory by using functional imaging materials. They identified an anterior temporal pole activation that reflected the psychological association with emotional memory retrieval.

## Color/moving image

The three controls recalled episodic images, and managed to recall the color of each

object in the images. They reported that the images were not like still photographs but moving images. The controls reproduced the episodic images of yesterday, week, month, and remote similarly all in this manner.

However, the forms of the episodic images recalled by the three patients with DAT were more variable. P-HEC clearly recalled the colors in the images, saying her episodic images were like color stills cut off from each other, with the exception of her remote memory images. With P-CJC and P-HGB, retrieved images of memory of yesterday and week were unclear, and looked like faded black-and-white photos. However, P-HGB managed to recall moving images instead of stills. Interestingly, in remote memory retrieval, they would retrieve either colorful moving images or black-and-white images depending on the context of the remote episodic memory. There were several studies concerning autobiographical images and visual images, focusing more on the generation and the maintenance and transformation of the visual images, differently here concentrated on the features of the image [21-25].

### Event related

Generally, healthy elderly controls retrieved everything that happened yesterday, whether the incident was routine or particular. Patients with DAT remembered particular events but not events unrelated to those events. They also could not remember routine events that took place in everyday life.

### Detail

The three patients retrieved some episodic images, but could not recall details of each image. P-HGB could not remember when he went to the dentist, whether it was in the morning or the afternoon. P-HEC could not remember why she went to the farm. P-CJC remembered participating in a meeting, but could not recall the context or attendees of the meeting. The confabulations were also observed in the patients

during the interview test, as in other studies [26, 27].

C-KYJ, who is under mild depression, recalled fewer images compared to healthy elderly subjects, but reproduced exact details of each image. [28] examined the relationship between emotional abuse and autobiographical memory specificity. They provided evidence for an association between emotional abuses and reduced memory specificity. [28] (2005) conducted a study on depressed and distressed subjects. It found that these types of people generally were cynical, apathetic and sometimes irritable. Their problem of memory retention might be more related to attention or concentration than memory loss. [29] (2006) found out that there is no global episodic autobiographical memory impairment in patients with remitted depression.

## Time order

All three patients reported episodic images from memory of yesterday, but could not recall them in time order. Two healthy elderly subjects and a subject with mild depression performed time ordering successfully without any difficulty.

Several previous studies found patients in the early stage of Dementia of Alzheimer Type had impaired time order memory [30-32]. This finding was reinforced in the present study as it too discovered patients in the early stage of Dementia of Alzheimer Type had difficulty arranging retrieved episodic images in order of occurrence. [33] investigated specifically impairment in temporal order memory, and suggested it was caused by direct disconnection between the frontal lobe and hippocampus by disruption of the fornix. Several studies also revealed that the hippocampus is closely related to pathogenesis of AD in the early stage of AD, as well as to episodic memory. [34] indicated in a neuroimaging study that patients with frontal lobe damage have great difficulty remembering the temporal order of events. [16] also previously discovered that the patients of Alzheimer's disease impaired at anterograde temporal context memory are likely the patients of Alcoholic Korsakoff.

The results are also supported by many studies of AD which discovered that

patients in the early stage of AD have impaired anterograde memory. For example, P-HGB recalled and reproduced episodic images of memory of yesterday in as much quantity as healthy elderly controls, as well as performing just as well in neuropsychological tests K-DRS and MMSE-K. Nonetheless he had difficulty recalling events of yesterday in time order. Such outcomes also manifested in a test of retrieving the contents of an interview the following day of a test performance. Healthy elderly subjects retrieved objects or images in time order on the following day, even when not asked to recall in sequence. Although the number of patients with DAT who retrieved memories is inadequate for analysis, those who did retrieve did not do so in time order.

#### Number of images and images in the following day

The most remarkable deficit observed in the early stage of AD is anterograde memory decline, an issue investigated in many studies [14, 32]. In the present study, all three patients with DAT were tasked to recall all episodic images retrieved on testing day on the following day of the interview test. As expected, they did not retrieve them as well as the controls. They were confused by the neuropsychological and interview test. P-HEC recalled the images in as much quantity as the controls, but she did not reproduce them in sequence or in detail. She had to be reminded to remember a significant amount of times. While P-HGB reproduced the images in detail and order, he nevertheless recalled less than P-HEC.

In retrieving remote memory, patients with DAT retrieved and reproduced episodic images at levels close to those of healthy elderly people. The impairment of retrieval of remote memory, encoded before the onset of the disease, has not been observed in the early stage of Dementia of Alzheimer Type in several studies [12, 13, 35]. According to present results however, patients with DAT were observed to not reproduce their remote memories as vividly in emotional quality as their healthy counterparts. Similarly, [36]observed that medial temporal lobe structures play a

significant role in re-experiencing autobiographical memories in the remote past through reporting two cases of amnesic patients with MTL lesions.

In this clinical case reports, practical problems observed and confronted in the actual clinical field provide a different perspective on the problems discussed. For example, P-HEC may be diagnosed as Dementia of Alzheimer Type according to the results of the neuropsychological test, but this patient was not diagnosed with the disease for more than a year. Instead, she was diagnosed and treated for her mild depression. She was able to remember things that happened yesterday as well as healthy controls, and she was only fifty years old. Her memory problems were taken to be light forgetfulness that comes with age. However, her deficit in episodic memory revealed otherwise.

P-HGB's case is the inverse of P-HEC's. This patient performed well in neuropsychological tests. His scores, in fact, were higher than the general score of healthy controls. He could not, however, recall order of occurrence or details in the interview test.

Some subjects recalled insignificant images during the retrieval of remote which were not related to particular events and the images which they had experienced in the past. More precisely, some subjects did not copy reality into the images. Such images might be their illusions and/or fantasy. They reorganized the event in the images in the reproduction and some of them could not distinguish illusion from reality in whatever they projected. Some studies defined this phenomenon or such metamemory as false memory and confabulation [37-43]. [44] investigated illusory memories of elderly people comparing younger adults. They reported that older people were relatively more susceptible to false recall and recognition effect than the young and indicated that elderly people have difficulty recollecting the true information in confusing perceived and imagined experiences. Several studies investigated the false memory effect in comparison between healthy older adults and AD's patients and indicated the patients group had increased susceptibility to false memory [45, 46]. Such findings were also observed in the current experiment. Some patients had great

difficulty maintaining the retrieved images. In the case of HGB, he had to recall the same images again in again to maintain them and became more incoherent and confused over time. We also observed that his images would overlap into each other or into illusory memory. Healthy elderly subjects from time to time also showed signs of this, but they would try to eliminate the false image and were capable of distinguishing between illusion and reality. In the experiment, this fact was verified and evaluated in the 'details' questioning of the subject on the congruence of the event in the retrieved episodic memory, but verification of false memory effect in patients with DAT is generally beyond the scope of this study. Further investigation in the role of illusory memory is crucial towards understanding episodic memory.

In the early stage of AD, the general symptoms of AD such as not being able to recognize family members or one's own street do not occur. Erroneous diagnosis is all too easy in the very early stages of AD. Healthy elderly subjects such as C-KJM and C-HKJ performed the tests without any kind of difficulty or problems. They reproduced retrieved images concretely, in sequence, and with emotion, even when not tasked to do so.

Following the results of this study, evaluating the retrieval ability of episodic memory from the patient's own past will be useful towards making a more accurate diagnosis of Dementia of Alzheimer Type.

#### **Acknowledgements**

We thank Prof. HyunTaek KIM of Department of Psychology at Korea University for valuable assistance, and Prof. WeiWan WHAG and Prof. JongWoo KIM of Department Oriental Neuro-Psychiatry at KyungHee University and KyungHee Medical Centre of Oriental Medicine for data collecting. We also thank all volunteer subjects for their participating.

## References

- [1] Braak, H. & Braak, E. "Demonstration of amyloid deposits and neurofibrillary changes in whole brain sections." *Brain Pathology*, 1-3, 213-216, 1991.
- [2] Fox, N., Harvey, R.J. & Rossor, M.N. "Protein folding, nucleation phenomena and delayed neurodegeneration in Alzheimer's disease." *Reviews in the Neurosciences*, 7-1, 21-28, 1996.
- [3] Fox, N., Warrington, E. K., Stevens, J. M. & Rossor, M. N. "Atrophy of the hippocampal formation in early familial Alzheimer's disease." Longitudinal MRI study of as-risk members of a family with an amyloid precursor protein717Val-Gly mutation. *Annals of the New York Academy of Sciences*, 17-777, 226-232, 1996.
- [4] Laakso, M. P., Soininen, H., Partanen, K., Lehtovirta, M., Hallikainen, M., Hänninen, T., Helkala, E.L., Vainio, P., & Riekkinen, P.J. Sr. "MRI of the hippocampus in Alzheimer's disease: sensitivity, specificity, and analysis of the incorrectly classified subjects." *Neurobiology of Aging*, 19-1, 23-31, 1998.
- [5] Vargha-Khadem F., Gadian, D.G., Watkins, K.E., Connelly, A., Van Paesschen, W., & Mishkin, M. "Differential effects of early hippocampal pathology on episodic and semantic memory." *Science*, 18-277, 376-380, 1997.
- [6] Nyberg, L., McIntosh, A.R., Houle, S., Nissou, L-G. & Tulving, E. "Activation of medial temporal structures during episodic memory retrieval." *Nature*, 380, 715-717, 1996.
- [7] Tulving, E. *Elements of Episodic Memory*. (Oxford University Press, New York, USA, 1983).
- [8] Fink, G.R., Markowitsch, H.J., Reinkemeier, M., Bruckbauer, T., Kessler, J., & Heiss W-D. "Cerebral representation of one's own past; Neural networks involved in autobiographical memory." *Journal of Neuroscience*, 16-13, 4275-4282, 1996.
- [9] Kopelman, M. D., & Kapur, N. "The loss of episodic memories in retrograde

- amnesia: single-case and group studies: Review.” *Philosophical Transactions of the Royal Society of London. Series B, Biological science*, 356, 1409-1421, 2001.
- [10] Conway, M. A. “Sensory-perceptual episodic memory and its context: autobiographical memory.” *Philosophical Transactions of the Royal Society of London. Series B, Biological science*. 356, 1375-1384, 2001.
- [11] Granholm, E. & Butters, N. “Associative encoding and retrieval in Alzheimer's and Huntington's disease.” *Brain and Cognition*, 7-3, 335-47, 1988.
- [12] Larsson, M., Semb, B., Winblad, B., Amberla, K., Wahlund, L.O. & Bäckman, L. “Odor identification in normal aging and early Alzheimer's disease: effect of retrieval support.” *Neuropsychologia*, 13-1, 47-53, 1999.
- [13] Leube, D.T., Erb, M., Grodd, W., Bartels, M., & Kircher, T.T. “Successful episodic memory retrieval of newly learned faces activates a left fronto-parietal network.” *Cognitive Brain Research*, 18(1), 97-101, 2003.
- [14] Greene, J. D., & Hodges, J. R. “Identification of famous faces and famous names in early Alzheimer's disease; Relationship to anterograde episodic memory and general semantic memory.” *Brain*, 119, 111-128, 1996.
- [15] Seltzer, B & Benson, D. F. (1974). “The temporal pattern of retrograde amnesia in Korsakoff's disease.” *Neurology*, 24-6, 527-530, 1974.
- [16] Kopelman, M. D. “Remote and autobiographical memory, temporal context memory and frontal atrophy in Korsakoff and Alzheimer patients.” *Neuropsychologia*, 27-4, 437-460, 1989.
- [17] Hodges, J. R., Salmon, D. P. & Butters, N. “Differential impairment of semantic and episodic memory in Alzheimer's and Huntington's disease: a controlled prospective study.” *Journal of neurology, neurosurgery and psychiatry*, 53, 1089-1095, 1990.
- [18] Graham, D. P., Cully, J. A., Snow, A. L., Massman, P., & Doody, R. “The Alzheimer's Disease Assessment Scale-Cognitive subscale: normative data for older adult controls.” *Alzheimer Disease and Associated Disorders*, 18-4,



236-240, 2004.

- [19] Hargrave, R., Maddock, R. J. & Stone, V. "Impaired recognition of facial expression in Alzheimer's disease." *Journal of Neuropsychiatry and Clinical Neurosciences*, 14-1, 64-71, 2002.
- [20] Dolan, R. J., Lane, R., Chua, P., & Fletcher, P. "Dissociable temporal lobe activations during emotional episodic memory retrieval." *Neuroimage*, 11, 203-209, 2000.
- [21] Cornoldi, C., De Beni, R., & Pra Baldi, A. "Generation and retrieval of general, specific and autobiographical images representing concrete nouns." *Acta Psychologica*. 72, 25-39, 1998.
- [22] Dror, I. E., & Kosslyn, S. M. "Mental imagery and aging." *Psychology and Aging*. 9-1, 90-102, 1994.
- [23] Cocude, M., Charlot, V., & Denis, M. "Latency and duration of visual mental images in normal and depressed subjects." *Journal of Mental Images*, 21, 127-142, 1997.
- [24] De Beni, R., Pazzaglia, F., & Gardini, S. "The generation and maintenance of visual mental images: evidence from image type and aging." *Brain and Cognition*, 63-3, 271-278, 2007.
- [25] Gardini, S., Cornoldi, C., De Beni, R., & Venneri, A. "Left mediotemporal structures mediate the retrieval of episodic autobiographical mental images." *Neuroimage*, 30-2, 645-655, 2006.
- [26] Nedjam, Z., Dalla Barba, G., & Pillon, B. "Confabulation in a patient with fronto-temporal dementia and a patient with Alzheimer's disease." *Cortex*, 36-4, 561-577, 2000.
- [27] Cooper, J. M., Shanks, M. F., & Venneri, A. "Provoked confabulations in Alzheimer's disease." *Neuropsychologia*, 44-10, 1697-1707, 2006.
- [28] Raes, F., Hermans, D., Williams, J. M., & Eelen, P. "Autobiographical memory specificity and emotional abuse." *British Journal of Clinical Psychological Society*, 44, 133-138, 2005.

- [29] Bergouignan, L., Lemogne, C., Vitoli, D., Allilaire, J. F., & Fossati, P. "Global impairment in the controlled access to the episodic autobiographical memory in depression: state or trait marker?" *European Neuropsychopharmacology*, 16, S279-S279, 2006.
- [30] Johnson, D. L., & Kesner R. P. "Comparison of temporal order memory in early and middle stage Alzheimer's disease." *Journal of Clinical and Experimental Neuropsychology*, 19-1, 83-100, 1997.
- [31] Storandt, M., Kaskie, B., & Von Dras, D. D. "Temporal memory for remote events in healthy aging and dementia." *Psychology and Aging*, 13-1, 4-7, 1998.
- [32] Lawlor, B., Blanco, A., & Coen, R. F. "Autobiographical, public remote and anterograde episodic memory impairment in early Alzheimer's disease: Further evidence for fractionation of memory systems." *Neurobiology of Aging*, 25, S118, 2004.
- [33] Yasuno, F., Hirata, M., Takimoto, H., Taniguchi, M., Nakagawa, Y., Ikejiri, Y., Nishikawa, T., Shinozaki, K., Tanabe, H., Sugita, Y. & Takeda, M. "Retrograde temporal order amnesia resulting from damage to the fronix." *Journal of Neurology, Neurosurgery and Psychiatry*, 67, 102-105, 1999.
- [34] Tulving, E., Kapur, S., Markowitsch, H. J., Craik, F. I. M., Habib, R., & Houle, S. "Neuroanatomical correlates of retrieval in episodic memory: Auditory sentence recognition." *Proceedings of the National Academy of Science of the USA*, 91, 2012-2015, 1994.
- [35] Greene, J. D., & Hodges, J. R. "The fractionation of remote memory." Evidence from a longitudinal study of dementia of Alzheimer type. *Brain*, 119-1, 129-142, 1996.
- [36] Steinvorth, S., Levine, B., & Corkin S. "Medial temporal lobe structures are needed to re-experience remote autobiographical memories: evidence from H.M. and W. R." *Neuropsychologia*, 43-4, 479-496, 2005.
- [37] Schacter, D.L., Koutstaal, W., & Norman, K.A. "False memories and aging."

Trends in Cognitive Sciences, 1-6, 229-236, 1997.

- [38] Hyman, Jr., I. E., & Loftus, E. "Errors in autobiographical memory." *Clinical Psychology Review*, 18-8, 933-947, 1998.
- [39] Hyman, Jr., I.E., Gilstrap, L.L., Decker, K., & Wilkinson, C. "Manipulating remember and know judgements of autobiographical memories: An investigation of false memory creation." *Applied Cognitive Psychology*, 12, 371-386, 1998.
- [40] Johnson, M. K., & Raye, C. L. "False memories and confabulation." *Trends in Cognitive Sciences*, 2-4, 137-145, 1998.
- [41] Miller, M. B., & Gazzaniga, M. S. "Creating false memories for visual scenes." *Neuropsychologia*, 36-6, 513-520, 1998.
- [42] Pezdek, K., Blandon-Gitlin, I., & Gabbay, P. "Imagination and memory: Does imaging implausible event lead to false autobiographical memories?" *Psychonomic Bulletin & Review*. 13-5, 764-769, 2006.
- [43] Karpicke, J. D., McCabe, D. P. & Roediger III, H. L. "False memories are not surprising; The subjective experience of an associative memory illusion." *Journal of Memory and Language*, 58, 1065-1079, 2008.
- [44] Norman, K. A., & Schacter, D. L. "False redognition in younger and older adults: exploring the characteristics of illusory memories." *Memory & Cognition*, 25-6, 838-848, 1997.
- [45] Balota, D. A., Cortese, M. J., Duchek, J. M., Adams, D., Roediger III, H. L., McDermott, K.B., & Yerys, B. E. "Veridical and false memories in healthy older Dementia of Alzheimer Typeults and in dementia of the Alzheimer's type." *Cognitive Neuropsychology*, 16-3, 361-384, 1999.
- [46] Waldie, B. D., & Kwong See, S. T. "Remembering words never presented: False memory effects in dementia of the Alzheimer's type." *Aging Neuropsychology & Cognition*, 10-4, 281-297, 2003.

1 차원고접수 : 2009. 2. 25

2 차원고접수 : 2009. 3. 13

최종게재승인 : 2009. 3. 14

요 약

## 알츠하이머성 치매환자와 건강한 노인의 일화기억 이미지 비교 분석

한 경 훈

Ernst, Pöppel

Institute for Medical Psychology, Medical Faculty University of Munich, Germany

공간, 시간적 환경정보를 함께 저장하는 일화기억(episodic memory)은 알츠하이머 병에 의해 손상될 뿐만 아니라 일반 노화과정에서도 손상될 수 있다. 본 연구의 목적은 인지능인 일화기억을 내적회상 기법을 사용하여 평가함으로써 초기 알츠하이머성 치매 환자의 일화기억을 분석하고 평가하는 것이다. 따라서 본 연구에서는 사진이나 동영상처럼 뇌에 투사되는 피시험자 자신의 과거를 직접 회상한 이미지(the mental image)를 분석하는 새로운 방법을 사용하였다. 초기 알츠하이머성 치매환자3명, 경도 우울증 환자 1명, 대조를 위한 건강한 노인 2명에게 검사 당일로부터 하루, 일주일, 한달 전 그리고 원과거(remote)에 있었던 일을 회상하게 하였다. 회상된 이미지 안에서의 감정상태, 이미지의 색, 사건 발생 순서 등의 중점을 두고 피시험자의 응답을 분석하였다. 순행성기억(anterograde memory) 손상을 관찰하고자 피시험자에 그들이 검사 당시 재현한 모든 이미지를 검사 다음날 다시 상기하도록 요구하였다. 3명의 환자군 모두 회상한 이미지들 사건 발생순서에 맞게 정리하는데 실패하였다. 이들은 대조군과 같은 수의 이미지를 회상해 내었지만, 색이 선명하지 않고 사진과 같은 정적인 이미지를 회상하였다. 이러한 결과는 초기 치매환자가 최근기억(recent memory)을 회상 하는데 일차적으로 손상이 있을 시사하며, 또한 의미기억의 양적인 손상보다 질적 손상이 먼저 발생함을 보여주었다.

주제어 : 일화기억, 자서전적 기억, 알츠하이머병

## Appendix

### Questions using in interview

1. What is your first picture for yesterday? Or what kind of pictures do you remember for yesterday? And then?
  2. What is your picture for last week excluding yesterday?
  3. What is your picture for last month excluding yesterday and last week?
  4. What is your first picture for your entire life (childhood, puberty and etc)?
- 
1. Could you tell (explain, describe) me everything about the picture as much as possible?
- 
1. Does your picture have colors or not?
  2. Is your picture moving or stationary?
  3. Are you yourself in the picture or front of the picture?
  4. Is there a specific person or many?
  5. Is there particular object in your picture?
  6. Do you have deep pain?
  7. Do you feel disgusted with this picture?
  8. Are you happy or surprised? Or are you angry, anxious or sad?
  9. Is this picture positive/negative memory for you? Why?
  10. Do you smell, hear, touch or taste something?
  11. How do you feel to this smell, sound, touch and taste accompanying the picture?
  12. Do you have pictures of sexual activity in your memory? (for yesterday, etc)
- 
1. Is the picture front, behind, up, down, left or right of you?
  2. Do you have entire vision?
  3. Is the picture moving like movie or is the picture itself moving?
  4. How many details could you describe in the picture?
- 
1. What are you doing in there?
  2. Do you think why you are there?
  3. Do you remember when?
  4. Do you remember where?
- 
1. Could you tell (describe) me everything about the picture of the day before yesterday that you have described me yesterday as much as possible?