Preface

Dementia is a progressive neurodegenerative disease. Presently, 44.4 million people have developed into such disease in the world, and the number is increasing every year as the aging processing (Department of Economic and Social Affairs Population Division, n.d.). While the diagnosis and treatment of such disease is still in the infant stage, and is the huge challenge of the present society. So many countries recognize the living condition of the dementia people as a significant investigate project, and try their best to develop effective diagnosis and treatment scheme to improve the living condition of the patients. Dementia is a serious loss of cognitive ability in a previously unimpaired person beyond what might be expected from normal aging. Until the end of the nineteenth century, dementia was a much broader clinical concept.

The typical dementia is Alzheimer’s disease (AD), and it also includes other types, such as Lewy body dementia, vascular dementia, frontotemporal dementia, progressive supranuclear palsy, corticobasal degeneration, normal pressure hydrocephalus and Creutzfeldt–Jakob disease. This dysfunction can seriously affect the routine life, such as thought, memory, and logic, and this may also grievously change their personality, mood, and behavior. Because the mechanism and the pathology of dementia are still unclear, there is no effective treatment of Dementia. Therefore, early detection is the only method to erase the suffering of the patients.

AD is characterized by the progressive formation of insoluble amyloid plaques and vascular deposits of amyloid beta peptide in the brain. AD patients suffer from a loss of neurons and synapses in the cerebral cortex and certain sub-cortical regions. Numerous researchers in pathophysiology and molecular neurology have focused on the cause of AD in an effort to identify clinical markers, such as the beta-site amyloid precursor protein-cleaving enzyme 1, which can be used to diagnose AD. However, until recently, there were no medical tests capable of conclusively diagnosing AD pre-mortem. The mini-mental state examination (MMSE), a brief, 30-point questionnaire, as well as the clinical dementia rating (CDR), a five-point numeric scale, are the standard tests used to help the physician determine whether a person suffering from memory impairments has AD. Both of these tests include
simple questions and problems in a number of areas, such as arithmetic, memory and orientation, used to quantify the severity of dementia symptoms. However, the sensitivity of the MMSE test is approximately 80%, and it has very limited use in screening for patients with mild cognitive impairment (MCI), a major risk factor for the development of AD (Bachman, et al., 1993; MacKenzie, Copp, Shaw, & Goodwin, 1996; McGue & Christensen, 2001; Cacho, et al., 2010).

Recent fMRI studies have used spatial attention tasks to study the different neural substrates activated in adults with AD and in normal age-matched adults. These reports found that the most pronounced differences between the two groups were found in the superior parietal lobule (SPL), which was more highly activated in controls, and the frontal and occipitotemporal (OCT) areas, which showed greater activity in AD patients. Differentiating between default networks in AD and normal age-matched adults is another approach and typically uses independent component analysis. A third kind of study uses functional connectivity MRI and focuses on the identification of hubs within the human cerebral cortex, determining the stability of hubs across subject groups and task states and exploring whether the locations of hubs can be correlated with one component of AD pathology.

In the very early stages of AD, altered cognitive symptoms involve mild impairments in learning, memory, or planning. Several researchers use cognitive tasks, including memory tasks, visuospatial tasks, and language tasks, in order to identify differences in cognitive function between AD patients and normal controls. These studies have convincingly demonstrated that it is possible to use cognitive tasks to detect deficits in AD patients during a preclinical period spanning several years. For instance, some researchers have found high levels of pathological lesions in the primary visual areas and certain visual association areas within the occipito-parieto-temporal junction and posterior cingulate cortex in AD patients.

The application of neuroimaging technology to the study of AD has been steadily increasing over the last two decades. To date, the majority of neuroimaging reports that have contributed to the understanding of the pathophysiology and clinical course of AD have utilized structural magnetic resonance imaging (MRI) and positron emission tomography (PET). In addition, functional MRI (fMRI) has been used as a research tool to study AD since 1999. The fMRI studies of AD have focused on two overlapping objectives: understanding the basic biological mechanisms and pathophysiology of AD and developing an effective diagnostic tool or clinical biomarker. The development of biomarkers via fMRI is anticipated to influence the clinical management of AD in three significant ways: differentiating healthy aging from AD, enhancing diagnostic specificity when evaluating a patient with dementia, and monitoring the biological progression of AD for the purposes of drug development and drug testing.
Language is succinctly defined as a “human system of communication that uses arbitrary signals, such as voice sounds, gestures, or written symbols” (“What Is Language?”, n.d.). This system is used to encode and decode information. In the literature on dementia, the presence or absence of language deficits has come to occupy a pivotal position with respect to certain nosological and nosographical issues. Simply using the correct language engenders trust. This is especially true of the language we use when talking about medical issues—particularly AD. Media reports on AD contribute significantly to the public’s awareness and knowledge of the condition. Increasing the general understanding of dementia makes seeking diagnosis or support easier for people with concerns about memory loss. The more that other people understand about their experience, the better the quality of life will be for people living with dementia. Language appears to be affected in the early stages of dementia, but the effect is often seen only in selected areas and with significant individual variability. It would appear that impairments in transcribing dictated information and in the pragmatic use of language can be detected early if sensitive tasks are employed. Performance transcribing dictations may indicate a partial lexical knowledge of written words, suggesting that some features of the words’ specification in the brain’s lexical stores are either absent or inaccessible as a result of brain degeneration.

While the present investigation indicated that some non-invasive cognitive neuroscience technologies can used to prove some available information. For example, via fMRI (functional magnetic resonance imaging) and EEG (Electroencephalogram), alteration of DMN (default mode network) state is connected with Dementia to some degree. Additionally, the behavioral information also can provide evidence for Dementia. All the cues described above can be used as proof of early detection, and healthcare for dementia.

Now, we considered that it is important for diagnosing some mental diseases and healthcare. For example, by using non-invasive fMRI (functional magnetic resonance imaging) and EEG (Electroencephalogram), change of DMN (default mode network) state could be found out and linked to the diagnosis of dementia. On the other hand, by watching the behavioral cognition, abnormal aspect could be considered by the reason of related mental disease. Thus, the early diagnose of mental diseases could be done by using several cognitive neuroscience methods, such as mentioned above, and it is necessary since the data could provide useful advice for healthcare before the arise or at the early state of disease.

Dementia is a serious loss of cognitive ability in a previously unimpaired person beyond what might be expected from normal aging. It may be static, as in the case of a unique global brain injury, or progressive, resulting in long-term decline due to damage or disease in the body. Although dementia is far more common in the geriatric population, it can occur in any stage of adulthood. Similar sets of symptoms
due to organic brain syndromes or dysfunction are given different names when they occur before adulthood. Until the end of the nineteenth century, dementia was a much broader clinical concept.

The diseases that can cause dementia include Alzheimer’s disease, vascular dementia, Lewy body dementia, frontotemporal dementia, Huntington’s disease, and Creutzfeldt-Jakob disease. Doctors have identified other conditions that can cause dementia or dementia-like symptoms, including reactions to medications, metabolic problems and endocrine abnormalities, nutritional deficiencies, infections, poisoning, brain tumors, anoxia or hypoxia, and heart and lung problems.

While there is no cure for dementia, advances have been made toward developing medications that can slow down the process. Cholinesterase inhibitors are often used early in the course of the disease. Cognitive and behavioral interventions may also be appropriate. Educating and providing emotional support to the caregiver are also important. There is some evidence that the regular, moderate consumption of alcohol and a Mediterranean diet may reduce the risk of developing dementia. In addition, a recent study has shown a link between high blood pressure and developing dementia. The studies, published in the *Lancet Neurology Journal* in July 2008, found that medications that lower blood pressure reduced dementia by 13% (Davis, Massman, & Doody, 2003; Kennelly, Lawlor, & Kenny, 2009).

Neurological rehabilitation is often used to reduce physical and cognitive impairments and related disabilities. It has also been shown to increase independence, so patients can participate in daily self-care and other activities to improve their health-related quality of life (QOL). Learning skills after a stroke, a traumatic brain or spinal cord injury or other diseases target the neural networks for movement, sensation, perception, memory, planning, motivation, reward, language, and other aspects of cognition that remain undamaged to compensate for those that were lost.

The rehabilitation of sensory and cognitive functions typically involves retraining neural pathways or training new neural pathways to regain or improve the neurocognitive functioning that has been diminished by disease or traumatic injury.

Speech therapy, occupational therapy and other methods that “exercise” specific brain functions are used. For example, eye-hand coordination exercises may rehabilitate certain motor deficits, while well-structured planning and organizing exercises might help rehabilitate certain frontal lobe “executive functions” following a traumatic blow to the head.

**OBJECTIVE OF THE BOOK**

The purpose of this book is to bring researchers and practitioners together, including engineers, medical doctors, health professionals, and neuroscientists, informat-
ics and computer scientists. They are engaged in dementia from pathological to healthcare in both theoretical advances and applications of information systems, artificial intelligence, signal processing, electronics and other engineering tools in biomedical areas related to cognitive neuroscience and medicine. Thus, researches can contribute to the survey on the disease principle of dementia and make efforts in order to cure patients.

TARGET AUDIENCE

Academicians, researchers, medical personnel, rehabilitation personnel, care personnel, advanced-level students and technology developers will find this book useful in furthering their research exposure to pertinent topics in assisting in furthering their own research efforts in this field.

ORGANIZATION OF THE BOOK

The book is organized into fourteen chapters. A brief description of each of the chapters follows:

Chapter 1 identifies the early diagnosis of Alzheimer’s. The chapter introduced that there is no effective treatment to stop the decline of the cognitive and memory. Only measures we can take are to ease or improve symptoms temporarily. Therefore, it is necessary to diagnosis the disease in the early stage, such as through imaging detection via CT, MRI, PET and MSR, or prediction before the disease (genetic examination). However, literature data have supported the notion that Alzheimer’s disease patients show cognitive reserve abilities to some degree. In the future, research perspectives may focus on the cognitive training paradigms in compensatory and restorative strategies.

Chapter 2 focused on the best practice in treatment is to help them maintain a positive view of their lives and balance their emotions, both personally, in terms of keeping their sense of self, and in social environments, where they have to recognize and interact with others. In this way, good environmental landscape design will have an important role to play in improving their quality of life.

Chapter 3 was to determine nutritional status and its influence on their quality of life in Alzheimer’s disease (AD) patients with Mini Nutritional Assessment (MNA) and anthropometric measurements. Found that nutrient intake among aged individuals with AD was found unbalanced; a statistically significant correlation between energy / nutrient intake and quality of life also was not detected.
Chapter 4 addressed the problem of the early detection of dementia from two points of view: Detection based on unobtrusive paradigms both in lab and home environments (behavioral monitoring, serious games, home based assisted living applications in telemedicine) and detection based on neuroimaging approaches. The chapter also provides information on setting up ecologically valid home labs for dementia related experiments. Consequently, the aim of this chapter is to provide an overview of a complete methodology of how researchers can possibly detect or predict the onset of dementia through the current state-of-the-art, underline open challenges and illustrate future work in the field.

Chapter 5 summarized a review of studies on bilingualism and dementia, supporting the viewpoint that bilinguals have an advantage in delaying dementia compared with monolinguals.

Chapter 6 introduced the tactile stimulation devices, which can be divided into many categories according to qualities, including their geometric properties, temperature, force, and vibration. Also introduced some devices that can be used to guide clinical diagnosis and treatment. These devices can be used to examine a patient’s haptic perception to help the patient’s doctors diagnose their illness.

Chapter 7 summarize the empirical evidence for the rehabilitation of individuals with cognitive disorders by using training tasks to enhance specific cognitive functions to combat against cognitive degradation and transfer the benefits to other widely used domains.

Chapter 8 aims to illustrate the cognitive and neural mechanisms that underlie interactions between touch and emotion.

Chapter 9 aims to summarize previous studies and describe the relationship between visual contrast and inverse effectiveness by behavior, ERP and fMRI experimental methods. By summarizing previous studies, we have determined the direction of future work.

Chapter 10 summarizes the current status of research into intention recognition and gives a brief description of the relationship between emotion and intention. We hope to provide more ideas for optimizing human-computer interactions.

Chapter 11 focused on the time cognition of the dementia. Summarizes numerous research studies on the neural networks involved in explicit timing during the measurement of sub-second and supra-second intervals.

Chapter 12 discusses tactile device scan provide the best rehabilitation program for patients. Presents previous fMRI-compatible stimulation devices, including texture stimulation, shape stimulation, vibrotactile stimulation, etc., which involve the hands, face, ears, legs and other parts of the body. Examine the design of the devices in greater detail. Summarize the characteristics of these devices and create an outlook for future fMRI-compatible devices.
Chapter 13 summarizes current visual system equipment and how this equipment can be used to determine how the visual system functions.

Chapter 14 provides a review of humanoid robots and mind control humanoid robots. Information was obtained mainly from journals and conference proceedings on robotics and mind control technology. We primarily focus on providing an overview of commercially available robots and prototype research-stage humanoid robots in addition to mind control humanoid robot systems. First, a history and overview of the humanoid robot is presented. Then, typical mind control humanoid robot systems are described, including the relevant brain-computer interface and the whole control framework. Finally, the remaining research challenges in the field of humanoid robot safety are summarized.

Qiong Wu  
Okayama University, Japan

Jinglong Wu  
Okayama University, Japan & Beijing Institute of Technology, China

REFERENCES


