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Introduction

The focus of the present study will be the language of patients with Alzheimer’s disease (AD). We know that AD patients have word finding problems. We still do not know enough about their ability to inflect verbs. Previous tests that have been conducted on the subject have been with English speaking patients (see for example Ullmann, Corkin, Coppola, Hickok, Growdon, Koroshetz, and Pinker (1997)). English is a language with relatively simple verbal morphology. There are both regular and irregular verbs in English with one regular type of verbs and several sub-groups of irregular verbs. Due to this simple verbal morphology, could it be that possible problems with verbal morphology will not be evident in English speaking AD patients? The main question in the present study will be whether verb inflection in AD patients can be language dependent, i.e. whether the complexity of the verbal system can have an impact on the processing of verbs or not. In order to find out more about this, two languages with very different verbal morphology were chosen to be compared, namely Russian and Norwegian. The reason why these two languages were chosen is that they both have more complex verbal morphology than English does. Verbal morphology of English and Norwegian differs from each other in the respect that Norwegian is a little more complex than English is: in Norwegian, there is not only one regular verb class, but two. Norwegian has irregular verbs with sub-group, as in English. Russian is a language with a verbal morphological system much more complex than both English and Norwegian, and following Jakobson’s (1948) one stem system, Russian has eleven verb classes. Since both Norwegian and Russian differ from English, they are interesting to use in order to test verbal processing in AD patients. By comparing two languages that are as different as Norwegian and Russian, this can possibly provide new information about the language of patients with AD. There are no previous studies on verb processing in Russian AD patients. In Norwegian, there have been two (Simonsen, Moen, Øksengård, Engedal, 2004; Uri, 1995).

In order to look at the verb inflection in Russian and Norwegian AD patients, two models representing different theoretical approaches within linguistic research have been used as a starting point. These models split on a long-standing debate within linguistic research, which can be referred to as the past-tense debate. Briefly, this debate is based on how we store and process regularly and irregularly inflected verbs. Some researchers believe that there are two mechanisms responsible for the mental grammar and the mental lexicon, respectively. This is referred to as dual-mechanism accounts. In models based on this dual system, the basic distinction is that grammar controls regularly inflected verbs, and the lexicon controls
irregularly inflected verbs. To represent this view, I chose Ullmann’s declarative/procedural model. A more detailed description of this model will be found below. One of the reasons why I chose this model was because the declarative/procedural model has also been used to test language abilities in English-speaking AD patients. This test with its conclusion will also be presented below.

The competing view to the dual mechanism account is what is referred to as single-mechanism accounts. Within this view, it is believed that grammar and lexicon are controlled by the same mechanism, that there is no clear-cut distinction between the two. To represent this view, I chose Bybee’s network model. The reason why I chose this model was to have another model that predicted different results of the AD patients than the declarative/procedural model. Since a test which used the declarative/procedural model as a starting point in testing language abilities in AD patients will be described, another test in the “other end of the scale” will also be described. This test also tested language abilities in AD patients, and was performed by Bates, Harris, Marchman, Wulfeck, & Kritchkevsky (1995).

I will not go too deep into earlier discussion about the topic, but focus on the two models, the declarative/procedural model and the network model, and the main parts in these as I see they are relevant to the present study.

The fact that we know AD patients have problems with lexical access is the base for the declarative/procedural model, as well as on a dual mechanism approach to the processing of regular and irregular verbs. In this model, Ullmann assumes that the same mechanism that controls the lexicon also controls the irregular verbs, and regular verbs are controlled by another memory system not affected by the disease. Based on this distinction it is expected that the AD patients that are tested in the present study will have more problems with irregular verbs than regular. The background for this assumption is that these verb classes are controlled by two distinct mechanisms and that AD starts in the area of the brain that controls irregular verbs.

On the other hand, based on the network model presuppose that those verbs that belong to a high type frequency class are easier to process than those that belong to a low type frequency class. Token frequency also matters for whether a verb is easy to process or not, especially for irregular verbs.

In order to better understand the replies of the informants that participated in the present study, the first chapter is dedicated to Alzheimer’s disease; what is happening to the brain when someone has AD, changes of personality in AD patients, the cause of AD, and their language abilities.
In chapter two, the declarative/procedural model will be described. A test performed to measure the language abilities in AD patients with the declarative/procedural model as a starting point will also be described. As a single-mechanism model, I will present the most important aspects for the present study of Bybee’s network model. Following this will be a presentation of another test performed to find out more about language abilities in AD patients, as an alternative to the test results from the test based on the declarative/procedural model.

In chapter three, I will briefly describe the Russian and the Norwegian verbal systems. My selection describes the aspects of the verbal systems that are important for the analysis of the data collected in the present study. Without these limitations, the whole paper could be about verbs. The first section will describe the Norwegian verbal system, and the second section will describe the Russian verbal system.

In chapter four, I present the method and material used in the present study. First, the Russian test and test material will be described, followed by a description of the Norwegian test and test material. The informants that participated in the present study will also be presented here. I will describe them in the same manner as the tests and test material: first, the Russian informants, and then the Norwegian informants. There are four groups of informants: Russian and Norwegian AD patients, and Russian and Norwegian control groups. The Norwegian control group is for the Norwegian nonce verbs.

Chapter five is dedicated to the results of the present study. The chapter consists of three main sections each with under-sections. The first part is concerned with the Russian test results. Furthermore, it is concerned with the error types to be found in the Russian test material, as well as the results from the Russian AD patients and the Russian control group. The next section is built up in the same way as the first section, but this section describes the Norwegian test results, both from the AD patients and the control group, as well as error types one can find in the Norwegian test material. The third section of chapter five is about correlation of the results of the mini mental state examination (MMSE) and the test results from the present study in both the Russian and the Norwegian AD patients.

In chapter six, the test results are analyzed according to the two competing models that were presented in chapter two. First, the Russian and Norwegian test result are analyzed according to the declarative/procedural model, preceded by an analysis if the results from the two languages according to the network model.

In chapter seven I will sum up what has been found in the present study and what it can tell us about language abilities in patients with AD. I will also make a conclusion based
on how the declarative/procedural model and the network model are able to account for the results.

To sum up thus far, the main goals of the present study are to find out if:

1) verb inflection in AD patients is language dependent
2) AD patients inflect verbs using other strategies than normal controls
3) AD patients have more problems with irregular verbs, or if
4) AD patients have more problems with low type frequency verbs
1.0 Alzheimer’s disease

This chapter consists of six parts. The first section is a presentation about Alzheimer’s disease in general. The second section is about changes in personality in AD patients. Following this is a section about how one can diagnose Alzheimer’s disease. One of the tests described in this section was used on both the Norwegian and Russian Alzheimer’s patients that participated in the present study. Possible explanation for what causes Alzheimer’s disease will also be presented. The last section of this chapter is describing language abilities in patients with Alzheimer’s disease; both preserved and non-preserved language abilities.

1.1 What is Alzheimer?

Dementia is a generic term for different diseases that cause cell death in the brain. One type of dementia is Alzheimer’s disease (AD). The first to describe this disease was the German neurologist Alois Alzheimer, and he did this in 1901. (Engedal & Haugen, 2005). AD is a progressive neurodegenerative disorder with cognitive, behavioral, and functional abnormalities (Cummings, 2003:57). AD is the most widespread dementia. At least 65 % of cases with senile dementia are due to AD (Terry & Katzman, 1992; Evans et al., 1989; Katzman, 1976; U.S. Congress Office of Technology Assessment, 1987, referred to in Parks, Zec, &Wilson, 1993:3), and this makes this type of cognitive deterioration one of the most common cortical dementias. Cortical dementia means that the cellular changes are primarily in the cortical areas of the brain (Obler & Gjerlow, 1999:91). Among the symptoms of cortical dementia are reduced memory, problems with language and reduced spatial understanding (Engedal & Haugen, 2005:20). AD is caused by neuritic plaques that lead to damage of the nerve cells in the brain. The most severe cortical damages are in the temporal lobe and in the parietal lobe (Engedal & Haugen, 2005:64). One can only be sure whether a person had AD by performing an autopsy; therefore, it is common to refer to patients with the diagnosis AD as probable AD.

AD is commonly divided into two main groups; AD with an early start, and AD with a late start. Early is here counted as before 65 years old, and late after the age of 65. If a person gets AD before the age of 65, the symptoms will usually be more dominant and severe, and the disease will develop faster than with a later debut (Engedal & Haugen, 2005:63). A variety of tests shows that the earlier you get AD, the more severe the language problems seem to be (Seltzer & Sherwin, 1983, referred to in Pekkala, 2004:10). However, recent
studies have shown that the younger and the older onset patients seemed to have somewhat similar language impairment, and the degree of language impairment was highly correlated to the severity of the disease, regardless of the age of the onset (Cummings et al., 1985; Selnes, Carson, Rovner & Gordon, 1988; Murdoch, Chenery, Wilks & Boyle, 1987, referred to in Pekkala, 2004:10).

AD patients will not experience the same types of deterioration in cognitive abilities, and the same deteriorations will not necessarily appear at the same rates in the patients affected, thus individual differences exists. AD is a progressive disease, which means that the disease starts in one area of the brain and over time, it will affect larger and larger areas of the brain. Eventually it will spread to larger areas of the brain, and in late stages of the disease most, if not all, of the brain will be affected. Hence, AD will spread from the area where it starts, and not be situated at the exact same area throughout the cause of the disease. Accordingly, since AD does not always start in the exact same area from patient to patient, the disease will affect the patients in different ways.

There are three phases of the disease; mild, moderate, and severe AD. In the early phases, it can be hard to detect the disease, because the patient is able to hide it by preforming daily activities automatically. During the first phase of the disease, AD can be mistaken for normal ageing, which also contributes to make it hard to discover. When it comes to the cognitive abilities, the patient will in the mild stage of the disease, among other symptoms experience increased forgetfulness, deterioration of judgement and problem solving as well as deterioration of concentration. It is also difficult for the patient to find the correct words (Pekkala, 2004:9). When the disease progress to the moderate stage, it will be increasingly difficult for the patient to remember recent events, it will be more difficult for the patient to produce speech; the concentration is poor, difficulties with perception, as well as impaired conversational skills (Pekkala, 2004:9). In the last stage of the disease, where the disease is severe the patient will experience poor memory functions, as well as poor speech production with echolalia, the comprehension of speech is very poor, severe difficulties with concentration, as well as disorientation and severe apraxia (Pekkala, 2004:9).
1.2 Changes of personality

People who are diagnosed as having Alzheimer’s disease often experience changes in personality. Among two common changes are apathy and agitation. Apathy is often characterized by a lack of interest in usual activities (Cummings, 2003:70). Agitation is also quite common, occurring in approximately 70% of AD patients (Cummings, 2003:72). When The Neuropsychiatric Inventory (NPI) is analyzed according to dementia severity, patients with more severe cognitive abnormalities are more likely to exhibit behavioral changes (Cummings, 2003:69). The NPI is a tool for assessment psychopathology in patients with dementia and other neuro-psychiatric disorders. This test is based on an interview with a caregiver who is familiar with the patient. (http://www.aafp.org/afp/20020601/2263.html, 13.06.07). Often patients with AD experience more than one neuropsychiatric symptom. The patient may seem unfocused and tired in the beginning, and many of the patients lose interest in their family (Engedal & Haugen, 2004:84). In the beginning, the person with AD is to some degree aware of the problems or limitations that have occurred. As the disease develops, the patient will have less knowledge about the situation. This again may make it harder to accept the changes.

One of the reasons why it might be hard to discover AD to begin with, is because the patient can perform many of the everyday activities based on routines. This means that the actions are automated.

In the different phases of the disease the patient’s behaviour changes. In the mild stage, the patient may experience delusions, hallucinations, paranoia, psychomotor restlessness, wandering, sleep disorder, depression, apathy, behaviour problems (Pekkala, 2004:9). The social skills are still relatively well preserved at this stage of the disease (Pekkala, 2004:9). In the last phase of AD, the patient may experience restlessness, behaviour problems, outbursts, agitation, sleep disorder, depression, and deviant motor behaviour (Pekkala, 2004:9).

1.3 Diagnosing AD

It is still not developed one single test that can demonstrate AD. One has to look at how the person used to be and behave, and how the person becomes. To begin with, the person is normally diagnosed with mild cognitive impairment (MCI). The subtype of MCI associated with AD is called amnesic MCI, and approximately 80% of people with amnesic MCI develop AD within 6 years (Medical Care Corporation, www.mccare.com, 15.02.07). There is
not consensus among researchers on the definition of MCI. Some researchers have proposed the idea to divide MCI into three subgroups; MCI-I, MCI-II and MCI-III. A patient is diagnosed with MCI-I when he or she experiences a problem with memory, which will also be shown when their memory ability is tested. The second subgroup, MCI-II, is a condition with light impairment in several cognitive areas, whereas MCI-III is a condition with impairment in a specific cognitive function (Engedal & Haugen, 2005:31-32). According to this definition the condition that will develop to AD is MCI-I. In Norway the classification system *International Classification of Diseases and Related Health Problems* (ICD) is used to diagnose diseases (Engedal & Haugen 2005:18).

The first signs of AD are very similar to those of normal aging, however some of the signs of AD are significant deterioration of the short-term memory and problems with learning new information compared to what is expected in the normal aging population. Language abilities will not change in normal developing older individuals, but general reaction time and memory functioning are affected (Engedal & Haugen, 2005:30). Hence, individual differences exist among AD patients that can make it difficult to draw the line between normal and abnormal memory and general cognitive functioning in the elder population.

Some clinical criterias for diagnosing probable AD has to be met, and these are that “the dementia is (a) established by clinical examination; (b) documented by the Mini mental state examination or some similar examination; and (c) confirmed by neuropsychological tests” (McKhann et al., 1984; sited in Parks, Zec, & Wilson, 1993:5). Another criereia is that there has to be a deficit in memory as well as in language, praxis, visual perception, and problem solving (Parks, Zec, & Wilson, 1993:5).

1.3.1 Mini mental state examination

In many countries, the *Mini-Mental State Examination* (MMSE) is used to help diagnose probable AD. This is a status questionnaire where the top score is 30 points. This questionnaire is developed to determine whether the individual is suffering from cognitive impairment, and if any, the severity of the cognitive impairment. The test is constructed in such a way that it will provide an overview on the person’s aptitude to orient him or herself in time and space, and what cognitive abilities may be impaired. People with AD usually score 26 points or less (www.alzheimers.org.uk, 23.03.07), however, important to show cautiousness when the results are evaluated. Level of education is usually relevant for the test result: the higher the education, the higher the score might be, even though a person might
have AD. Age is also a factor that can influence the test results: a very old individual can get a total score of less than 26 points without having AD.

The MMSE consists of five sections. The first section is aimed at testing the person’s ability to orient him or herself in time and to see whether they know where they are (i.e. spatial orientation). The second part is constructed to determine memory functioning. The third part of the test assesses the attention and calculation abilities. Section number four, is designed to again assess memory, and last in section five, the language, writing and drawing skills are tested.

1.3.2 Alzheimer’s quick test

Alzheimer’s quick test, AQT, is a quick and easy test, and the function of the test is to detect impaired parietal function. One of the advantages about this test is that it is culture-free and not connected to the patient’s level of education, and hence not influenced by practice, learning and prior experience (Wiig, Nielsen, Minthon, & Warkentin, 2002). The test consists of three different parts where the main goal is to name, as quickly as possible, the different stimuli presented; one by the means of color and form, another by the means of color and numbers, and the third by the means of color and letter. The main purpose of this test is to see how fast the person that is being tested responds to automation and speed when it comes to naming, the ability to quickly make cognitive switches between visual stimuli, and to measure the functional level within the temporal and parietal brain areas when there are neurological sufferings (Wiig et al. 2002).

1.4 Cause of AD

It is assumed that there are 65 000 people with AD in Norway today (Engedal & Haugen, 2005:22), but there are still no clear answers to what causes AD. Even though the exact cause of AD is unknown, there are some risk factors that seem to be more dominant than others. The risk of getting AD seems to increases with age (Cummings, 2003). According to studies conducted on individuals with AD, it is said that for people over 90 years and older as many as 50-60% have AD, but other studies conclude that there are no more than 40% suffering from AD (Engedal & Haugen, 2005:69). As people live longer than before, more people will be diagnosed as having AD. Genetic vulnerability has also been proposed as a risk factor for developing AD. Some types of AD seem to be hereditary, and for other types, no genetic link has been found (Cummings, 2003). The ones that constitute a hereditary factor are less than
one percent of all that develop AD. Onset of the disease in patients with hereditarily vulnerable kind of AD is normally between 30-60 years of age (Engedal & Haugen, 2005:70). Educational level seems also to be a risk factor in developing AD. Studies have shown that people that have minimal education (less than four years of school) more often develop AD, compared to people with more education (Engedal & Haugen, 2005:74). This could be explained by the fact that the brain develops new synaptic connections between the brain cells when stimulated, and if the brain has not been stimulated enough this can perhaps make the brain more vulnerable to damage and disease later in life (Engedal & Haugen, 2005:74). It is important though to be cautious drawing the conclusion that many years in school can fully protect you from having AD, as other factors related to education might confound this observed link in some patients. Other risk factors may be high blood pressure, high cholesterol values in the blood, diabetes, severe head injuries that occurred after childhood. In addition, depression in late adulthood may cause dementia (Engedal & Haugen, 2005:74-76). There is no single reason why some might develop AD, but rather several. It is reasonable to assume that there are several factors that play a role in the development of the disease, and further research is necessary to disentangle the impact of different risk factors already identified.

1.5 Language of AD patients

Problems with naming different objects are often one of the first signs of AD; the patients have word finding deficits (Cummings, 2003). When they experience this kind of trouble they tend to use empty speech (like ‘thing’ or ‘it’), or they use circomlocutions\(^1\) around the specific word that cannot be identified (Cummings, 2003:60). Difficulties in finding the correct words or naming different objects can also be seen in normal developing elderly people, and it is thus difficult to determine whether the inability to name objects is due to early signs of AD or not. People with AD are able to recognize objects even if they are not able to name them (Cummings, 2003:60). To test this kind of ability it is common to perform a verbal fluency test. With this test the patient is asked to name as many items as possible from a specific category (e.g. animals), and they are supposed to do this in one minute (Cummings, 2003:60). As the disease progress, their object naming abilities will be more severe and turn into anomia. Anomia is a condition where the patient has problems finding words, and word

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\(^1\) Circomlocutions are strategies used when one cannot find the correct word or phrase, and therefore say what one wishes in another way.
classes like nouns, verbs and adjectives are most troublesome for the patient; however, grammatical words are better preserved. Their speech also contains many pauses and hesitation. Anomia refer to “impaired retrieval of words that have a conceptual referent (…)” (Goodglass & Wingfield, 1997). The person with AD will experience other kinds of language problems in addition to naming problems, like deterioration in comprehension. In the early and mild stages of the disease, other language abnormalities may occur.

In the mild phase of the disease, the AD patient may have problems starting a conversation, bringing up and maintaining a topic, and following the course of the conversation (Obler & Albert, 1981; Orange, Lubinski, & Higginbotham, 1996; Ripich & Ziol, 1998; referred to in Pekkala, 2004:14). It is also in this stage that the use of semantically empty words start and the AD patient also uses circumlocutions (see explanation above), as well as replacing names with pronouns as well as gestures, and these mechanisms are used in order to be able to remain fluency in the conversation (Appell et al., 1982; Obler & Albert, 1981; Nicholas, Obler, Albert, Helm-Estabrooks, 1985; Kempler, 1995; Ripich & Ziol, 1998; Bucks et al., 2000; Croot et al., 2000; Orange & Ryan 2000, referred to in Pekkala, 2004:14). In this stage of the disease there might be difficult to detect any syntactic errors, it seems that the patient do not have any particular problems with this aspect of language. On the mild stage, it can be difficult for AD patients to comprehend what they are reading, and they can have trouble in generating spontaneous written language (Pekkala, 2004:11).

In the moderate phase of the disease, the language ability will gradually get worse. It is more difficult for the patient to maintain a topic and to make relevant and complete contributions to the conversation. It is also increasinly difficult for the patient to self-correct speech errors (Pekkala, 2004:11). The vocabulary is becoming more limited, the use of empty speech increases, and the word fluency is poor (Pekkala, 2004:11). At this stage, it is more difficult for the AD patient to comprehend complex structures, and there are more grammatical errors in the speech of the patient with a simplified syntax (Pekkala, 2004:11). The phonology in the mild phase is relatively well preserved, but there might occur some mistakes and articulatory difficulty (Pekkala, 2004:11). The reading and writing skills do not change very much from the mild to the moderate phase.

When the disease has reached a severe phase, all aspects of language will also be severely affected. It is hard for the AD patient to follow a conversation because the patient is not able to maintain any coherence or correct turn taking or to make meaningful contributions to the conversaion (Pekkala, 2004:11). The vocabulary is severely limited and the speech is
filled with echolalia\(^2\) and paraphasias\(^3\) (Pekkala, 2004:11). The AD patients will produce incomplete sentences, and when it comes to phonology, there will occur more errors than in the earlier stages of the disease (Pekkala, 2004:11). The reading and writing abilities are also severely impaired in this last stage of the disease (Pekkala, 2004:11).

### 1.6 Preserved language abilities and memory

#### 1.6.1 Preserved language abilities

In most of the literature about language abilities in AD patients the focus is on what deficits one can find in the language of AD patients and not so much about preserved language abilities. Nevertheless, aspects regarding preserved language are of importance in research on AD patients and will therefore be briefly presented in the following paragraph.

According to Nebes et al., (1989) preserved language abilities seem to be phonology and syntax (Nebes et al., 1989, referred to in Pekkala, 2004:2), and this seems to be preserved throughout the disease. The AD patient will not have much language at all at a late stage in the disease, but still the phonology seems to be preserved, but not without errors. It is important to note that there is not consensus among researchers whether the syntax in fact is well preserved in AD patients or not, which will be further discussed in the present study when two contradicting linguistic views are compared below.

Reading aloud has also shown to be well preserved in the first two stages of the disease because of the automacy of the process (Pekkala, 2004:11). The more automated a word or a phrase is, the more preserved it is. Difficulty in reading comprehension and creative writing may appear, although mechanical writing and reading skills are relatively well preserved (Kempler, 1995; see also Platel et al., 1993; Luzzatti et al., 2003; referred to in Pekkala, 2004:14). However, Patterson et al. (1994) found that irregularly spelled low frequency words like yatch pose problems for these patients (Patterson, 1994, referred to in Obler & Gjerlow, 1999:99).

When it comes to phonology in the mild stage, the AD patient usually has normal articulation, pitch, volume, and speaking rate (Pekkala, 2004:11). Other preserved language abilities on this stage is conversational skills, as well as using compliments and expressions of appreciation, and there are no clear errors in the syntactic abilities (Pekkala, 2004:11). The

\(^2\) Echolalia is when the patient is repeating what a conversational partner is saying.

\(^3\) When some consonants are removed or changed in words, this is called paraphasia.
conversational skills are limited, and it can be hard for some AD patients to stay on topic or on their own initiate a conversation and it can also be hard for some to follow the course of a conversation (Pekkala, 2004).

In the next stage, the moderate stage of the disease, the AD patients are still able to answer questions. The syntax is still better than pragmatic and semantic abilities even though more grammatical errors occur. It is the same with the phonological abilities; they are still relatively well preserved, but some errors do occur (Pekkala, 2004:11).

In the latest stages of the disease, where the AD is severe, there are clear deficits in all areas of their language. Still, the phonological ability seems to be the best-preserved language ability (Pekkala, 2004:11). This ability is not completely preserved, but compared to the other aspects of language, it is.

1.6.2 Memory systems

Our memory can be divided in different kinds of memory systems. Memory is a prerequisite for learning, hence enables us to remember previous events to guide future action. The two main types of memory are short-term memory and long-term memory. Short-term memory is activated when one needs to remember something for a few seconds. If a tourist in a country does not speak the local language and need to buy bandage in a drug store, the person look up the word in a tourist phrase book, order the bandages, buy them, and when walking out the store, it is likely that the tourist have already forgotten the word for bandage. The tourist needed his/her short-term memory to get a message across, and when the mission was completed, the word was not memorized and hence did not become part of the long-term memory. If one, on the other hand, have moved to a new country, one would probably be interested in learning as many words as possible in the new language so one did not have to look everything up in the dictionary, and the new words would probably be repeated enough times so it eventually became part of the long-term memory.

It is now common to divide the long term memory in episodic memory, semantic memory, and procedural memory (Engedal & Haugen, 2005: 37-38). When people experience something and learn this (i.e. consolidate it in the long-term memory), this can be related to time and place, it is episodic memory. Shape and movement are among things that will be stored in this memory, as well as verbal statements and sounds (Engedal & Haugen, 2005:37). If someone is great in geography, and know all the capitals in the world, this information will be part of the semantic memory. This subsystem of the long-term memory includes a person’s knowledge about facts. These facts are not tied to the person’s autobiography, but rather facts
that the culture one grows up in has “agreed upon” as facts. What to say and how to behave in different social settings will be part of the semantic knowledge. The procedural memory is the third group of the long-term memory. Everything, which is automatic, is stored in procedural memory. If someone has learned to ride a bicycle, they do not think of what to do every time they sit on a bike. The person automatically know what to do in order to get the bike to move. Everything one do that is automated was once learned.

The memories where the first changes appear in AD patients are in episodic and semantic memory. The procedural memory is less impaired to begin with, but it is hard to claim that it is not impaired at all. Since the procedural memory is less impaired in the beginning phase of the disease, this can be one of the reasons why it is hard to discover AD in the beginning. The patient can perform many of the everyday rituals because of routines. This phenomenon will be further presented and discussed when dealing with how memory affects storing and processing of regular and irregular forms of words.
2.0 Theoretical background

For many years there has been disagreement within linguistics on how we store and process morphologically complex words. This dispute is based on whether the mental grammar and the mental lexicon are controlled by two distinct mechanisms, or whether they are controlled by the same mechanism and principles. These models are referred to as single- and dual-mechanism models (for further descriptions of dual-mechanism accounts, see, among others, Fodor, 1983; Chomsky, 1980, 2006; Pinker, 1994; Clahsen, 2004; and for further descriptions of single-mechanism models, see among others Rumelhart & McClelland, 1986; Bates, 1997; Langacker, 1987). The controversy between single- and dual mechanism models will not be discussed in detail here, as it is not the focus in the present study. Nevertheless, it is important to know the background for why the two models described below were chosen. These two models represent both sides of the past tense debate (which by no means is settled). First Ullmann’s declarative/procedural model will be presented, followed by a description of a test (A Neural Dissociation within Language: Evidence that the Mental Dictionary Is Part of Declarative Memory, and that Grammatical Rules Are Processed by the Procedural System) that uses the declarative/procedural model to test language abilities in AD patients. Then Bybee’s network model will be presented and a test performed by Bates, Harris, Marchman, Wulfeck, & Kritchevsky (1995) will be described. The latter test represents an alternative to the one performed by Ullmann et al. (1997).

Productivity is also important in this discussion. This can be seen as a process by which certain patterns or rules apply to new forms in a given language. Researchers describe productivity in different ways, thus it can be hard to find the core explanation on what this phenomenon really is. Bauer (2003) sees productivity not as “all or nothing, but a matter of more or less (…)” (Bauer, 2003:70). Since productivity is such a huge field, and since I have chosen to look at Ullmann declarative/procedural model and Bybee’s the network model, I will in the presentation of these models mention how productivity is defined by these particular researchers.

2.1 The Declarative/Procedural Model

The focus of this section will be on how Ullman’s declarative/procedural model (2001) pertains to verb processing, as this is of relevance to the present study. What is interesting about this model is that Ullmann ascribe the two-memory systems (declarative and
procedural) different status in the processing of regular and irregular verbs as well as proposing that both memory systems are not responsible for language only.

These two memory systems are located in different areas of the brain. He believes that the frontal basal/ganglia structures are responsible for the procedural system, (De Renzi, 1989; Gabrieli et al., 1993; Graybiel, 1995; Mishkin et al., 1984; Schacter & Tulving, 1994; Squire et al., 1993; Squire & Zola, 1996; Winocur & Moscovitch, 1990, referred to in Ullmann, 2001:46), and these structures are also involved in the learning of new, and the control of long-established, motor and cognitive skills and habits. This kind of knowledge is not conscious, and therefore it often is referred to as the “implicit memory” system (Alexander, Crutcher, & DeLong, 1990; De Renzi, 1989; Gabrieli, Corkin, Mickel, & Growdon, 1993; Graybiel, 1995; Mishkin, Malamut, & Bachevalier, 1984; Schacter & Tulving, 1994; Squire et al., 1993; Winocur & Moscovitch, 1990; referred to in Ullmann, 2001:46). Our implicit knowledge is the knowledge of how we tie our shoelaces, or how to drive a car (at least after driving a lot, so the process has become automatic). The declarative memory is our explicit knowledge. We can easily say something about the knowledge stored in this memory system, for example facts about geography, what a dog is and so on.

For linguistic skills Ullmann assumes that the procedural memory controls grammar in general, and he hypothesizes that this system that is activated when we learn new as well as maintain already established grammatical rules. For verbal morphology, this memory system will control regularly inflected verbs (Ullmann, 2001). Furthermore, the model posits that the procedural system potentially is informationally encapsulated, because it does not necessarily need any input by the declarative memory system in order to function properly.

The declarative memory controls the mental lexicon. Since the procedural memory system controls regularly inflected verbs, Ullmann assumes that the irregularly inflected verbs are stored and computed in the declarative memory. This is because their past tense form has to be remembered and stored in the lexicon, undependent of grammatical rules as the regularly inflected verbs are.

On modularity Ullmann means that the declarative and the procedural memory systems partially will overlap when a word is processed or stored, and either the procedural or the declarative memory will “win the competition” of the processing. This differs from models where the mental grammar and lexicon are two clearly distinct mechanisms; in this respect, he combines these two and therefore approaches the single mechanism idea more than other dual mechanism models. He does not explain what exactly determines what form “wins the competition” when a verb is to be processed, only that “(…) psychological and
neural disconnections between these types of morphological transformations are predicted” (Ullmann, 2001:50).

A morphological transformation is according to Ullmann a “phonological mapping between word stems and roots and inflected forms for a given (morpho) syntactic configuration” (Ullmann, 2001:39).

To explain how Ullmann sees productivity and default, one need to take a closer look at the morphological changes we find in English, as this is the language he has used as a starting point for his model, and from which he has tried to explain his model. In English, there are two classes of verbs, one regular class, and one irregular. The regularly inflected verbs in English gets an affix, -ed, added to the stem, like the verb look-looked.

The class that is considered the irregular class can be divided into different sub-groups based on what kind of transformation the verb undergoes. Some verbs will have a completely different past tense form than the base form, and go-went is a verb of that type. Another sub group of verbs is where a phonological change will modify one part of the stem. Verbs of this kind are verbs like swim-swam and ring-rang. There are also sub-groups of verbs that do not undergo any of these transformations when the past tense is formed, and these are verbs like beat-beat. To separate the regular verbs from the regular it depends on whether they get the -ed suffix added or not. He also posits that the procedural system underlies the learning and computation of the transformation that are fully productive (i.e., defaults).

Productivity of verbs is explained by Ullmann as follows; “the level of productivity of a morphological transformation refers to which extend it applies to new forms (new words and novel forms) that meet any particular set of conditions, within a given syntactic configuration” (Ullmann, 2001:40). He divides productivity into fully productive transformations and partially productive transformations. Furthermore, he divides fully productive transformations into either local default or global default. By local default he means the transformations that are applied to a form under particular conditions, hence there are either a phonological, semantic, or a morphological restriction in the transformation. On the other hand, if a transformation applies to any kind of conditions, phonological, semantic, or morphological, this will be what he calls global default. The past tense suffix –ed in English is a global default.

Partially productive transformations are those forms that do not have such a broad distribution as the fully productive transformations, but there are still forms to which partially productive transformations may apply (Ullmann, 2001:41). The examples he provides to explain this are feed-fed, lead-led, breed-bred that can apply to new forms like cleed-cled, but
they do not apply to *heed* and *need*, that are –ed suffixed (Ullmann, 2001:41). It can be rather difficult to separate the local default from the partially productive transformations. This point is very important when a verb that belongs to a language with complex verbal morphology is analyzed according to the declarative/procedural model since there are only those transformations that are fully productive that can be learned and computed by the rule system. It is also important to differ between these transformations when closely examining the language of AD patients as it decides what result one can expect of the different verb classes included in the verb tests in the present study.

A high frequency word that is normally computed by the rule system might eventually be computed by the associative memory, but generally, it is suggested in the declarative/procedural model that transformations controlled by rules should not be affected by frequency.

*Phonological neighborhood effects* for regular verbs are not expected, but anticipated for irregular verbs. Phonological neighborhood effect is when, for example, a verb and its inflection is learned, and the inflection of this verb resembles another verbs inflection. By strengthening the inflection of one of the verbs, both verbs and their inflection will be strengthened; if the verb *sing-sang* is learned, the verb *ring-rang* will also be strengthened. This is based on the assumption that there are only irregular forms that are stored and processed in the declarative/memory system which makes them “vulnerable” to this kind of frequency effect, while words in the procedural system is controlled by rules, which will be added to the stem regardless of other factors.

Ullmann does not address or preclude the possibility that other (...) cognitive or computational components may play an important role in the mental grammar or the mental lexicon, other than the ones proposed in the declarative/procedural model (Ullmann, 2001:48).

According to the declarative/procedural model, it is for the present study expected that both the Russian and the Norwegian AD patients would have problems with the irregular verb classes since they are expected to be controlled by the same memory system that is also responsible for the mental lexicon. Therefore, since AD patients have problems with the lexicon, they should also have problems with irregular verbs. For the regular verb classes, the results are, according to the declarative/procedural model, expected to be high, without many errors since Ullmann assumes that regularly inflected verbs are controlled by another memory system than irregular verbs are.
2.1.1 Testing the declarative/procedural model

Ullmann, Corkin, Coppola, Hickok, Growdon, Koroshetz, and Pinker (1997) have studied the language of people with different kinds of language deficits, among them AD patients. The aim of the study was to find evidence that grammar is located in the procedural memory system, and that grammar is separated from the lexicon, which is situated in the declarative memory system (Ullmann et al., 1997:276). They have, among other things tested AD patients, and individuals with anterior and posterior aphasia. In the follow section the focus will mainly be on the results reported on AD patients as well as the types of aphasia mentioned above.

There are two kinds of aphasia that are included in this study in order to support a dual mechanism account since these two types of aphasia results in different language deficits, and the injuries are located in different areas in the brain. These are Broca’s type aphasia (non-fluent aphasia), and Wernicke’s type aphasia (fluent aphasia). Since the injuries are not located in the same areas of the brain, and the two types of aphasia result in different kinds of language errors, it is used as evidence that grammar is situated in one part of the brain, whereas the lexicon is situated in another part. However, as Goodglass (1993) points out:

”Strictly speaking, as Hughlings Jackson (1874) pointed out, such correlations give the localization for a symptom, but not necessarily for the injured function. That is, a complex function such as naming may depend on interconnections between multiple regions and may thus be totally disrupted by lesions at various points in the system; none of the regions, either individually or jointly, can be considered a “naming center” (Goodglass, 1993:39).

People with aphasia of the Broca type, have an injury in the brain area adjacent to the motor cortex and part of the frontal lobe (Carroll, 2004:341). The injury that causes Wernicke’s aphasia, on the other hand, is in a region in the left temporal lobe near the auditory cortex (Carroll, 2004:341). It is mainly grammar that is affected in Broca’s aphasia. They have what is called agrammatic speech. Grammatical morphemes and incorrect use of these seem to be the main problem. The fact that the people with this type of aphasia mainly have problems with grammar is thought to indicate that grammar and the lexicon are situated in anterior and posterior areas of the brain whereas grammar is situated in the frontal areas of the left hemisphere.

For people with Wernicke’s type aphasia the main problem is the lexicon, the injury is located in posterior areas of the brain, and this suggests that the lexicon is situated in these (posterior) areas of the brain (Ullmann et al., 1997). Problems with the lexicon in Wernicke’s
type aphasia results in difficulties with the access to nouns, verbs, and adjectives (content words), but the grammar seems relatively intact, at least compared to Broca’s type aphasia.

In order to test whether the grammar and the lexicon are situated in different areas of the brain, Ullmann et al. used a simple language task in which the use of the two linguistic capacities is contrasted while other factors, such as complexity, meaning and task demands, are held constant (Ullmann et al., 1997:267).

They hypothesize that AD patients will mainly have difficulties with irregularly inflected verbs because AD causes severe impairments in learning new, and remembering old facts, events and words (Corkin, 1982; Nebes, 1989; Sagar et al., 1988; referred to in Ullmann et al., 1997:268). This should then imply that the injury is most severe in the same areas as the declarative memory system is located. There are two possible ways to test this proposed hypothesis:

One test examines a correlation across an entire group of patients: the greater the word-finding difficulty, the greater the predicted difficulty inflecting irregular verbs (though not regular or novel verbs). The second test focuses on the subset of patients with the most marked word-finding deficits. They should have greater difficulty inflecting irregular than regular or novel verbs, and should make overgeneralization errors (Ullmann et al., 1997:269).

In the study there were 24 AD patients were tested, and in these patients, the difficulties remembering words correlated with difficulties remembering facts (Ullmann et al., 1997:269). The Information, Memory and Concentration (IMC) subtest of the Blessed Dementia Scale (Blessed et al., 1968; referred to in Ullmann et al., 1997:268) was used in order to test how serious the dementia was in the AD patients participating in this study. The task the patients were supposed to perform was to read a sentence was printed on a page, and there was only one sentence per page. They were supposed to fill in blanks, and a task could look like this: “Everyday I dig a hole. Just like every day, yesterday I _______ a hole” (Ullmann et al., 1997:268). There were sentences that included regular verbs and sentences that included irregular verbs. In order to test the informants’ lexical memory, the participants were shown 84 drawings of objects (Goodglass et al., 1983, referred to in Ullmann et al., 1997:268) which they were supposed to name. Regular or novel verbs did not rhyme with the stem of any irregular verb, and further the five most frequent irregulars and the six least frequent regulars were eliminated from the test (Ullmann et al., 1997:268). In this study, they did not expect to find any difficulties for the AD patients with grammar, only in the lexicon, and this would then be shown through difficulties with irregular verbs. In this test Ullmann et al. (1997) concludes that difficulties for the AD patients were irregular verbs, at least they did more
errors inflecting irregular verbs contra regular verbs. I believe that it is in fact hard to test the declarative/procedural model when both high and low frequency verbs were removed from the test performed by Ullmann et al.

Since they removed verbs that were more frequent, or less frequent than other verbs from the test, they do not address the possibility, which is assumed assumed in the declarative/procedural model, namely that morphologically complex forms will be affected by frequency. By removing verbs that are more frequent than others, or less frequent, they are also not able to test another aspect of the declarative/procedural model where it is assumed that a high frequency word that is normally computed by rules in the grammar eventually can be computed by the lexicon. The results obtained by this test can thus be summed up like this:

“Patients with relative damage to temporal or parietal neocortex, and with general impairments of declarative memory (in Alzheimer’s disease) or specifically of lexical memory (in posterior aphasia), had more trouble converting irregular verbs to their past tense forms than regular or novel verbs, and overgeneralized the suffix” (Ullmann et al., 1997:274).

Since there are controversies in the field of how our mental lexicon and grammar works, an alternative view is presented in the next paragraph.

2.2 An alternative view to Ullmann

In this section, I will present an alternative view to Ullmann’s declarative/procedural model. First, some general cognitivistic principles will be described, followed by a presentation of Bybee’s The Network model. This model builds on the assumption that the mental grammar and the mental lexicon are not separated. I will emphasise the points that are most important in order to explain the Norwegian and Russian test results in the present study.

Several tests have been carried out to investigate the hypothesis of a unified mind. Bates and her colleagues, Harris, Marchman, Wulfeck, & Kritchevsky (1995) performed the one that I will describe in the following paragraph. They also tested language abilities in AD patients. This is why Bates et al.’s study was interesting to describe, as well as a contrast and to compare it with Ullmann’s model (2001) and study (1997).

Not all researchers agree that we have two distinct memory systems; hence it is plausible to believe that a unified memory system will have a somewhat different effect on our mind, and therefore also a different influence on our language. If this is the case, how we compute regular and irregular verbs will necessarily differ from the declarative/procedural model.
Cognitive linguistic principles build on the assumption that language is an ability in humans to the same extent as other cognitive abilities. In this respect, it is common to refer to these researchers as cognitivists, as opposed to those who believe that language, and especially grammar holds an autonomous part of the brain. Thus, as Bybee (2001) writes: “Our enormous memory capacity, fine motor control, the ability to organize experience, and the ability to make inferences may be fine-tuned for language, but are all clearly used in other domains as well” (Bybee, 2001:17). This is in contrast to the view that syntax is an autonomous system not affected by use i.e. frequency or other cognitive systems. Bates (1997) argues that the brain might develop modules that are responsible for different aspects of language, but these modules are made, and not something, we are born with (Bates, Bretherton, & Snyder, 1988, referred to in Bates, 1997:166). Linguistic forms are themselves a part of the world within which the organism functions and to which it must adapt (Bates & MacWhinney, 1989:8). A reason why children learn to speak as adults in the community they grow up in is that children are inherently motivated to learn, and they want to find out how things work, therefore they imitate adults in their way of speaking and communicating (Bates & MacWhinney, 1989:32). If language is affected by the way we use it, and frequency is an important component, something that is often used will also be remembered and accessed more easily. If someone seldom drives a car, they will not become good at it, and if someone seldom cook, they will not be good at making food. It is the same with language; if there are, for example, some words you use more often than others, these will have a stronger representation in the mind than those you rarely use, and they will be easier accessed and produced. Cognitivists see grammar as a network with symbolic structures. These structures are phonological and semantic, and together they form a symbolic structure. All these symbolic structures (words, phrases and sentences) are connected in a mental network.

In the network model, both *type frequency* and *token frequency* are relevant. Type frequency says something about how many verbs for example there are in a verb class, how frequent this particular morphological pattern is. Token frequency says something about how frequent one particular verb is (i.e., the occurrence of the verb in the language). What are normally referred to as regular verbs usually belong to a pattern with high type frequency. This does not mean that all the verbs belonging to this pattern have to be frequent. Verbs that are normally referred to as irregular verbs usually have high token frequency, which is why they stay irregular because high token frequency strengthens the particular verbs mental representation, and therefore resists converting to the more productive, regular class/classes. When an irregular high frequency verb becomes less frequent, it often regularizes, for
example the Norwegian verb å grave, that earlier was grov in past tense, but because of less frequent use now is gravde.

The network model is based on the idea that all inflections are treated in the same way, and do not formulate autonomous symbolic rules for regular inflection (Bybee, 1995:427). Rather it is believed that there is a network where there are mappings from the base form to the past tense form. This network memorises individual patterns as well as regularities (Bybee, 1995:427).

All words in the mental lexicon have some degree of lexical strength. According to Bybee, lexical strength is due primarily to the token frequency of the verb. The lexical strength is the main factor for why some words are more easily accessible than others are. The stronger a word is lexically, the more resistant it is to be influenced by other words and to change (Bybee, 1995). This explains why irregular verbs stay irregular. Each time we use or hear a word, the lexical representation of the word is strengthened. It is like walking up a path, the more the path is walked, and the more evident it will be. It is the same for verbs that belong to a frequent pattern; each time a form of a pattern is repeated all the forms belonging to the pattern are strengthened as well.

To fully understand a word when we encounter it we have to match this word with a concept that already exists in the mind. This matching process is dependent of two factors: phonology and semantics. The word we want to match with an already existing item has to match as far as how it sounds, and the meaning of the word has to be correct (Bybee, 1985). In the network, these semantic and phonological features of words make up the connection between the different items. Some words share both phonological and semantic features, some only semantic, and some only phonological. Lexical connections can vary in strength according to the type and number of features shared. Words can relate to eachother in different ways because they can share semantic features and phonological features (Bybee, 1985). A word that has high token frequency will form weaker connections with other items because they have greater lexical autonomy, while words that do not have such a high token frequency is better learned in relations to other items (Bybee, 1995:429).

The schema is important in the network model. This is described as follows: “Sets of words having similar patterns of semantic and phonological connections reinforce one another and create emergent generalizations (…)” (Bybee, 1995:430). There are two factors that are important when looking at what decides whether the schema will be extended to other items or not. This is whether there are several restrictions that make it hard for the schema to be applied to new items, and second the strength of the schema (i.e. the type frequency of the
particular schema). Furthermore, the schemas are divided into two different types; *source-oriented schemas* and *product-oriented schemas*. Source-oriented schemas are generalizations over pairs of basic and derived forms (wait-waited), and product-oriented schemas are generalizations over complex or “derived” forms (strung, stung, flung). The operations it takes to produce such forms are not stipulated (Bybee, 1995:430). It is possible for both source-oriented and product-oriented schemas to exist for the same morphological relation “since in this model lexical connections relate basic and derived forms as well as derived forms of different paradigms (…)” (Bybee, 1995:431).

On productivity, the network model says, “differences in degree of productivity are not attributed to different processing types, but to differences in type frequency and the openness of defining schemas” (Bybee, 1995:432). In other words, the type frequency of a verb class influences all kinds of verbs, irregular as well as regular. Frequency of use does not necessarily have to strengthen a word in the mental lexicon: “Not only do words gain in strength, but they can also decline in strength with disuse” (Bybee, 1985:118). If someone learn a language but never practice it, it is likely that many of the words will be forgotten.

Bybee (1985) also makes a claim that there is no strict line between fully autonomous and non-autonomous processing, but rather that this is a gradual process. For the storing of language in the brain, this means that there is nothing that disables both different affixes to be stored as well as words with affixes. In other words, this means that all words are stored and somehow connected in our mental lexicon. Therefore both adding an affix to a stem, as well as whole word forms (stem plus affix), can be processed when needed (Bybee, 1985).

Expected results of the tests with the AD patients in the present study based on the network model, is that they will experience problems both with regular and irregular morphological forms. Verbs belonging to a verb class of high type frequency are expected to be better preserved than a verb belonging to a class of low type frequency. If a verb has low type frequency, but high token frequency, these are also expected to be well preserved in the AD patients.

### 2.2.1 Testing Bates’ hypothesis

An alternative view to Ullmann’s model (Ullmann, 2001; Ullmann et al., 1997) is, as described above, Bates, Harris, Marchman, Wulfeck, & Kritchevsky’s (1995) hypothesis about language abilities in AD patients, and especially their grammar and syntactic abilities. The reason for choosing to compare Ullmann and Bates’ studies was because of the use of the
same population and main focus; AD patients and their language abilities, and especially their grammatical abilities. With this study, the researchers are also trying to answer the ongoing questions of how we organize language in the brain, and whether we can talk about separate grammar and lexicon, or a unified mind and memory system.

The argument that AD patients have preserved grammar, and that it is only the lexicon that is affected by the disease, has been one of the strongest arguments for some researchers that processing of regular and irregular forms of words are controlled by two distinct mechanisms. If this actually were the case, it would indeed be a convincing argument for the dual processing mechanisms. However, as Bates et al. find evidence for in their study, this might not be the case. Their hypothesis for the study is:

“We will argue that AD patients suffer from a progressive decrease in their ability to access, compare, select, and/or deploy alternative linguistic structures, leaving the most frequent and/or predictable forms intact until late stages of the disease. If this hypothesis is correct, then the single underlying cause (i.e. progressive loss of access) may be sufficient to explain lexical and grammatical deficits in this population” (Bates et al., 1995:491).

One of the first signs of AD is difficulties with finding words, which eventually turns into anomia. When speaking with a person with AD, it might seem that the grammar is well preserved, at least until later stages of the disease where there are obvious deficits in all parts of the patient’s language (as well as all other cognitive abilities). The main problem seems to be the lexicon and word finding difficulties. Bates et al. (1995) want to further investigate if this really is the case. Moreover, how can we find out more about these questions? In their study, they tested AD patients’ abilities in passive constructions versus sentences in the active voice. These results were compared to two control groups. One consisted of informants that were age matched with the AD patients, and second, a control group consisting of college students. They wanted to see whether there were any differences in the elderly normal control group and the AD patients. In other words, to see whether, and how, our language may change when we age opposed to that of AD patients.

AD is a general brain disease, and as the disease progress, more and more areas of the brain are affected. This could make a modular view on language hard to explain, since the disease eventually spreads to the whole brain. However, the disease starts in one particular area of the brain; usually it originates in the temporal and parietal lobes. Since there are certain areas of cortex that are more affected than others to begin with, this led dual mechanism supporters to use the initial damages to cortex as evidence to argue fir a distinction in processing regular and irregular verbs. Nevertheless, in Bates et al. (1995), they
argue against such a view. One of the biggest differences between the view proposed in this article, and the one proposed in Ullmann’s declarative/procedural model is the way in which data is interpreted. In Bates et al. they propose that the differences between grammar and lexicon occur because of differences in the automaticity and/or accessibility of content words and grammatical structure within a unified lexicon that breaks down gradually across the course of the disease (Bates et al., 1995:490). If this were the case, it would mean that the differences observed in the grammatical and lexical abilities so far are not due to a disconnection between modules (Bates et al., 1995:490).

In Bates et al.’s study, 16 AD patients were tested (seven females and nine males). One of the tests they used to measure the informants’ cognitive abilities was the MMSE (MMSE: Folstein, Folstein, & McHugh, 1975; referred in Bates et al., 1995:498). Additional tests were the Boston Naming Test (Goodglass & Kaplan, 1983; referred to in Bates et al., 1995:498), a biographical interview and laboratory tests of sentence production (Bates et al., 1995:498). The average MMSE score in Bates et al.’s study, was 20.37.

The test itself consisted of 24 sets of actions or event-films that were animated. These were in black-and-white. The semantic roles included in these films were agent, patient, and object, recipient, location and experiencer (for a more detailed description of the material see Bates et al., 1995:500). The informants were supposed to describe what they saw on the film; both free descriptions and probed descriptions. Using both free and probed descriptions one can see what kind of structures are used when the informants can choose them selves, and how they perform when they are “given the context” to describe in. Trial runs were administered to make sure that the informants understood the task.

Bates et al. wanted to show that there are deficits in the grammar as well as in the lexicon in AD patients. The test results showed that AD patients made more errors than the two control groups. In producing sentences in the passive voice, there were fewer responses from the AD patients than for the two control groups (i.e., AD does have an effect on the production of complex syntax, when syntax is assessed in a tightly controlled discourse situation) (Bates et al., 1995:525). AD patients produced less sentences in the passive voice than the control groups, and the passives they produced were also different from passives produced by participants in the control groups (more specifically the AD patients produced more “get-passives” than “be-passives”). There were also significant changes in the fit between grammar and discourse, with more “off-target” structures that do not match our predictions for specific event and discourse types (Bates et al., 1995:525). The kind of grammatical errors made by the AD patients resembles the lexical problems that one might
find in this patient group as well. The deficits one might find in lexical errors made by these patients are also evident in the grammar; the AD patients struggle with finding the correct words that fit the context, they rely on high frequency forms as well as empty forms. “The last resemblances between grammatical and lexical deficits in these patients are the occasional production of substitutes that are off target even though they are still well formed, in the absence of frank paraphasic errors” (Bates et al., 1995:526). Sentences in the passive voice are less frequent than sentences in the active voice, and the AD patients did worse on the least frequent grammatical constructions. The AD patients also used emptier do-gap forms (e.g. “A hit B and C did too”) than the control groups (Bates et al., 1995:525). Thus Bates at al. (1995) conclude as follows:

“Patients with AD will demonstrate preservation of both lexical and grammatical forms, but only for over learned patterns and/or in situations that strongly constrain the structures that ought to be used. The same patients will demonstrate impairments of both grammar and the lexicon if they are required to suppress highly accessible structures and/or generate and decide among a set of structural options to fit a novel situation” (Bates et al., 1995:531-532).

According to these researchers not only the mental lexicon is affected by AD, but the syntax and grammar as well.

I will compare the results of this study with the results of the present study consisting of Russian and Norwegian AD patients. I will also compare them to the results of Ullmann et al.’s (1997) study.
3.0 Norwegian and Russian Verbs

Since the Norwegian and Russian verbal systems are very different from each other, it is possible that a comparison of Russian and Norwegian AD patients will tell us whether the verbal morphology of a language has any effect on the ability to inflect verbs. Furthermore, it can provide information on how AD patients store and use regular and irregular forms of verbs. The comparison can possibly illuminate some of the questions that are still unanswered regarding the dispute on how grammar and the lexicon work.

There are two sections in this chapter. In the first section, some of the aspects of the Norwegian verbal system are presented mainly the aspects that are relevant to the present study that are included. In the second section, aspects of the Russian verbal system are presented. As with the Norwegian verbs, there are only those aspects that are relevant to the present study that are included in the presentation.

3.1 The Norwegian Verbal System

It is common to divide the Norwegian verbs into weak and strong verbs, or regular and irregular. In this paper, they will be referred to as regular and irregular verbs. That does not mean though, that all verbs that are referred to as irregular are irregular. There are regularities in the different sub-goups of the Norwegian irregular verbs. All verbs that are referred to as regular are not necessarily regular, irregularities may occur, like with the verb å fortelle (to tell) that forms an irregular past tense, fortalte.

Furthermore, there are two types of verbs and one strong (with sub-groups). What separate regular and irregular verbs, are whether the verb gets a syllabic suffix added in the past tense or not. If the verb gets a syllabic suffix added, it is a regular verb, and if not, it is an irregular verb. The verb class in Norwegian containing the most verbs will here be referred to as the larger weaker class, WL, following Ragnarsdóttir, Simonsen and Plunkett (1999 referred to in Bjerkan 2000:36). In South-East Norwegian, this is the most productive class, but that does not mean that other verb classes are not productive as well. Based on the Norwegian dictionary Bokmålsordboka (BO 1986), this class has approximately 2700 members (Simonsen & Endresen, 2001:85). Furthermore, this means that 56% of the Norwegian verbs belong to this verb class. The past tense of the verbs in this group is formed by adding a suffix that starts with a vowel, or a suffix that is a vowel. The suffixes are either /-et/ or /-a/, like in the verb to jump: å hoppe (infinitive) – hoppet / hoppa. What determines
which suffix to choose, is based on dialect or sociolect. The WL class is phonologically a very open class, and because of this, many of the new verbs that come into Norwegian fall into this verb class.

The second biggest class in the Norwegian verbal system is also a verb class consisting of weak verbs, and this class will be referred to as the smaller weaker class, WS (also following Ragnarsdóttir, Simonsen and Plunkett 1999 (Bjerkan, 2000:36)). The syllabic suffix in this verb class starts with a dental consonant, and the suffixes are /-te/ or /-de/. The differences between these variants of the suffix are phonologically conditioned. According to BO (1986) there are approximately 1900 verbs in this class (Simonsen & Endresen, 2001:85). That means that 40 % of all the Norwegian verbs belong to this class. Some examples of verbs belonging to this class are å smile – smile (to smile); å leve – levde (to live); å bo – bodde (to live). Most monosyllabic verbs that are not strong belong to the WS class. All verbs ending in –ere belong to this class a well, like the verb å reparere (to repair/mend/fix) which in the past tense will be reparerte.

There are, according to the BO (1986) approximately 200 strong verbs in Norwegian, which means that 4% of all verbs in Norwegian are strong (Simonsen & Endresen, 2000:85). As we can see from these numbers this is a rather small group. In contrast to the regular verbs, strong verbs do not have a syllabic suffix in the past tense. In most cases, the stem vowel in the past tense will change from the stem vowel in the infinitive form, but not necessarily (see subclass 6 in the table below). The irregular verbs in Norwegian belong to different subgroups, but the criteria for this classification are different from different approaches. I have chosen to follow Endresen’s and Simonsen’s (2001) classification of the irregular verbs because they divide these verbs into seven sub classes, based both on a source oriented approach (i.e., the infinitive stem), and on a product oriented approach (i.e., the past tense form). They have organized the strong verbs like this:
Table 1: The Norwegian vowel system (Simonsen & Endresen, 2001:89)

<table>
<thead>
<tr>
<th>Subclass</th>
<th>Infinitive stem vowel</th>
<th>Past tense stem vowel</th>
<th>Examples</th>
<th>Number of verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/i, e, y/</td>
<td>/a/</td>
<td>drikke – drakk, dette – datt, synge - sang</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>/i:/</td>
<td>/e:/(/æj/)</td>
<td>bite – bet / beit</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>/y:/</td>
<td>/ø:/(/øj/)</td>
<td>fryse – frøs</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>/a:,e:,å:,æ/</td>
<td>/u:/</td>
<td>dra – dro, le – lo, slå – slo</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>/æ:,e:,i:,e/</td>
<td>/a:/</td>
<td>bære – bar, be – ba, si – sa, legge – la</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>/ø:,o,a,e:,ø:/</td>
<td>No change</td>
<td>sove – sov, komme – kom, falle – falt, hete – het, løpe – løp</td>
<td>9</td>
</tr>
<tr>
<td>The rest</td>
<td></td>
<td></td>
<td>se – så, gå – gikk</td>
<td>5</td>
</tr>
</tbody>
</table>

The strong patterns are usually not productive, and this class has lost many members to the weak classes over the years. There are also examples of modern Norwegian where originally strong verbs like å bære (to carry) now are inflected both as strong and weak verbs: bar (like a strong verb) or baerte (like a weak verb).
Table 2: Frequency overview of Norwegian verbs (BO, 1986)

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total verbs</td>
<td>4800</td>
<td></td>
</tr>
<tr>
<td>Strong</td>
<td>200</td>
<td>4%</td>
</tr>
<tr>
<td>WL</td>
<td>2700</td>
<td>56%</td>
</tr>
<tr>
<td>Weak</td>
<td>4600</td>
<td>96%</td>
</tr>
<tr>
<td>-/de/</td>
<td>150</td>
<td>3%</td>
</tr>
<tr>
<td>-/te/</td>
<td>1750</td>
<td>37%</td>
</tr>
<tr>
<td>Other</td>
<td>80</td>
<td>1.5%</td>
</tr>
<tr>
<td>monosyllabic</td>
<td>70</td>
<td>1.5%</td>
</tr>
<tr>
<td>Other</td>
<td>250</td>
<td>5%</td>
</tr>
</tbody>
</table>

(Referred to in Simonsen & Endresen, 2001:85)

3.2 The Russian Verbal System

The Russian verbal system differs from the Norwegian since the Russian morphological system is more complex than the Norwegian. There are different ways to either classify the Russian verbal system, as a two-stem system, or as a one stem system. In this paper, the Russian test is based on Jakobson’s classification (1948) of the Russian verbs, which is a one-stem system.

The grammatical categories for the Russian verbs are person (1st, 2nd, 3rd), number (singular and plural), gender (masculine, feminine, neuter), active and passive, tense (past, present, and future), aspect (imperfective and perfective), and mode (indicative, conditional, and imperative) (Mathiassen, 1996:302). The finite forms of the Russian verbs are inflected in person, number, tense and mode. The verbs are partially also inflected in gender, but this is only in the past tense and conditional, and these forms are not inflected in person (Mathiassen, 1996:302).

There are only the imperfective verbs that can be inflected in the present tense and also have present tense meaning. An action that has come to an end and where the focus is on this
result cannot necessarily be going on right now. This means that a perfective verb that is
inflected in the present tense will have future tense meaning. Future tense of the verbs is not
part of the test in this thesis, and I will not go further into that here since it is not relevant to
what is being tested. All the verbs included in the Russian verb test are imperfective.

The Russian test was based on Jakobson’s (1948) one-stem system, and the reason for
this was “because it allows the generation of all forms of all the Russian verbs with the
exception of a dozen truly irregular ones by the application of a set of rules. These sets of
rules are different for the different verb classes (and subclasses)” (Gor & Chernigovskaya,
2000:7).

According to Jakobson’s one stem system, there are 11 verb classes in Russian. These
class distinctions are made based on the suffix, also called a morphological marker or verb
classifier. One of these 11 classes has a zero suffix, and this group consists of subclasses. The
subclasses are divided into groups depending on the quality of the root-final consonant and
the root vowel (Gor & Chernigovskaya, 2003:5-6). There are not many verbs belonging to
this class; there are less than 100 basic stems in it (Townsend 1975, referred to in
Chernigovskaya & Gor, 2000:7). The other classes in Jakobson’s system are -aj-, -a-, -e-, -ej-,
-i-, -o-, -ova-, -avaj-, -nu- (including the “disappearing –nu-”), and -zha- (as well as the zero
suffix class) (Gor & Chernigovskaya, 2001:530). These suffixes do more than just give names
to the classes, they also provide information about:

- Conjugation type, either 1st or 2nd conjugation. Conjugation provides information about
  the thematic vowel of the ending of the verb.
- Consonant mutation (mutation of the root final consonant)
- Stress shift
- Suffix alternation
Table 4: Complexity of paradigm of Russian verbs

<table>
<thead>
<tr>
<th>Verb classes:</th>
<th>-aj-</th>
<th>-a-</th>
<th>-i-</th>
<th>-ova-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consonant truncation before consonant ending</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vowel truncation before vowel endings</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Consonant mutation</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stress shift</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suffix alternation</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

(Table from Gor & Chernigovskaya, 2000:9).

Taking a closer look at conjugation shows that the 1st conjugation means that the verb has the thematic vowel –e in present tense. For the 2nd conjugation this thematic vowel is –i. The verb *chitát’* (to read) belongs to the 1st conjugation, and the verb *gotóvit’* (to prepare, cook) belongs to the 2nd conjugation:

1. chitáj-u     sing. 1. gotóvl’u
2. chitáj-e-sh’ 2. gotóv’-i-sh’
3. chitáj-e-t    3. gotóv’-i-t
1. chitáj-e-m    pl. 1. gotóv’-i-m
2. chitáj-e-te   2. gotóv’-i-te
3. chitáj-ut     3. gotóv’-at

The point of stress shift is also important to understand, there are different and specific patterns for the classes where this occurs. The classes were stress shift takes place is in the -a-, -e-, and -i- classes. An example is the -a- class verb *pisát’* (to write). In the infinitive and in the past tense the stress is on the last syllable. When inflected in the present tense the stress is in the 1st p. sing. on the last syllable, and in the remaining forms of the present tense paradigm the stress in on the first syllable:

1. píshú
2. píshesh’ Sing.
3. píshet
1. píshem
2. píshete Pl.
3. píshut
Suffix alternation is relatively rare in Russian, but this is found in the -ova- and -avaj- classes. For the -ova- class the -ova- alternates with -uj-, and for the -avaj- class, the -avaj- alternates with -aj-. An example of an -ova- class verb is *celovat’* (to kiss), and this verb is inflected as follows:

1. cel-új-u
2. cel-új-esh’ Sing.
3. cel-új-et
1. cel-új-em
2. cel-új-ete Pl.
3. cel.új-ut

The past tense is relevant to the verb test in the present study, since the informants in the second part of the test are given the stimuli verb in the past tense. The same verbs were given in the infinitive in the first part of the test. In this tense, Russian verbs are inflected according to either number or gender. The verbs are only inflected according to gender in the singular, and in the plural, there is one common form for masculine, feminine, and neuter. The past tense form of Russian verbs is –л. For masculine, the ending is Ø and -a is the feminine ending. For neuter it is –о, and for plural it is –i. The verb *chitat’* will in masculine, singular be *chitalØ* (He read). For feminine singular, it is *chitala* (she read). If we want to state that both of them read, we add the suffix -i to the stem, and it will be *chital’i* (they read).

A frequency overview of the Russian verbs is listed below. The numbers in this table are based on the dictionary of Zalizniak (1980) as referred to in Gor (2004).

**Table 5:** Frequency overview of the Russian verb classes included in the present study

<table>
<thead>
<tr>
<th>Verb classes</th>
<th>-aj-</th>
<th>-a-</th>
<th>-i-</th>
<th>-ova-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian</td>
<td>11814</td>
<td>940</td>
<td>7019</td>
<td>2816</td>
</tr>
<tr>
<td>language</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type frequency</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>

In Zalizniak’s Grammatical Dictionary of the Russian language (1980), there are approximately 100 000 entries (Gor, 2004:61).
4.0 Method and material

This chapter consists of three parts. First, I will describe the Russian and Norwegian tests and test material. Following this is a description of the informants that participated in the present study, both the Russian and the Norwegian informants. The last section of this chapter is discussing possible error types in the Russian and Norwegian tests, respectively.

This is a multi case study, which means that there will be an analysis of the results of each informant, followed by a comparison of these results in order to find similarities and differences. There will be no statistics based on the results obtained. The reason for this is that the group of informants forms such a diverse group with too many different variables, and it is a relatively small group. The level of education differs, the results of the MMSE differ, and the age differs as well as how long each patient has been ill. Therefore, the mean results will be irrelevant since there are too many different factors that will affect this score. On the other hand, by looking at such a diverse group, it is possible to see a wider range of how AD might affect different people in the population.

The tests with the Russian informants were conducted at the hospital (Geriatricheskij gorodskoj centr so stancionarom) where the informants lived, or stayed when the experiment took place. The psychiatrist Sofia Fedorovna Sluchevskaya picked out the informants. They were told about the experiment before the testing started, and they had the opportunity to withdraw at any time during the testing, or after the testing was completed. Since the Russian test consists of two parts, there was always a break between the first and second part in order to give the informants time to rest. How the tests are and how they were performed, will be thoroughly explained below.

The Norwegian tests took place at Ullevål university hospital, at Hukommelsesklinikken (The memory clinique). All the Norwegian informants were outpatients, so they came to the hospital for the testing. They got information about the project before the testing started, and could withdraw from the test at any time. One informant performed the test at home.

4.1 The Russian Test and Test Material

Gor and Chernigovskaya (2001) tested 27 adult native speakers of Russian to, among other things, find out what the default pattern of Russian is, if type frequency will influence verbal processing, what the role of morphological cues in verbal processing is, and whether rules
shaping a conjugational pattern is applied in a set, or not (Gor & Chernigovskaya, 2001:529). The results of the test showed that the default pattern for the nonce verbs in Russian is vowel+j (V+j). This means that the informants applied the V+j- pattern when they could not recover the stem of the verb. They chose this pattern, thus one mechanism, instead of applying an entire conjugational pattern for a verb class. Therefore, by applying this rule to verb classes that could not have this pattern, they created a conjugational pattern that is illegal in Russian (Gor & Chernigivskaya, 2001:533). The processing of verbs was also influenced by the type frequency of the verb; high type frequency verb classes and their patterns were more often generalized to the other verb classes (Gor & Chernigovskaya, 2001). When it came to morphological cues and their role on the processing of verbs, it turned out that this worked better on verbs of high frequency than for verbs with low frequency.

The Russian test consists of 80 verbs; 40 real verbs and 40 nonce verbs. There are four classes of verbs that are included in the present study: the -aj- class, the -a- class, the -i- class and the -ova- class. Each group of 40 verbs is further divided into four groups with five verbs in each. These four groups are high frequency real verbs (hfrv), low frequency real verbs (lfrv), high frequency nonce verbs (hfnv) and low frequency nonce verbs (lfnv). However, in reality, there is no such thing as high frequency or low frequency nonce verbs. The nonce verbs in this test are created by manipulating the initial segments in real Russian verbs (Gor & Chernigovskaya, 2001:529). Some Russian nonce verbs were created from high frequency real verbs, others from low frequency real verbs. That is why the nonce verbs can be called either high frequency or low frequency. Nonce verbs can provide a lot of information that real verbs cannot. With real verbs it is difficult to say whether the person being tested has memorized the verb, or whether the person knows how to inflect the verb. Nonce verbs are able to provide this kind of information. Nonce verbs can naturally not be memorized; hence, if the person tested is able to inflect the nonce verb, the person is able to use that particular inflectional pattern. It is also interesting to see what inflectional pattern is chosen for the nonce verbs, and why this pattern was chosen.

The test is divided into two different parts; one where the stimuli verb is given in the infinitive, and another where the same verb is given in the past tense, plural. The stimuli verbs were the same in the infinitive and the past tense test. The informants are supposed to answer with the 1st person singular and the 3rd person plural present tense of the verb in both the infinitive part and the past tense part. When the informants are presented with the verbs, they also look at pictures of the action. There are also pictures for the nonce verbs. The pictures are
collected from cartoons and magazines, and they are all in color. The test situation was preformed in the following way:

*Experimenter:* Here you see some people who like to _______/yesterday they _______. What are they doing today/now?
*Informant:* Today/now they _______
*Experimenter:* And you?
*Informant:* Today/now I _______

The verbs in the test were chosen because the -aj- and -a- classes look similar in the infinitive and the past tense, but they differ in productivity as well as in type frequency, and of course, in the way they are inflected. The -aj- class is the productive one and it has high type frequency. The -a- class has low productivity and has low type frequency. They are also matched in complexity of paradigm. The -a- class has consonant alternation in the present tense, whereas the -aj- class does not. There are, as can be seen from the table above (Table 4), more morphological changes in the -a- class verbs than in the -aj- class verbs. There is nothing in the phonology of the -a- and the -aj- classes in the infinitive and the past tense indicate whether it is a -aj- class verb or a -a- class verb, hence it is interesting to see what verb form is most ofte chosen with this competition between patterns.

The -i- class has, as the -aj- class, high type frequency, and is a productive class. What the -aj- class and the -i- class do not have in common, is complexity of paradigm, where the -i- class is the more complex one, but here the -a- and the -i- classes are similar.

The -ova-class is also a productive class in Russian, and when it comes to type frequency, this is high. As far as complexity of paradigm is concerned, the -ova- class is somewhere between the -aj- class on one side and the -a- and -i- classes on the other side (for further description of the Russian verbs, see above).

As mentioned in the introduction, the Russian verb test has not been used to test AD patients. However, other populations have been tested with the same test, but without pictures (Gor, 2004; Gor & Chernigovskaya, 2000; 2001; 2003; Svistunova, 2005; Kalinina, 2005; Tkachenko, forthcoming). For the test used in the present study, all pictures were picket by Tkachenko (Tkachenko, forthcoming) picked out all the pictures.
4.2 The Norwegian test and test material

The Norwegian test consists of eighty verbs, both real verbs and nonce verbs. Sixty of the verbs are real Norwegian verbs, both regular and irregular. There are sixteen verbs belonging to the WL class of verbs, seventeen verbs belonging to the WS class, and twenty-seven verbs belonging to the irregular verb class. The total score of the test without the nonce verbs are sixty, and the minimum score within a normal range is fifty-five (Lind, Moen, Simonsen, 2007:16). The Norwegian past tense test is part of the Norwegian Verb and Sentence Test (VAST). This test was originally developed by Bastiaanse, Edwards, Maas, and Rispens (2003), and it was developed to assess verb and sentence processing. The test was originally created to test people with aphasia, but can also be used on other populations (Bastiaanse et al., 2003:49). The past tense test is a part of the Norwegian test only, and not the original test.

There are 20 nonce verbs in the test, and some of them are based on real Norwegian verbs by changing the initial sound of a real verb. The other nonce verbs were made based on Norwegian phonotax (Tkachenko, forthcoming). Tkachenko (Tkachenko, forthcoming) chose all the pictures to the Norwegian verb test. This means that not all the Norwegian nonce verbs were made in the same way as the Russian nonce verbs. All the verbs in the test were presented together with a picture as a perceptual representation of the action described by the verb, and the experimenter presented the verb in the infinitive and in the present tense and the informant was encouraged to say the verb in the past tense. It is of course impossible to find pictures of the nonce verbs, but pictures were shown in this condition as well. The pictures in this test are from cartoons and magazines, and they are in color. To get the informants to say the verb in the past tense, a small dialog was initiated between the experimenter and the informant:

*Experimenter:* Here you see a girl smile. She is smiling. Yesterday she did the exact same thing as she is doing now, what did she do?

*Informant:* She (smiled).

Unlike the Russian test, the Norwegian test consists of only one part, namely where the informant is supposed to answer with the verbs in the past tense.

There has been one previous test using the same test described here used to test Norwegian AD patients (Simonsen, Moen, Øksengård, & Engedal, 2004). In this test, there
were only real verbs and no nonce verbs. The advantage of nonce verbs is that they can provide information real verbs cannot (see above in section 4.1), for example like what pattern are the ones used most productively. However, this test has been used on other Norwegian populations, like specifically language impaired children (Bjerkan, 2000), people with cri du chat-syndrome (Wium, 2006) and bilingual (Russian/Norwegian children) (Tkachenko, forthcoming).

4.3 The Russian Informants

There were six Russian AD patients participating in the experiment: four females and two males. The youngest informant was 59 years old, and the oldest was 79 years, which gives a mean age of 71.5 years. Before the verb test started a MMSE was performed on all informants. The mean score on the MMSE was 16.16, which implicates a rather low score. The highest score on the MMSE was here twenty four, and the lowest score was eight, which means that the range was very wide. Sofia Fedorovna Sluchevskaya picked out the informants at the Geriatric city center in St. Petersburg.

Informant number one, A.A, is a 74-year-old female. She had no higher education, but ten years of school. The onset of the disease was in the summer of 2005 (the experiment was conducted in October/November 2006). Her score on the MMSE test was 12 points. She could not orientate herself in time or place, and she did not know her age. She did not understand that she is ill.

Informant number two, B.B, is a 79 year old female. Her educational background was seven years of grade school. The onset of the disease was in the spring 2006. Her score on the MMSE test was 20 points. This woman did not seem very ill when we first met her, but as we spoke with her, it was obvious that she was. She seemed pretty confident in her self.

Informant number three, C.C, is a 68 year old male. He has a higher education from the university. The onset of the disease was in 2002. He also had epileptic seizures. The results of his MMSE test were 24 points. When he was told what the experiment was about, he became a little skeptic because he said he could not see the point in looking at pictures and answering with what he said was easy sentences. Nevertheless, he agreed to participate.

Informant number four, D.D, is a 59 year old male. He had had seven years of school. His result on the MMSE test was 19 points. The onset of the disease was in 2002. He can partly orientate himself in time and place; he knows his own age and name. He also understands that he is ill.
Informant number five, E.E, is a 75 year old female. She has a higher education from the university. The onset of the disease was in 2003. The results of her MMSE test were 8 points. She can orientate herself in place, but not in time. She knows her name, but not her age. She understands that she is ill.

Informant number six, F.F, is a 74 year old female. She does not have higher education, but elementary school. The result of her MMSE test was 14 points. The onset of the disease was in 2003-2004. She can not orientate herself in time and place. She knows her name, but not her age. She understands that she is ill.

**Table 6: The Russian informants**

<table>
<thead>
<tr>
<th>Informant</th>
<th>Gender</th>
<th>Age</th>
<th>Education</th>
<th>Onset of disease</th>
<th>MMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A</td>
<td>F</td>
<td>74</td>
<td>10 years</td>
<td>Summer, 2005</td>
<td>12</td>
</tr>
<tr>
<td>B.B</td>
<td>F</td>
<td>79</td>
<td>7 years</td>
<td>Spring, 2006</td>
<td>20</td>
</tr>
<tr>
<td>C.C</td>
<td>M</td>
<td>68</td>
<td>University</td>
<td>2002</td>
<td>24</td>
</tr>
<tr>
<td>D.D</td>
<td>M</td>
<td>59</td>
<td>7 years</td>
<td>2002</td>
<td>19</td>
</tr>
<tr>
<td>E.E</td>
<td>F</td>
<td>75</td>
<td>University</td>
<td>2003</td>
<td>8</td>
</tr>
<tr>
<td>F.F</td>
<td>F</td>
<td>74</td>
<td>Elementary school</td>
<td>2003-2004</td>
<td>14</td>
</tr>
</tbody>
</table>

(The age of the Russian AD patients varied from 59 to 79 years, giving a mean age of 71.5 years.)

The Russian control group was tested by Kalinina (2005). This group consisted of twenty-two people without any kind of language deficit. Their age was from 17 years old to 72 years old, with a mean age of 29.3 years. There were fourteen females and eight males. Nine of the females and two of the males were students, three females and three males had a university education, and two females and three males had high school.
4.4 The Norwegian informants

There were five Norwegian informants participating in the present study. Informant A.A was a 74-year-old female. She had higher education, and her score on the MMS was 21. Her diagnosis was dementia of the Alzheimer’s type (DAT).

Informant B.B was a 69-year-old male. He also had a higher education. The MMSE score was 24.

Informant C.C was an 87-year-old female.

Informant D.D was a 67-year-old male with higher education. His MMS score was 25.

Informant E.E was a 69-year-old female, also with higher education. As with informant D.D, E.E’s MMSE score was 25.

Table 7: The Norwegian informants

<table>
<thead>
<tr>
<th>Informants</th>
<th>Gender</th>
<th>Age</th>
<th>Education</th>
<th>MMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A</td>
<td>F</td>
<td>74</td>
<td>Higher education</td>
<td>21</td>
</tr>
<tr>
<td>B.B</td>
<td>M</td>
<td>69</td>
<td>Higher education</td>
<td>24</td>
</tr>
<tr>
<td>C.C</td>
<td>F</td>
<td>87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.D</td>
<td>M</td>
<td>67</td>
<td>Higher education</td>
<td>25</td>
</tr>
<tr>
<td>E.E</td>
<td>F</td>
<td>69</td>
<td>Higher education</td>
<td>25</td>
</tr>
</tbody>
</table>

(The age range was from 67 to 87, giving a mean of 73, 2 years.)
5.0 Results

In this chapter, I will first present possible errors types in the Russian AD patients, followed by a presentation of possible error types in the Russian normal control group. There will also be a table of generalization errors, on how they are generalization of other patterns. Following this, I will give a presentation of the Russian test results. The results of the real verbs and nonce verbs will be presented together in a table in order to make the differences between them as lucid as possible. However, I will describe them separately. The reason for this is that in reality it is not possible to say that a nonce verb is either correctly inflected or not. Nevertheless, it is interesting to see what pattern the informants choose when inflecting nonce verbs, what pattern “wins” the competition. I will compare the results of the real verbs with the results of the nonce verbs. Following this, I will present the results of the Russian control group. Since there are twenty-two normal controls, I will present the results of the real verbs and nonce verbs in two separate tables.

In the next section of this chapter, I will present the results of the Norwegian test. As with the Russian material, I will first give a description of possible error types, both in the Norwegian AD patients as well as in the Norwegian control group. This section will be followed by a presentation of the results from the Norwegian AD patients. The results from all the five Norwegian AD patients are presented in a table. I will show the results of the nonce verbs and real verbs in two separate tables. Since the Norwegian control group only was tested with nonce verbs, there will be one table for this group. The tables will be presented first with comments. Most of the explanation and discussion of the numbers in the tables will be discussed after the tables have been presented.
5.1 Results of the Russian tests

5.1.1 Error types in the Russian tests

In all kinds of tests where the informants have some kind of language deficit, the errors produced might tell us more than what they are able to answer correctly. In order to know anything about what the errors made in this test might tell us, a table of error types can be found below. The errors made in this test belong to either of these groups:

- Generalization errors (Gen.)
- Wrong verb (w.v)
- Past tense (pt)
- Infinitive (inf.)
- Real verb (r.v)
- Other (oth.)

There are several different generalization errors occurring in the test. In the table below (Table 8) there are examples of generalizations to and from the verb classes included in the present study.

Table 8: Generalization errors

<table>
<thead>
<tr>
<th>Generalization</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen. -aj- → *-uj-</td>
<td>Wrong: Plavju/plavujut</td>
</tr>
<tr>
<td></td>
<td>Correct: Plavaju/plavajut</td>
</tr>
<tr>
<td>Gen. -aj- → -a-</td>
<td>Wrong: Lavchu/lavchut</td>
</tr>
<tr>
<td></td>
<td>Correct: Lavkaju/lavkajut</td>
</tr>
<tr>
<td>Gen. -a- → -aj-</td>
<td>Wrong: Plakaju/plakajut</td>
</tr>
<tr>
<td></td>
<td>Correct: Plachu/plachut</td>
</tr>
<tr>
<td>Gen. -a- → *-uj-</td>
<td>Wrong: Pratujut</td>
</tr>
<tr>
<td></td>
<td>Correct: prachut</td>
</tr>
<tr>
<td>Gen. -i- → *-uj-</td>
<td>Wrong: Znakomuju</td>
</tr>
<tr>
<td></td>
<td>Correct: znakomlju</td>
</tr>
<tr>
<td>Gen. -ova- → -aj-</td>
<td>Wrong: Drobovaju/drobovajut</td>
</tr>
<tr>
<td></td>
<td>Correct: Drobuju/drobujut</td>
</tr>
<tr>
<td>Gen. -ova- → -a-</td>
<td>Wrong: Dovnju</td>
</tr>
<tr>
<td></td>
<td>Correct: Devnuju</td>
</tr>
</tbody>
</table>

If the informant makes a generalization error, he or she generalizes a pattern to a verb class that does not belong to this pattern (i.e., inflect a verb from one class as a verb belonging to another verb class). There are many kinds of generalization errors that might occur, since most of the verbs included in the test could be generalized to other classes.
If the informants answer with the wrong verb, this will be marked with w.v. This can be because either the informant did not hear the correct verb, or that the informant was guessing, especially on the nonce verbs.

It is likely that the error type where the verb is given in the past tense is a perseveration\(^4\) since the stimuli verb is given in the past tense in one of the two parts of the Russian test. The same might be the case with the verbs that are answered in the infinitive form.

The nonce verbs could in some cases be misinterpreted as, or replaced by real verbs. If the nonce verb znavit’ is replaced by znat’ (to know), this would be an error of this kind.

In the last error category, “other”, the replies can be given as another word class than verbs, for example nouns, or other verbs that do not resembles the target verb. Generalization errors other than those in Table 8 also belong to this category of errors. In many of the other verb classes than those described in Table 8, there were generally few generalization errors.

5.1.2 Results of the Russian AD patients

The results of the Russian AD patients are collected in one table. The replies of both the nonce verbs as well as for the real verbs can be found in the table below.

\(^4\) Perseveration means that something, in this case a verb ending, is repeated without necessarily fitting the context.
### Table 9: Replies of the Russian AD patients (in order of correct responses)

<table>
<thead>
<tr>
<th>Informant:</th>
<th>Nonce verbs</th>
<th></th>
<th>Real verbs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Infinitive test</td>
<td>Past-tense test</td>
<td>Infinitive test</td>
<td>Past-tense test</td>
</tr>
<tr>
<td><strong>B.B:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-aj-:</td>
<td>40 %</td>
<td>60 %</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>-a-:</td>
<td>35 %</td>
<td>0 %</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>-i-:</td>
<td>90 %</td>
<td>65 %</td>
<td>100 %</td>
<td>95 %</td>
</tr>
<tr>
<td>-ova-:</td>
<td>95 %</td>
<td>100 %</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td><strong>C.C:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-aj-:</td>
<td>80 %</td>
<td>80 %</td>
<td>80 %</td>
<td>70 %</td>
</tr>
<tr>
<td>-a-:</td>
<td>25 %</td>
<td>20 %</td>
<td>100 %</td>
<td>90 %</td>
</tr>
<tr>
<td>-i-:</td>
<td>70 %</td>
<td>100 %</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>-ova-:</td>
<td>40 %</td>
<td>95 %</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td><strong>A.A:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-aj-:</td>
<td>30 %</td>
<td>55 %</td>
<td>70 %</td>
<td>75 %</td>
</tr>
<tr>
<td>-a-:</td>
<td>25 %</td>
<td>10 %</td>
<td>90 %</td>
<td>95 %</td>
</tr>
<tr>
<td>-i-:</td>
<td>90 %</td>
<td>70 %</td>
<td>100 %</td>
<td>95 %</td>
</tr>
<tr>
<td>-ova-:</td>
<td>95 %</td>
<td>100 %</td>
<td>100 %</td>
<td>90 %</td>
</tr>
<tr>
<td><strong>D.D:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-aj-:</td>
<td>80 %</td>
<td>90 %</td>
<td>100 %</td>
<td>90 %</td>
</tr>
<tr>
<td>-a-:</td>
<td>15 %</td>
<td>0 %</td>
<td>60 %</td>
<td>40 %</td>
</tr>
<tr>
<td>-i-:</td>
<td>45 %</td>
<td>64 %</td>
<td>85 %</td>
<td>90 %</td>
</tr>
<tr>
<td>-ova-:</td>
<td>100 %</td>
<td>90 %</td>
<td>90 %</td>
<td>95 %</td>
</tr>
<tr>
<td><strong>F.F:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-aj-:</td>
<td>45 %</td>
<td>60 %</td>
<td>70 %</td>
<td>70 %</td>
</tr>
<tr>
<td>-a-:</td>
<td>10 %</td>
<td>55 %</td>
<td>55 %</td>
<td>90 %</td>
</tr>
<tr>
<td>-i-:</td>
<td>45 %</td>
<td>70 %</td>
<td>70 %</td>
<td>100 %</td>
</tr>
<tr>
<td>-ova-:</td>
<td>90 %</td>
<td>95 %</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td><strong>E.E:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-aj-:</td>
<td>55 %</td>
<td>35 %</td>
<td>85 %</td>
<td>80 %</td>
</tr>
<tr>
<td>-a-:</td>
<td>5 %</td>
<td>0 %</td>
<td>75 %</td>
<td>70 %</td>
</tr>
<tr>
<td>-i-:</td>
<td>75 %</td>
<td>50 %</td>
<td>100 %</td>
<td>80 %</td>
</tr>
<tr>
<td>-ova-:</td>
<td>75 %</td>
<td>70 %</td>
<td>100 %</td>
<td>75 %</td>
</tr>
</tbody>
</table>
In the nonce verbs, the class with the highest score was the -ova- class, both in the infinitive and the past tense test. The class with the next highest score in the nonce verbs was the -i- class. The test result was almost the exact same in the infinitive and the past tense test. The class with the second lowest score among the nonce verbs is the -aj- class. The score for this verb class is a little better in the past tense test than in the infinitive test. The -a- class got the lowest score among the nonce verbs, and it clearly differs from the other three classes. Furthermore, this class has a little higher score in the infinitive test than in the past tense test.

The six Russian AD patients did not make the same kind of generalizations; hence, they did not all use the same pattern as the most productive one. Still, there are tendencies to and consistency among the Russian AD patients in how they inflected nonce verbs. How they generalized to and from the verb classes included in this test, can be found in Table 10 below.
Table 10: Generalizations of the nonce verbs

<table>
<thead>
<tr>
<th>Informant</th>
<th>Gen $\rightarrow$ -aj-</th>
<th>Gen $\rightarrow$ -a-</th>
<th>Gen $\rightarrow$ -i-</th>
<th>Gen $\rightarrow$ -ova-</th>
<th>Gen $\rightarrow$ *-uj-</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.B</td>
<td>15 %</td>
<td>8, 75 %</td>
<td>22, 5 %</td>
<td>23, 75 %</td>
<td>30 %</td>
</tr>
<tr>
<td></td>
<td>Past tense</td>
<td>25 %</td>
<td>0 %</td>
<td>16, 25 %</td>
<td>25 %</td>
</tr>
<tr>
<td>C.C</td>
<td>51,25 %</td>
<td>13, 75 %</td>
<td>17, 15 %</td>
<td>10 %</td>
<td>0 %</td>
</tr>
<tr>
<td></td>
<td>Past tense</td>
<td>37,5 %</td>
<td>8, 75 %</td>
<td>25 %</td>
<td>23,75 %</td>
</tr>
<tr>
<td>A.A</td>
<td>15 %</td>
<td>11, 25 %</td>
<td>22, 5 %</td>
<td>23, 75 %</td>
<td>25 %</td>
</tr>
<tr>
<td></td>
<td>Past tense</td>
<td>22, 5 %</td>
<td>2,5 %</td>
<td>17, 5 %</td>
<td>25 %</td>
</tr>
<tr>
<td>D.D</td>
<td>45 %</td>
<td>3, 75 %</td>
<td>11, 25 %</td>
<td>22, 5 %</td>
<td>8, 75 %</td>
</tr>
<tr>
<td></td>
<td>Past tense</td>
<td>45 %</td>
<td>1, 25 %</td>
<td>16, 25 %</td>
<td>22, 5 %</td>
</tr>
<tr>
<td>F.F</td>
<td>21, 25 %</td>
<td>5 %</td>
<td>11, 25 %</td>
<td>22, 5 %</td>
<td>33, 75 %</td>
</tr>
<tr>
<td></td>
<td>Past tense</td>
<td>20 %</td>
<td>21, 25 %</td>
<td>17, 5 %</td>
<td>23, 75 %</td>
</tr>
<tr>
<td>E.E</td>
<td>23, 75 %</td>
<td>6, 25 %</td>
<td>18, 75 %</td>
<td>18, 75 %</td>
<td>17, 5 %</td>
</tr>
<tr>
<td></td>
<td>Past tense</td>
<td>11, 25 %</td>
<td>1, 25 %</td>
<td>12, 5 %</td>
<td>17, 5 %</td>
</tr>
</tbody>
</table>

The Russian AD patient also made other kinds of errors other than generalization errors. These errors can be found in the table below (Table 11).
Table 11: Errors in the Russian AD patients

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen: -a-&gt;-oj-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 %</td>
</tr>
<tr>
<td>Gen: -i-&gt;-ej-</td>
<td>2,5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gen: -i-&gt;-ij-</td>
<td>2,5%</td>
<td>17,5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gen: -ova-&gt;-avaj-</td>
<td>5 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gen: -ova-&gt;*-uj-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,5%</td>
</tr>
<tr>
<td>Past tense</td>
<td>12,5%</td>
<td>5%</td>
<td>7,5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>45%</td>
</tr>
<tr>
<td>r.v</td>
<td>5%</td>
<td>7,5%</td>
<td>10%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>17,5%</td>
<td></td>
<td></td>
<td>7,5%</td>
<td>2,5%</td>
<td>40%</td>
</tr>
<tr>
<td>Inf.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12,5%</td>
<td>2,5%</td>
<td>17,5%</td>
<td>15%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2,5%</td>
<td>2,5%</td>
<td>5%</td>
<td>10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,5%</td>
</tr>
</tbody>
</table>

The results of the nonce verbs in the AD patients clearly show that the -a- class pattern was the least productive pattern. Many of the nonce -a- verbs were generalized to other classes, in most of the cases the -aj- and *-uj- patterns, both V+j. There was some nonce -a- verbs that were inflected like -a- class verbs, which means that this pattern can be productive. Nevertheless, they apply the -a- pattern relatively rarely to novel verbs. There were more real -a- class verbs that were inflected correctly; the results of the real -a- verbs were closer to the results of the real verbs belonging to the other three verb classes in this test.

The Russian AD patients often used the -aj- pattern when inflecting nonce verbs, especially for the nonce verbs that were created based on real -a- verbs. In those cases where the nonce verbs that were based on real -aj- verbs were genarlized to another pattern, the *-uj- pattern was the one the Russian AD patients used. For the real -aj- verbs the score was a hundered percent, which means that they did also not have any problems with these verbs.
Both the -i- and -ova- patterns were used productively, the -ova- pattern a little more than the -i- pattern. Both of them were used a little less productively than the -aj- pattern. Since the suffix -uj- really “belongs” to the -ova- class, it could be said that the verbs that were inflected this way were a result of generalization to the -ova- pattern. Nevertheless, they were kept in their own column due to the fact that they form an ungrammatical verb class when used on other verbs than the -ova- verbs.

5.1.3 Results of the Russian control group

In order to see how the results of the AD patients can tell us anything about their language abilities, we need to know how a normal control group would do on the same test. This is interesting in order to see whether the normal control group and the AD patients inflect verbs in the same way. It is also interesting to see if there are some verb classes that cause problems for the AD patients only, or for the control group as well. Furthermore, it is interesting to see whether the errors made by the AD patients are the same kind of errors made by the control group.

Below is the table of the Russian control group and their responses on the nonce verbs. Since there were twenty-two normal controls, the results on the nonce verbs and real verbs are presented in two tables.
Table 12: Results of the nonce verbs in the normal controls

<table>
<thead>
<tr>
<th>Informant</th>
<th>-aj-</th>
<th>-a-</th>
<th>-i-</th>
<th>-ova-</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A</td>
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<td>B.B</td>
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<td>C.C</td>
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<td>D.D</td>
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<td>E.E</td>
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<td>F.F</td>
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<td>G.G</td>
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<td>H.H</td>
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<tr>
<td>I.I</td>
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<td>J.J</td>
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<td>K.K</td>
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<td>M.M</td>
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<td>N.N</td>
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<td>Q.Q</td>
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<td>R.R</td>
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<td>80 %</td>
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<td>S.S</td>
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<td>75 %</td>
<td>95 %</td>
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<td>T.T</td>
<td>100 %</td>
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<td>60 %</td>
<td>60 %</td>
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<tr>
<td>U.U</td>
<td>95 %</td>
<td>80 %</td>
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<tr>
<td>V.V</td>
<td>90 %</td>
<td>100 %</td>
<td>20 %</td>
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</table>

The Russian control group did in general better on the verbs test than the Russian AD patients. The class with the lowest score was the -a- class. They did use this pattern as a productive pattern, but not to the same degree as the other three classes.

The control group and the AD patients followed the same pattern in the -aj- class as well. As the AD patients, the control group made the second fewest generalizations to the -aj-class. Nevertheless, the gap between the -a- class and the -aj- classes is bigger than in the AD patients, and the score of the -aj- class is close to those of the -i- and -ova- classes.
For both the -i- and -ova- classes the score was high, slightly higher in the -i- class. They were both used productively. Possible reasons for this finding, will be discussed below.

The real -aj-, -i-, and -ova- verbs all got hundred percent correct stem recognitions in all twenty-two informants. Therfore I will not put these in a table. For the -a- class the situation is different.

**Table 13: Results of the nonce verbs in the normal controls**

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</thead>
<tbody>
<tr>
<td><strong>Infinitive</strong></td>
<td>100%</td>
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<td>95%</td>
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<tr>
<td><strong>Past tense</strong></td>
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<td>100%</td>
<td>90%</td>
<td>100%</td>
<td>100%</td>
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</tbody>
</table>

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</thead>
<tbody>
<tr>
<td><strong>Infinitive</strong></td>
<td>100%</td>
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<tr>
<td><strong>Past tense</strong></td>
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<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>95%</td>
</tr>
</tbody>
</table>

Overall, the control group did better on the test than the AD patients, but the class where both groups made most errors, is the -a- class. This finding will be discussed below.

**Table 14: Generalization errors in the control group**

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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>→ -a-</td>
<td>→ -a-</td>
<td>→ -uj-</td>
<td>→ -uj-</td>
<td>→ -ij-</td>
<td>→ -aj-</td>
<td>→ -a-</td>
<td>→ -a-</td>
</tr>
<tr>
<td>6, 13%</td>
<td>0, 40%</td>
<td>19, 90%</td>
<td>0, 90%</td>
<td>0, 81%</td>
<td>0, 95%</td>
<td>2, 09%</td>
<td>2, 09%</td>
</tr>
</tbody>
</table>

Since the control group is a more homogenous group than the group of AD patients, the errors of the whole group is gathered in one table. The control group made fewer errors than the AD patients. One of the most frequent errors in the AD patients was that they replaced nonce verbs with real verbs. None of the informants in the control group did this. The number of generalizations is lower for all the generalizations in the control group than it is for the AD patients.
5.2 Results of the Norwegian tests

5.2.1 Error types and generalizations in the Norwegian test

Possible error types in the Norwegian AD patients are generalization errors, where generalizations to the WL class will be marked as Gen → WL, generalizations to the WS class will be marked as Gen → WS, and generalizations to the irregular verbs will be marked as Gen → S. These generalizations will be used when the nonce verbs are describes in order to see which pattern the informants used most frequently.

If a nonce verb is replaced by a real verb this means that they replied with a real verb instead of the nonce verb that was the stimuli verb, as with the nonce verb å fle if this is replaced by å flette (to braid hair). Other possible error types are verbs that are wrong, i.e. they are not inflected like the verb the informant is supposed to inflect, or they answer with a word that does not resemble a verb in the past tense, like sme for å smy (nonce verb).

5.2.2 Results of the Norwegian AD patients

Table 15: Results of real verbs in the Norwegian AD patients

<table>
<thead>
<tr>
<th>Informants</th>
<th>WL</th>
<th>WS</th>
<th>S</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A.</td>
<td>87, 50 %</td>
<td>94, 11 %</td>
<td>88, 88 %</td>
<td>93, 33 %</td>
</tr>
<tr>
<td>B.B.</td>
<td>75 %</td>
<td>100 %</td>
<td>92, 59 %</td>
<td>90 %</td>
</tr>
<tr>
<td>C.C.</td>
<td>93, 75 %</td>
<td>100 %</td>
<td>92, 59 %</td>
<td>95 %</td>
</tr>
<tr>
<td>D.D.</td>
<td>100 %</td>
<td>100 %</td>
<td>96, 29 %</td>
<td>98, 33 %</td>
</tr>
<tr>
<td>E.E.</td>
<td>93, 75 %</td>
<td>100 %</td>
<td>100 %</td>
<td>98, 33 %</td>
</tr>
</tbody>
</table>

As can be seen from the table the score is relatively high for all the Norwegian informants. None of the three classes has a score that is clearly lower than the other classes. For several of the informants the score for some of the classes were a hundreded percent. The total score is for all five informants. Therfore, there is nothing that thus far that tells us that Norwegian AD patients have any particular problems with verb inflection. This will be further discussed below.
Table 16: The replies of the nonce verbs in the Norwegian AD patients

<table>
<thead>
<tr>
<th>Informant</th>
<th>Gen→WL</th>
<th>Gen→WS</th>
<th>Gen→S</th>
<th>Nonce verbs replaced by real verbs</th>
<th>Persevaration</th>
<th>Present tense</th>
<th>Non-verb form</th>
<th>Infinitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A</td>
<td>50 %</td>
<td>20 %</td>
<td>10 %</td>
<td>20 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.B</td>
<td>25 %</td>
<td>65 %</td>
<td>5 %</td>
<td>5 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.C</td>
<td>30 %</td>
<td>25 %</td>
<td>15 %</td>
<td>25 %</td>
<td>5 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.D</td>
<td>20 %</td>
<td>45 %</td>
<td>15 %</td>
<td>10 %</td>
<td>5 %</td>
<td>5 %</td>
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</tr>
<tr>
<td>E.E</td>
<td>40 %</td>
<td>50 %</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>10 %</td>
</tr>
</tbody>
</table>

In most of the generalizations, the Norwegian AD patients used the WS pattern, with over half of the nonce verbs generalized to this verb class, which means that they used this pattern very productively. Following the generalization to the WS pattern were generalizations to the WL pattern. This pattern was also used in a productive way, but not to the same extent as the WS pattern. The AD patients relatively rarely used the irregular pattern when they inflected novel verbs which means that this pattern was not used in a productive manner.

The Norwegian AD patients did, as the Russian AD patients replace nonce verbs with real verbs. There were quite a few nonce verbs that the AD patients replaced by real verbs.

However, the five Norwegian AD patients did not use the same regular patterns as their default pattern. Three of the informants used the WS pattern most frequently, and two used the WL pattern most frequently. None of them used the irregular pattern as the most frequent pattern.

When A.A. was introduced to the nonce verbs during the testing, this seemed to slightly worry her, and she repeated for each of the nonce verbs that “if you ask me later, I’ll not be able to recall this word”. Even though she was clearly insecure about the nonce verbs, she did reply to them. She did make some errors when inflecting the nonce verbs. A few of the verbs the informant replaced with real verbs, like with the verb å fite, she replaced with å fise (to fart), as well as saying the real verb in the present tense. When the nonce verb å domme was presented to her, she answered with var dum (was stupid). The nonce verb å kape was replaced by the real verb å kappe (to chop), and the nonce verb å deparere was replaced...
by the real verb \(\bar{a}\) reparere (to repair). For most of the nonce verbs, informant A.A made many generalizations to the WL pattern.

Informant B.B did not seem to have too many problems with the nonce verbs that were introduced to him during the test. He answered to them promptly. The nonce verb that was replaced by a real verb was \(\bar{a}\) fle, and B.B answered with the past tense of the verb \(\bar{a}\) flette (to braid hair).

Each time a nonce verb was introduced, C.C asked: “And what is that? What does it mean? I cannot say that I have heard this word before.” Even though she was a bit confused by the fact that she did not understand the meaning of the verb, she did reply to all of the nonce verbs. For some of these verbs it was hard to decide whether they were replacements of real verbs, or if the informant had heard all the verbs correctly or not. Two of the verbs were clearly replacements of real verbs, but three are not that obvious. The nonce verbs that are obviously replacements of real verbs are the verbs \(\bar{a}\) fite and \(\bar{a}\) mitte. The first nonce verb was replaced by the verb \(\bar{a}\) skryte (to brag). In the picture that accompanies the nonce verb, Calvin is showing Hobbes a snowman he made, so clearly C.C understood this as bragging, and used the verbs she knew. The other nonce verb was replaced by \(\bar{a}\) lytte (to listen), and the informant said the real verb in the infinitive, she did not inflect it in the past tense. This is also a picture if Calvin and Hobbes, and in this picture they are moving around and there is a radio in the background. C.C probably got the picture as Calvin and Hobbes were listening to music. The other nonce verbs that are a little harder to decide whether were replacements of real verbs or misunderstanding of all the sounds in the nonce verb are \(\bar{a}\) delpe, that was replied with dempa (past tense of the WL verb \(\bar{a}\) dempe), which means to lessen/moderate/tone down/lower. The verb \(\bar{a}\) mi was replied with mimet (the past tense form of the WL verb \(\bar{a}\) mime, which means to mime). She replied with \(\bar{a}\) deppe (to be depressed) to the nonce verb \(\bar{a}\) depareere. The first verb is hard to say whether the /l/ was misinterpreted and that she understood it as a /m/, or whether she indeed meant the real verb \(\bar{a}\) dempe. It has been considered as the last alternative here. The second verb \(\bar{a}\) mi is generally a difficult nonce verb, because all the normal controls stopped when this verb came up. Maybe also C.C thought this verb was too strange, and then found the real verb that resembled this verb the most likely one and replaced it with this. One perseveration occurred in the replies of informant C.C. This was the nonce verb \(\bar{a}\) velikisere, which she inflected as velikisog. This is a clear dialectal form of the past tense because the informant had this ending in other real verbs as well. The verb that the informant had replied just before \(\bar{a}\) velikisere was the nonce verb \(\bar{a}\) dr\(\bar{a}\) where she replied with drog and the real
verb å le where she replied with log. Therefore, it is likely that the reply velikisog was a perseveration.

Informant D.D replied with one of the nonce verb in the present tense, and this was the verb å gåve, which in the present tense is gåver. The form that does not resemble any past tense form is the reply to the verb å smy, and this was sme. This word resembles the Norwegian noun smed (blacksmith), in fact the pronunciation is the same since the /d/ in smed is silent. It is also possible that D.D tried to inflect this verb as a strong verb. The nonce verbs that were inflected like real verbs was å fle which was replaced with the strong verb å fly (to fly), and the nonce verb å søpe was replaced by the real verb å supe (to drink (alcohol)). Like informant B.B, D.D also made most generalizations to the WS class. There was almost an equal amount of generalizations to the WL class and the strong verbs.

Informant E.E differs slightly from the other informants because E.E did not generalize to the irregular verb class at all, and she did not replace any of the nonce verbs with real verbs. There was almost an equal amount of generalizations to the the weak classes, but most to the WS class.

One WL verb that four of the five informants inflected wrong was the verb å love (to promise). In Norwegian dictionaries, the verb å love is listed with two possible inflections, first the WL, but the other possibility is the WS class. This verb has a long stem vowel, which is more common among WS verbs than WL verbs (Simonsen & Endresen, 2001). That could explain why four of the informants answered with this verb as a WS verb instead of a WL verb. Since it is becoming more usual to inflect this verb as a WS verb in Norwegian, and if we choose to not see this as an error in the results in the Norwegian AD patients, three of the Norwegian informants are within the normal range of the test score, namely 55 correct verbs out of 60. The fourth informant, on the other hand, would then have answered all the verbs correctly.
Table 17: AD patients’ generalizations of the nonce verbs

<table>
<thead>
<tr>
<th>Nonce verb</th>
<th>Gen → WL</th>
<th>Gen → WS</th>
<th>Gen → S</th>
<th>Replacement of nonce verb with real verb</th>
<th>Infinitive</th>
<th>Present tense</th>
<th>Perseveration</th>
<th>Non past tense form</th>
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<tbody>
<tr>
<td>Delpe</td>
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<td>Gåve</td>
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<td>Velikisere</td>
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<td>Plave</td>
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<td>Kape</td>
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<td>Mi</td>
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</table>

There were more generalizations to the WS class than to the WL class, which means that the WS patterns was the one the Norwegain AD patients used most productively. There were relatively few generalizations to the irregular verbs class. Moreover, none of the five AD patients used this pattern as their default pattern. Another error that the AD patients made was the replacements of nonce verbs with real verbs. There was also perseveration among the AD
patients, as well as replies given in the infinitive form and in the present tense. Furthermore, one reply was not a verb at all.

5.2.3 Results of the Norwegian control group

Since nonce verbs are not included in the original Norwegian verb test, a control group was needed in order to see how they inflected these nonce verbs; which classes were most often used, and why these classes were used. The most important aspect was to assess whether the normal controls and the AD patients inflected the nonce verbs in the same way, and if not, how they differ from each other.

There were eleven normal controls without any kind of language deficit participating in the study. The age range was from 25 years to 91 years. The informants were introduced to twenty-one nonce verbs (the same as described above). The reason why there were 21 nonce verbs for the normal controls and 20 for the AD patients is that the AD patients got a practice nonce verb. They were supposed to answer with the verbs in the past tense. The verb was read to them in the infinitive, and they were not shown any pictures with the verbs as the AD patients were. This was in order to make the informants answer as quickly as possible.

If the generalization was to the WL class, this will be marked with $Gen \rightarrow WL$; generalization to the WS class, will be marked with $Gen \rightarrow WS$, and generalization to the irregular verbs, will be marked as $Gen \rightarrow S$. Another possible error is overmarking of the verbs, and this will be marked as $OVERMARK$. If a verb is marked with this type of error, it means that the verb was inflected both as a WL verb and as a WS verb. One of the verbs that were overmarked was $\ddot{a}fle$, and it then got the past tense overmarking $fledda$. The ending $–dd + (V)$ is a WS verb ending in the past tense, and the $–a$ is one of the two possible WL verb ending in the past tense. There might be some nonce verbs that are not inflected with a past tense form, for example verbs that are inflected in the past participle. If so, this will be marked with $PP$.

First, there will be a table of which real verbs the nonce verbs resembles, followed by a table of the results from the control group (for a translation of the Norwegian verbs in the following table, please see Appendix II). Since the replies of all the nonce verbs differed among the informants, it is interesting to see why there were different replies, and the reason(s) for these differences. Given the fact that not all the Norwegian nonce verbs were created from real Norwegian verbs, it is an idea to see which Norwegian real verbs the nonce verbs resembles.
### Table 18: Table of nonce verbs and the real verbs they resemble

<table>
<thead>
<tr>
<th>Nonce verb</th>
<th>Infinitive</th>
<th>Similar to</th>
<th>Past tense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Å delpe</td>
<td>Å hjelpe</td>
<td>Hjalp</td>
<td>Dempl/-a</td>
</tr>
<tr>
<td>Å byse</td>
<td>Å lyse</td>
<td>Lyste</td>
<td>Fros</td>
</tr>
<tr>
<td>Å fryse</td>
<td>Å nysen</td>
<td>Nos</td>
<td></td>
</tr>
<tr>
<td>Å gåve</td>
<td>Å sove</td>
<td>Sov</td>
<td>Lovet lovte</td>
</tr>
<tr>
<td>Å mitte</td>
<td>Å smitte</td>
<td>Smittet/-a</td>
<td>Tittet/-a</td>
</tr>
<tr>
<td>Å fle</td>
<td>Å kle</td>
<td>Kledde</td>
<td>Så</td>
</tr>
<tr>
<td>Å fite</td>
<td>Å bite</td>
<td>Bet/beit</td>
<td>Slet/slet</td>
</tr>
<tr>
<td>Å deparere</td>
<td>Å reparete</td>
<td>Reparerte</td>
<td>Protestere</td>
</tr>
<tr>
<td>Å søpe</td>
<td>Å kjøpe</td>
<td>Kjøpte</td>
<td>Døpte</td>
</tr>
<tr>
<td>Å sme</td>
<td>Å fly</td>
<td>Floy</td>
<td>Sydde</td>
</tr>
<tr>
<td>Å smy</td>
<td>Å sy</td>
<td>Sydde</td>
<td>Brød bryde</td>
</tr>
<tr>
<td>Å drå</td>
<td>Å få</td>
<td>Fikk</td>
<td>Sto</td>
</tr>
<tr>
<td>Å pade</td>
<td>Å bade</td>
<td>Badet/-a</td>
<td>Spradet/-a</td>
</tr>
<tr>
<td>Å domme</td>
<td>Å bomme</td>
<td>Bommet/-a</td>
<td>Trommet/-a</td>
</tr>
<tr>
<td>Å duse</td>
<td>Å suse</td>
<td>Suste</td>
<td>Ruste</td>
</tr>
<tr>
<td>Å britte</td>
<td>Å smitte</td>
<td>Smittet/-a</td>
<td>Tittet/-a</td>
</tr>
<tr>
<td>Å resi</td>
<td>Å lese</td>
<td>Leste</td>
<td></td>
</tr>
<tr>
<td>Å velikiser</td>
<td>Å operere</td>
<td>Opererte</td>
<td>Protestere</td>
</tr>
<tr>
<td>Å plave</td>
<td>Å lauge</td>
<td>Lagde</td>
<td>Lavev/-a</td>
</tr>
<tr>
<td>Å myge</td>
<td>Å smyge</td>
<td>Smøg/smyng</td>
<td></td>
</tr>
<tr>
<td>Å kape</td>
<td>Å gas</td>
<td>Ga</td>
<td>Red/rei</td>
</tr>
<tr>
<td>Å røpe</td>
<td>Å vri</td>
<td>Vred/vrei</td>
<td></td>
</tr>
<tr>
<td>Å tinne</td>
<td>Å finne</td>
<td>Fant</td>
<td>Vant</td>
</tr>
<tr>
<td></td>
<td>Å vinne</td>
<td></td>
<td>Skinte</td>
</tr>
<tr>
<td></td>
<td>Å skinne</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 19: Results from the Norwegian control group

<table>
<thead>
<tr>
<th>N nonce verb</th>
<th>Gen → WL</th>
<th>Gen → WS</th>
<th>Gen → S</th>
<th>OVERMARK</th>
<th>PP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delpe</td>
<td>45, 45 %</td>
<td>27, 27 %</td>
<td>27, 27 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byse</td>
<td>9, 09 %</td>
<td>72, 72 %</td>
<td>9, 09 %</td>
<td>9, 09 %</td>
<td></td>
</tr>
<tr>
<td>Gåve</td>
<td>18, 18 %</td>
<td>36, 36 %</td>
<td>36, 36 %</td>
<td>9, 09 %</td>
<td></td>
</tr>
<tr>
<td>Mitte</td>
<td>90, 90 %</td>
<td></td>
<td>9, 09 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fle</td>
<td></td>
<td>27, 27 %</td>
<td>45, 45 %</td>
<td>27, 27 %</td>
<td></td>
</tr>
<tr>
<td>Fite</td>
<td>36, 36 %</td>
<td></td>
<td>63, 63 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deparere</td>
<td>90, 90 %</td>
<td></td>
<td></td>
<td>9, 09 %</td>
<td></td>
</tr>
<tr>
<td>Søpe</td>
<td>9, 09 %</td>
<td>81, 81 %</td>
<td>9, 09 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smy</td>
<td>9, 09 %</td>
<td>72, 72 %</td>
<td>18, 18 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drå</td>
<td>9, 09 %</td>
<td>72, 72 %</td>
<td>18, 18 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pade</td>
<td>72, 72 %</td>
<td>18, 18 %</td>
<td>9, 09 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domme</td>
<td>54, 54 %</td>
<td>36, 36 %</td>
<td>9, 09 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duse</td>
<td>36, 36 %</td>
<td>54, 54 %</td>
<td>9, 09 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Britte</td>
<td>45, 45 %</td>
<td></td>
<td>54, 54 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rese</td>
<td>100 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Velikisere</td>
<td>90, 90 %</td>
<td></td>
<td>9, 09 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plave</td>
<td>54, 54 %</td>
<td>36, 36 %</td>
<td>9, 09 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myge</td>
<td>45, 45 %</td>
<td>36, 36 %</td>
<td>18, 18 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kape</td>
<td>63, 63 %</td>
<td>36, 36 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mi</td>
<td>27, 27 %</td>
<td>54, 54 %</td>
<td>18, 18 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tinne</td>
<td>45, 45 %</td>
<td>27, 27 %</td>
<td>18, 18 %</td>
<td>9, 09 %</td>
<td></td>
</tr>
</tbody>
</table>

The generalizations made in the control group are in accordance with the type frequency of the real verb classes. However, it is interesting to see that even with unknown verbs that could have been Norwegian due to the phonotax, the most frequently used pattern is the pattern most frequently used in real Norwegian verbs as well, namely the WL pattern. The WS class follows the WL class. These two generalizations differ from the Norwegian AD patients. The control group used the WL pattern more frequent, whereas the AD patients used the WS pattern more frequent. Neither the control group nor the AD patients used the irregular pattern as the most frequent one. For the control group it is obvious that type frequency plays an important role in the processing of novel verbs.
There could have been more examples on real verbs, but I chose to have no more than three examples for each of the verbs in order to keep the table as small as possible.

Since the generalization of the nonce verbs follows the type frequency of real Norwegian verb class based on the results of this control group, it is reasonable to assume that type frequency is important in inflection of novel verbs. The nonce verbs were in some cases, but not always inflected as the verbs it resembled phonologically, and the factor that seems to override this is type frequency.

Another, and perhaps the clearest difference between the control group and the AD patients is the replacement of some of the nonce verbs with real verbs. This error was not found in the control group. The AD patients were shown pictures to each of the verbs in the test, also the nonce verbs, but the normal controls performed the test without seeing any pictures. Is it possible that the AD patients replaced some of the nonce verbs by looking at the pictures and saying the real verb for the action in the picture instead (i.e., that they were influenced by the pictures). There is reason to believe that this is not necessarily the case. There was only one of the Norwegian informants that did use a real verb that could describe the picture she was shown, and this was not a pattern for all the nonce verbs she replaced by real verbs. This verb was å fite, which she replaced by å skryte (to brag; see description of picture above). Second, the other Norwegian AD patients did not replace the nonce verbs with real verbs that could fit the picture they were shown. For example did one of the AD patients replace the nonce verb å fle with å fly (to fly). In this picture, Calvin and Hobbes are sitting on a bed holding a shoe down to lure a “monster” under the bed to get out so they can “shoot” it. In the picture, nothing resembles flying.

One verb class clearly differs from the other verb classes in both the AD patients and in the control group and that is the low generalization to irregular verbs. This class is not productive, it has low type frequency, and that had clearly an effect on the generalizations in the two groups.

In general, the AD patients did more errors than the control group; in the control group there were neither nonce verb in the infinitive form or any nonce verbs in the present tense, as well as no replacements of nonce verbs with real verbs or any perseverations as could be found in the AD patients.
5.3 Correlation between test results and MMSE

One might expect the MMSE test result to have an influence on the test results of the verb test. If this is the case, the differences between the Norwegian and Russian AD patients may be due to the MMSE test and not due to the differences in the verbal morphological systems in the two languages. I will first take a closer look at the Russian test results compared to the MMSE test results, and then proceeding to the Norwegian test results compared to the results of the MMSE test.

5.3.1 The Russian AD patients

There does not necessarily have to be a correlation between the MMSE result and the results of the verb test. In the Russian test, informant B.B. did not have the highest MMSE score. Nevertheless, this informant got the highest score on the tests among the Russian AD patients. Furthermore, V.R is the oldest informant, and has only seven years of school.

The informant with the second highest score on the verb test is C.C. He has the highest score on the MMSE among the Russian AD patients, with 24 points. He was second youngest among the informants, and he had a university education.

The informant that had the third highest score on the verb test is A.A. This informant’s MMSE score is 12, which is relatively low compared to the two described above. A.A. is 74 years old.

There were two informants with the same total score of the verb tests, informants D.D. and F.F. They did not have the same MMSE score, and the age difference is 15 years. D.D’s MMSE score is 19, and he is 59 years old. The MMSE score of F.F is 14, and she is 74 years old. Their educational background is elementary school.

The one with the lowest total score also has the lowest MMSE result with 8 points. This is informant E.E. This informant is 75 years old, and she has university education.

As we can see from the Russian AD patients there does not have to be a correlation between the test result and their results on the MMSE. There is a relation between the two tests in only one of the six Russian AD patients, namely informant E.E.
5.3.2 The Norwegian AD patients

For the Norwegian AD patients it is harder to say whether there is a clear correlation between the test results and the results of the MMSE. All the Norwegian informants did very well on verbal inflection; none of them got a very low score on the verb test. However, the two informants with the highest MMSE score (D.D and E.E) got the highest score on the verb test. Unfortanely, for one informant the MMSE result is unknown. This informant did also very well on the verbs test, and it would of course be very interesting to see how her MMSE test result correlated with the verb results. However, the results from the verb test and the MMSE for the other four informants, show that those with a somewhat better MMSE result, also did a little better on the verb test. This differs slightly from the results of the Russian AD patients where there was nothing that indicated a correlation between the two tests (the MMSE and the verb test).
6.0 Analysis of the results from all the tests

In this chapter, the results from both the Norwegian and Russian tests will be analyzed. There will also be a comparison of the results from the Russian and Norwegian test. Furthermore, there will be a comparison of the results with the two competing linguistic views (the declarative/procedural model and the network model) included in the present study, as well as an analysis of the results from the present study according to the two competing models. This chapter consists of two main sections. In the first, the test results from the Russian and Norwegian tests will be analyzed according to Ullmann’s declarative/procedural model. First, I will see the Russian test results in light of this model, and then the Norwegian. In the second part, the Russian and Norwegian test results will be analyzed according to Bybee’s network model.

6.1 The Test Results seen in Light of Ullmann’s Declarative/Procedural Model

As all the results from the Russian and Norwegian AD patients as well as a Russian and Norwegian control group are collected, it is possible to see whether the results are in accordance with what Ullmann predicts in his declarative/procedural model. It should also be possible to see whether the declarative/procedural model is able to show that there is a difference in normal controls and AD patients.

First, there will be an analysis of the results from the Russian tests according to the declarative/procedural model, followed by an analysis of the results from the Norwegian participants.

6.1.1 The Russian results analyzed according to the declarative/procedural model

Before analyzing the Russian test results, some important questions will be discussed. If the results from the Russian test are to be analyzed according to Ullmann’s model, the verb classes in the Russian test have to be divided into regular or irregular verbs, as well as fully productive or partially productive verb classes (these are connected to each other in Ullmann’s model). This is important in the declarative/procedural model, and it presupposes that verbs do fall into these clearly separated categories. The reason why this is of such importance is that there are only those verbs that are fully productive that the procedural
memory controls. This is where it gets problematic. Because of all the Russian verb classes it is not possible to divide them into clearly diverse regular or irregular classes and not either fully productive or partially productive classes the way Ullmann sees this. All these limits are graded, and not clear-cut in the Russian verbal system. It is also not possible to say that one of the classes is the one regular class that the procedural memory controls. Ullmann is also not clear on what really separates local default (which is part of fully productive verbs), and partially productive verbs. The way he describes it, it seems like the same kind of transformation. It is difficult to say for sure, as Ullmann does not provide these descriptions with examples. Thus far, the model is problematic, as it has not taken into account languages that have such complex verbal morphology as for example Russian. The closest we get to regularity in Russian verbs are the V+j pattern as the default pattern.

6.1.1.1 The -a- class

I will first discuss how the -a- class can be problematic or non-problematic relative to the declarative/procedural model. This verb class is not necessarily the most problematic of the classes included in the present study. The -a- class is not a fully productive class, and therefore the procedural memory cannot process and be responsible for this class. Hence, it is likely that the -a- class is an irregular verb class that is processed in the declarative memory. Another reason why this is considered an irregular verb class is the complexity of paradigm; there are three morphological transformations that are “activated” and applied when an -a-class verb is being inflected. These rules are vowel truncation before vowel ending, consonant mutation, and stress shift (see Table 4). According to the declarative/procedural model it is, as mentioned above, assumed that AD patients should have more difficulties and make more errors with irregular verbs than regular since the damage to the brain usually start in the posterior regions of the left hemisphere where the declarative memory system, according to Ullmann (1997; 2001), is believed to be situated. As far as the real -a- verbs are concerned, this prediction is in accordance with the results from the Russian AD patients obtained in the present study. The real -a- verbs got a relatively low score in the AD patients.

As far as the nonce verbs that are based on real -a- verbs are concerned, the -a- pattern was the one used least productively in the Russian AD patients. This class differs clearly from the three other classes with its low scores in all six informants. Ullmann predicted that AD patients “should have greater difficulty inflecting irregular than regular or novel verbs (…)” (Ullmann et al., 1997:269). This does not explain the low generalizations to the nonce -a- verbs (all the nonce verbs got a lower score than real verbs (see Table 9). Based on these
predictions the AD patients should do rather well on nonce verbs. They are able to inflect these nonce verbs, but the declarative/procedural model is not able to say anything about why the AD patients use the patterns they do. Thus, the declarative/procedural model did not predict what was the result of the nonce verbs that are based on real -a- class verbs.

The results of the real verbs differ in some respect from the results of the nonce verbs, but there are some similarities as well. Ullmann assumes in his declarative/procedural model that the AD patients should make errors and generally have problems with this verb class. As can be seen from Table 9, the Russian AD patients make far more errors in the -a- class; they clearly have problems with this verb class. As far as Ullmann’s model goes, one could expect this result for the irregular -a- class. However, there is another aspect of the declarative/procedural model that has to be examined more closely. In this model, the assumption is that morphologically complex forms are possibly affected by frequency (Ullmann, 2001). Most of the -a- class verbs that were not inflected correctly by the AD patients, were inflected either as -aj- class verbs or *-uj- class verbs. This means that what seems to be the default pattern of Russian verbs, V+j, was applied in the cases where the -a-class was not recognized correctly. Since there are other classes included in this test not yet explained and analyzed, there is still not evidence that the declarative/procedural model can account for all the replies from the AD patients in the Russian test. Furthermore, it is not yet clear to what degree the model is able to uncover language deficits in AD patients.

The AD patients made far more generalization errors from the -a- class to the *-uj-class than the control group. Moreover, as we have seen so far, the Russian AD patients do have problems with the -a- class. However, so does the control group. The control group consisted of normal, healthy controls that did not have any language deficits, and no brain damages. As for the AD patients, the -a- class was clearly the class that was most problematic. The control group did all in all better than the AD patients on all the verb classes, also the -a-class, but there was a difference between the results of this verb class and the other three included in the Russian test. Since both the control group and the AD patients did worse on the -a- class it is likely that other factors than a damaged declarative memory system can explain that result.

6.1.1.2 The -aj- class

The -aj- class is the Russian verb class in the present study closest to being a regular verb class, according to Ullmann’s model. It is then a fully productive transformation controlled and processed in the procedural memory. The morphological transformation the
-aj- class will go through is consonant truncation before consonant ending. This means that in the present tense V+j will be applied to the forms of the verb (chitat’ (inf.) \( \rightarrow \) chitaju (1st p. sing)/ chitajut (3rd p. pl). Since this is a regular verb class, with the default pattern of Russian verbs (Gor & Chernigovskaya, 2001), this class should not, according to the declarative/procedural model be affected by AD since the regular verbs are stored and processed in the procedural memory system. The replies to the real -aj- verbs given by the Russian AD patients could imply that this is not necessarily the case. The real -aj- verbs did get a relatively high score among the AD patients, but not the highest. Infact, this was the class with the second lowest score. The results of this class are close to those of the real -a-verbs, especially in the past tense test, where the results are almost the same. According to the declarative/procedural model, the score should have been higher; at least the difference between the -a- verbs and the -aj- verbs should have been more evident. Therfore it seems as though what Ullmann’s model predicts is not how the Russian AD patients reply. However, if the errors made in the real -aj- class are analyzed, we can see that most of the errors are generalization errors from the -aj- class to the *-uj- class. In other words, if the verb is inflected correctly, it is the same kind of transformations one could expect. Nevertheless, the vowel /a/ is replaced by /u/, but the pattern V+j is preserved. At first glance, it might seem, as the AD patients did not inflect the verbs correctly since they did not use the -aj- pattern. When we take a closer look on the errors made in this verb class, we see that the pattern that is supposed to be applied to the -aj- class, V+j, is in fact applied with *-uj-. One can possibly argue that the “rule system” has not failed because the correct pattern is indeed applied. As it is only the -ova- class that in reality can take the -uj- suffix, this suffix is considered ungrammatical when added to other verb classes. Furthermore, this leads to the assumption that -aj- class verbs inflected with the suffix *-uj- are in fact ungrammatical and therefore non existing in Russian. Hence, the rule failed to be applied correctly and the model could not account for the low score on the -aj- class, and not the even score among the -aj- and the -a-classes in the Russian AD patients. The -aj- class is a case of regular verbs generalized to another verb class. According to the declarative/procedural model, generalization errors in regular verb classes should not occur.

The nonce verbs based on real -aj- verbs has the second lowest score among the AD patients. The -aj- class is closer to what can be called a regular verb classe, controlled by the procedural memory. The -aj- pattern applies to new forms to a greater extent than the -a-pattern. Since Ullmann (1997) predicted that novel as well as regular verbs should not be difficult for AD patients, one could expect nonce verbs that are based on a regular verb class
to get a somewhat higher score than they did in the Russian AD patients. For all six of the informants, the score was closer to fifty percent than to a hundred. Again, this is not in accordance with the predictions of the declarative/procedural model. The AD patients were, on the other hand, able to inflect nonce verbs.

The control group did better than the Russian AD patients on the real -aj- class and the difference between the two groups of informants on the -aj- class are relatively clear. For the normal controls the test results show that the -aj- class was not problematic. Given the fact that there is such a clear difference between the normal control group and the AD patients on the -aj- class, it is possible that the poor results in the AD patients have to be explained in other ways than by a preserved grammar.

6.1.1.3 The -i- class

The -i- class is probably one of the most difficult Russian verb classes included in this test to analyze according to the declarative/procedural model. There are several reasons for this. First of all the class is a productive class. This could imply that the verb class is a regular verb class. Still, to say that it is a fully productive class can be problematic, if it is not fully productive the procedural memory cannot, according to the declarative/procedural model, process the class, and hence it cannot be a regular verb class. If this class is not a regular verb class, it can be predicted that the class will have approximately the same score as the -a- class since these two classes undergo the same morphological changes when inflected, and none of them have the pattern V+j. If the verb class is a regular verb class, the expected results should be that the score is high among the Russian AD patients. I will argue that it is an irregular verb class due to the complex morphological paradigm, and because it is difficult to see this as a fully productive class.

The AD patients did very well on this verb class. This was the class with the second highest score on the real verbs. If then, both the -a- and the -i- classes are irregular, this should logically imply that these two classes should pose an equal amount of problems for the AD patients and more or less give the same total score. Since they do not, it is natural to search for an answer to this question elsewhere rather than in a separated grammar and lexicon and an impaired declarative memory. The errors made in the -i- class are most often generalization to either the -aj- or the *-uj- class. One can ask why the the AD patients did not make more generalizations to the -ij- class, the “default partner” of the -i- class. There are very few verbs in Russian that belong to the -ij- class, only seven, and this class has low type frequency and is not a productive class (Gor & Chernigovskaya, 2001). Nevertheless, the AD patients did
not use this pattern. Looking at the results of the real verbs for all the AD patients the -i- class is approximately ten percent better than the -aj- class in both the infinitive- and the past tense test. If irregular verbs are stored and processed in the declarative memory, they should be severely impaired, and the -aj- class, which is a regular class, stored and processed in the procedural memory should be closer to a hundred percent correct answers, which is not the case with the Russian verbs tested in the present study on AD patients.

Since the normal controls are not expected to have any kind of damage to the brain, it is also not expected that they should show any difficulties with the irregularly inflected verbs, and for the real -i- verbs they do get a high score. Infact, all the twenty-two normal controls have hundred percent correct answers for the verbs in this class.

The nonce verbs that are based on real -i- verbs got a higher score than those based on real -aj- verbs. The results of these verbs are the same in the infinitive and the past tense tests. The same explanation as for the other nonce verbs described above, also applies to these verbs because the score is not close to a hundred percent for the six Russian AD patients. The AD patients usually used the -aj- and *-uj- patterns if they did not use the -i- pattern for the nonce verbs based on real -i- verbs. According to Ullmann’s declarative/procedural model, the results for the -aj- class should be better than for the -i- class, which in this case, it is not.

6.1.1.4 The -ova- class

The -ova- class is also difficult to categorize based on the criteria necessary in the declarative/procedural model. This verb class is in-between the -a- and the -i- classes on the one hand and the -aj- classes on the other as far as morphological complexity is concerned; it is less complex than the -a- and the -i- classes, but more complex than the -aj- class. This class is also one of the few Russian verb classes that have suffix alternation (from -ova- to -uj-). Since this verb class has suffix alternation, this class cannot say to be fully productive as this is such a rare phenomenon in Russian verbs. The suffix -uj- also has the pattern V+j. In this regard, it is a regular verb class, and the procedural memory should thus be responsible for it. On the other hand, the verb class has a suffix alternation, which in itself is rare, and the class has a relatively complex paradigm, at least more complex than the -aj- class. In this regard, the -ova- class is an irregular verb class. From these criteria, it should be clear that there is more than one aspect that makes this verb class hard to analyze according to the declarative/procedural model. But the fact that this model, as well as other dual mechanism views on language, do not make a clear point on how to analyze verb classes that are more complex than for example English, is a weak point.
The tables of the results for the real verbs from the AD patients, show that the -ova-class is the class with the highest score of the verb classes included in this test. In other words, not what the declarative/procedural model predicts if the -ova- class is an irregular verb class. According to this model, the results should be closer to the results of the -a- and the -i- classes, but worse than the -aj- class. However, as we know, it is not. Thus far, we also know that the results of the -a- and -i- classes differs from eachother. The results of the -ova- class are better than the -aj- class. The model is still not able to cover all the aspects of the verbal inflection in the Russian AD patients. Based on the declarative/procedural model it is now evident that there is not only one verb class that is difficult to explain.

For the nonce verbs that are based on real -ova- verbs, the situation is a little different from the verbs described above. These nonce verbs got the highest score among the six AD patients, but still not close to a hundreded for all of the informants. Nevertheless, overall it does not seem as they experienced too much difficulties with these nonce verbs.

The control group is also for this verb class not expected to encounter any difficulties, and they do not either. For the real -ova- verbs all the twenty-two normal controls answered with a hundred percent correct answers.

6.1.1.5 A comparison of the four Russian verb classes

The AD patients are able to inflect nonce verbs, so even if they use some patterns to a lesser degree than other patterns, this does not mean they cannot inflect the nonce verbs. Since the score is lower for the nonce verbs than it is for real verbs, this implies that the AD patients found these verbs more difficult than real verbs. The AD patients replaced many of the nonce verbs with real verbs. The AD patients looked at pictures for each of the nonce verbs, still there is no reason to believe that this influenced their processing of the verbs. In most of the cases, they replaced the nonce verbs with real verbs that resembled the nonce verbs phonologically. The declarative/procedural model does not predict this. None of the twenty-two Russian normal controls made this error.

For the nonce verbs the results in the past tense test is somewhat better than for the infinitive test, except for the -a- class. For the -i- class the result in the two tests are the same. This is also the case for real -i- verbs, the result in the two tests are about the same. For the real -a- verbs, the test results are also the same in the infinitive and the past tense tests. For the real -ova- verbs the infinitive test got a higher score than the past tense test, as did the real -aj- verbs.
Tore Nesset (unpublished article) writes: “While the infinitive is the citation form used in grammars and dictionaries, it seems likely that the more frequent past tense forms enjoy a more central status in the mental grammars of the language users. One possible explanation to why this does not apply to all the verbs classes in the Russian test is that the infinitive test was always tested first, followed by the past tense test (with a break inbetween).

Perhaps not everyone will agree in the distinction between regular and irregular verb classes as they are described here. It is indeed difficult to group Russian verbs as either regular or irregular since the boundaries are not clear-cut as in languages with less complex verbal morphology. What is most important is that the verb classes included in the test all differ from each other in one way or another and the classes share some features with the other classes, whether it is productivity, type frequency, or complexity of paradigm. Therefore, it is possible to say that some new knowledge about morphology and mind has been achieved regardless of whether the classification is agreed upon or not, as well as new information that is not possible to obtain from English or other languages that do not have complex verbal morphology. Some of the classes in the Russian test share the same features; hence, they should cause the same degree of problems to the AD patients, or the same degree of ease, which is not the case as we can see from the results obtained here. With this new information, it is hard to accept a clear-cut distinction between grammar and the lexicon; verb classes that only have one morphological transformation, hence one rule according to a modular view, are not necessarily easier to compute than verbs that will be considered irregular with a complex paradigm.

To sum up, the declarative/procedural model is not able to account for the results of the Russian tests even though it is evident that the Russian AD patients differ from the normal control group when inflecting verbs. No matter how one choose to classify the Russian verb classes, the declarative/procedural model presuppose that the results of the -a- and the -i-classes should be similar to eachother. Furthermore, the -ova- class should also get a relatively low score. This is not the case. It is also not possible for the declarative/procedural model to account for the fact the class that is the most regular verb class is the one with the second lowest score among the AD patients. Hence, it is good reason to ask whether there are two memory systems that each handle irregular and regular forms of words, and perhaps that there are other explanations for the results of the Russian AD patients.
6.1.2 The Norwegian results analyzed according to the declarative/procedural model

The Norwegian verbs differ, as we have seen, from the Russian verbs. Above the responses of the Russian AD patients have been analyzed according to the declarative/procedural model. How will this model account for the responses of the Norwegian AD patients, and will this differ from the Russian responses? First, the responses of the AD patients will be discussed, and then, the nonce verbs will be discussed and compared to the Norwegian control group.

6.1.2.1 The WS class

It is easier to divide the Norwegian verb classes into clearly separated regular and irregular verbs than it is with Russian verbs. Nevertheless, this classification poses some problems as well. At first glance, it seems easy, but when the declarative/procedural model is further examined, we can see that this is not necessarily the case. The problems of deciding which of the regular verb classes in Norwegian is the one processed by the procedural memory starts with Ullmann’s fully productive transformations, which he further divides into global and local default, and partially productive transformations. The irregular verb class is not fully productive, so the declarative memory controls this class. However, is it the WL class or the WS class that is fully productive? Both these classes are regular verb classes in Norwegian. Both also have a syllabic suffix added in the past tense, either –te/de/ or –et/-a. These suffixes are added to the stem of the verb in the past tense. For verbs that has a /t/ in the stem can hardly have the –te/de/ suffix added in the past tense. For example, like the verb å kaste (to throw). The stem of this verb is kast. The suffix for the WS class cannot be added to this stem, *kastte (or kastde). Therefore the suffix –te/de/ is not applicable in any set of conditions, which cannot make this a global default suffix. Whether this class is partially productive or has local default suffix is harder to decide. There are also irregularities occurring in this class, like vowel alternation in the past tense. The verb å fortelle (to tell) will be fortalte in the past tense. Therefore, there are irregularities in the verb class, which means that it is not necessarily fully a regular verb class. If we assume that this class is partially productive, this would furthermore imply that the procedural memory does not control this verbs class. If the declarative memory system controls it, the expected results of the Norwegian AD patients are that there will be several errors in this class based on Ullmann’s model. On the other hand, the WS class is in fact seen as one of two regular verb classes in Norwegian. If the class is considered a regular verb class, the results that can be expected from Ullmanns model is that the Norwegian AD patients inflect these verbs without making too many errors. As can be
seen from the tables of the Norwegian informants, they do not make many errors in this class. Infact, in the AD patients this is the class with the highest score among the three Norwegian verbs classes. For the real verbs it is important to keep in mind that the differences between the results of the three Norwegian verbs classes are small. All three classes are relatively even.

When the Norwegian AD patients infelcted nonce verbs, they used the WS pattern most frequently. Most of the nonce verbs were inflected as verbs belonging to this pattern. This differs from the control group. The control group used the WL pattern as their default pattern, but they also used the WS pattern rather frequently.

6.1.2.2 The WL class
The WL class also has to be classified as either fully or partially productive before it can be analyzed according to Ullmann’s declarative/procedural model. The suffix of this class, -et/-a, can be applied to most kinds of verbs in the Norwegian verbal system, although there are few restrictions. This means that this class is a fully productive class; hence, it is controlled by the procedural memory. This implies that the Norwegian AD patients should not make many errors in this class. As is possible to see from the tables (Table 15), they are not doing that. Still, the result of this class is not in accordance with the predictions of Ullmann’s model; this is the class with the lowest score among the Norwegian AD patients. If the verbs are controlled by the procedural memory, they should be in an area of the brain where the deficits to begin with are not that comprehensive, which again should mean that they do not have any problems with these verbs. From the results of the Norwegian AD patients it is not correct to say that they do have problems with the WL class only because this is the class with the lowest score. Even though the score is lower than for the other two classes, the score is still high. In this respect, the declarative/procedural model does not show any clear differences between AD patients and people without any language deficits.

The AD patients used the WL pattern productively when they inflected nonce verbs. However, this was not the pattern they used most productively (see above). This differs from the control group, because they used the WL pattern most productively when inflecting nonce verbs. One of the differences between the WL and the WS classes is that the WS class is more phonologically restricted than the WL class; there are more restrictions for new verbs to be classified as WS verbs. This seems to provide the AD patients with valuable information for the inflection of nonce verbs, as well as real verbs.
6.1.2.3 The irregular verbs

Before any conclusions can be drawn, the last Norwegian verb class has to be analyzed according to this model. This is the irregular class, which according to Ullmann’s model should be more difficult for the AD patients to process since the declarative memory system controls the verbs belonging to this class. The responses of the Norwegian AD patients show that these verbs do not cause any particular problem for the informants; the total score of this class is high, which the declarative/procedural model does not predict. The result of this class is in fact higher than that of the WL class. The declarative/procedural model predicts that the WL class should get a higher total score than the irregular verbs. Based on Ullmann’s model, there does not seem that Norwegian AD patients have problems with verb inflection. The predictions of the declarative/procedural model are not applicable to the results of the Norwegian AD patients since the result of the irregular class is as high as the two regular classes. This indicates that the declarative/procedural model cannot account for the answers given by the Norwegian AD patients. The explanation has to be found elsewhere and not through dissociation between the processing of regular and irregular verbs respectively as Ullmann predicts. These results could further imply that for the AD patients one single system handles the process of both regular and irregular verbs. This means that the declarative/procedural is not able to show that Norwegian AD patients and normal controls use different strategies in the processing of verbs.

The Norwegian AD patients used the irregular pattern least productively when they inflected nonce verbs. One informant did not use this pattern at all for any of the nonce verbs. The rare use of the irregular pattern also applies for the normal controls.

6.1.2.4 A comparison of the replies to the Norwegian verb classes

It is difficult for the declarative/procedural model to account for the results of the Norwegian test. The results of the Norwegian AD patients do not show that they have any particular problems with verbal morphology. All three classes got a high score, none of them differs clearly from the others. According to the declarative/procedural model, the score for the irregular verb class should be lower than for the other two classes. It is true that the Norwegian AD patients do not have any difficulties with the regular verb classes, but they do not have any difficulties with the irregular verb class either. Since the declarative/procedural model is not able to show a difference in the processing of real verbs among AD patients and normal controls, one expects that they inflect verbs in the same way as people without any language deficits. However, when the results of the nonce verbs in AD patients and normal
controls were compared, it was evident that they did not use the same strategies for this task. The AD patient replaced some of the nonce verbs with real verbs, and the normal control group and the AD patients used the different patterns most productively. In other words, AD patients do use other strategies when inflecting verbs than normal controls, and this is not possible to see based on the declarative/procedural model. Hence, the declarative/procedural model did not predict the responses given by the Norwegian AD patients.

Since the class that is more phonologically restricted got a higher score than the one that is less phonologically restricted, this obviously plays a role in the processing of verbs for AD patients. If we look at the phonology, we know that the phonological abilities in AD patients are well preserved until later stages of the disease. Therefore, the class that is more phonologically restricted will be easier for the AD patients to process, but the declarative/procedural model does not account for this.

As with the Russian results, Ullmann does not predict that AD patients should have problems with nonce verbs. The Norwegian AD patients managed to inflect the nonce verbs, but everybody but one replaced some of the nonce verbs with real verbs. None of the Norwegian controls replaced nonce verbs with real verbs. If the nonce verbs are compared to real verbs based on their phonological shape, most of the verbs can be counted as both regular and irregular (see Table 18). Since both regular and irregular real verbs resemble the nonce verbs, it is interesting to see what verb class is chosen for the nonce verbs, as well as to see whether the AD patients are able to inflect nonce verbs or not.

6.2 The test results seen in the light of cognitive linguistics

Since the results of the Russian and Norwegian test was not predicted by the declarative/procedural model it is time to search for the answers to why the AD patients answered the way they did elsewhere. For the Russian AD patients it was from the declarative/procedural model expected that they should have problems with some of the classes since they were considered irregular, whereas the regular class should be easier for them to process. The network model also predicts differences among different verb classes. This distinction is not based on different processing mechanisms of regular and irregular verbs, but rather in frequency of different verb classes. First, I will analyze the Russian results according to the network model, and then I will analyze the Norwegian results according to the same model.
6.2.1 The Russian results analyzed according to the network model

6.2.1.1 The -aj- class

The first class to be analyzed is the -aj- class. This class has high type frequency, and it is productive. Among the four verb classes in the Russian test, this is the class with the highest type frequency (see Table 5). The network model thus predicts a high score for this verb class. For the real -aj- verbs, this is true. The score is high, but not the highest among the verb classes included in the present study. This was in fact the class with the second most errors, making it somewhat better than the -a- class, but worse than the -i- and -ova- classes. This result is perhaps surprising according to the network model since verbs that are frequent should be easier to process. Most of the generalization errors made in the -aj- class are generalizations to the *-uj- pattern. This means that when an -aj- class verb was not inflected correctly, the pattern that was chosen instead was the same kind of pattern that is found in -aj- verbs, namely V+j. The AD patients kept the default pattern even though it was with a wrong suffix. The normal control group did better than than the AD patients on the -aj- class as all the informant in the control group got a hundred percent.

For the nonce verbs, the AD patients used this pattern relatively productively (see Table 9). Nevertheless, they did not use this pattern as the default pattern. The control group used the -aj- pattern productively when they inflected nonce verbs, but as with the AD patients they did not use this pattern as the default pattern.

6.2.1.2 The -a- class

For the real -a- verbs, the score was about the same as for the real -aj- verbs. This is not what the network model predicts since the type frequency and productivity differs in these two classes. The network model predict that the -a- class should get a lower score than the other classes included in the test due to low type frequency and low productivity. The result of the -a- class is lower than for the other classes except for the -aj- class. This is where phonology is evident again. There is nothing in the infinitive and the past tense forms of the -a- and -aj-class verbs that separate the two classes from each other phonologically. If the AD patients rely more on phonological cues than normal controls, this can explain the even result of the real -a- and -aj- classes. The relatively low score in the -a- class was due to generalization errors to the other classes in the test, and most often to the -aj- class, which means that the class with the lowest type frequency “lost members” to the class with higher type frequency. This was the case for both the nonce verbs as well as for the real verbs. The -a- and the -aj-
patterns low- and high type frequency patterns in Russian, and they are both affected by either type frequency and/or productivity. Most generalization errors in the -a- class are generalizations to the -aj- class which is a more frequent and productive class. In the -aj- class there are generalization errors to the *-uj- verb class which originally stems from the -ova- class which is both productive and has high type frequency. Both the -aj- and the *-uj- suffixes have the V+j pattern.

The -a- pattern was the least productive pattern among the AD patient when they inflected nonce verbs. This is what one could expect based on the network model; the least frequent pattern in real verbs was also the pattern that was least used on nonce verbs.

6.2.1.3 The -i- class

The third verb class included in the Russian test is the -i- class. This class was according to the declarative/procedural model supposed to be inflected with more or less the same result as the verbs belonging to the -a- class. This was not the case. The results of these two classes are expected to be different if the results are analyzed according to the network model. The morphological changes taking place when verbs from these two classes are inflected are the same. This model predicts that the -i- class should get a higher score due to higher token frequency. This is in accordance with how the Russian AD patients answered the real -i- verbs. The -i- class got a higher score than the -a- class. Since the -a- and the -i- class are only separated by type frequency and productivity, these two factors (type frequency and productivity) obviously has to be important when processing the verbs belonging to these classes. Therefore, the network model can account for the results of the -a- and the -i- classes better than the declarative/procedural model since the class with the highest type frequency got a higher score than the class with lower type frequency.

Since the -i- class got a higher score than the -aj- class it becomes difficult to explain the findings by frequency effects alone since the type frequency of the -aj- class is higher than for the -i- class. The verbs belonging to this class are the only ones in the test that ends in –it’ in the infinitive, and –il’i in the past tense. All the other three verb classes end in –at’ in the infinitive and –al’i in the past tense. This might function as a phonological cue for the AD patients helping them to inflect the verbs belonging to this class correctly, since they differ phonologically from the other classes included in the test. Nevertheless, since the -i- class got a high type frequency, the results based on the network model was expected to give a high score for this verb class, which was the case in the Russian AD patients.
The Russian control group did not make any errors for the real -i- verbs. The high score is also something predicted for normal controls by the network model due to the type frequency of the class. For the nonce verbs, the control group used the -i- pattern productively, they actually used this as the most productive pattern.

6.2.1.4 The -ova- class

The real verb class where the Russian AD patients had most correct answers was the -ova- class. The network model predicted the high score of this class due to high type frequency. This class is somewhere in-between when it comes to regularity and irregularity. As we have seen from the other classes described above, type frequency and productivity better explains why the AD patients answer the way they do rather than the declarative/procedural model can account for. However, this cannot be the whole explanation since both the -aj- class and the -i- class has higher type frequency than the -ova- class. But what is special about the -ova- class compared to the other classes included in the test, is that it has a very clear phonological marker, the -ova- suffix, which is alternated with -uj- when inflected in the present tense. As already mentioned, suffix alternation is very rare in Russian verbal morphology. Since the Russian AD patients do best in this class with the least errors, it is possible that the clear phonological marker has an affect on the AD patients’ ability to inflect the verbs correctly, together with the high type frequency of the class.

In addition, for the -ova- class the result of the normal control was in accordance with the result one could expect from the declarative/procedural model. The score for this class was a hundred percent.

Thus far, it seems as though type frequency is important for the processing of verbs for the Russian AD patients. It appears that the AD patients rely on a combination of high type frequency as well as clear phonological cues when processing verbs. Even though it seems as though the control group to a certain extent also rely on phonological cues, AD patients seem to rely on this to a larger extend. The pattern the AD patients used most productively, was the -ova- pattern.

The network model can explain the way the normal control group inflected nonce verbs. The three patterns that all have high type frequency were all used productively, whereas the pattern that has low type frequency (the -a- pattern) was not used as often. The normal controls did use the low type frequency pattern more often than the AD patients did, but it is clear that both groups of informants used the -a- pattern as the least productive pattern (for results, see Tables 12 and 13).
For the results of the Russian tests, it is clear that the network model better account for the replies of both the AD patients as well as for the normal control group. The model predicted that the classes with high type frequency would get a higher score than low frequency classes, and this is how the AD patients and the normal control group responded.

6.2.2 The Norwegian results analyzed according to the network model

For the Norwegian AD patients the total score of the verb test is high; it does not seem that they experienced too much difficulty with any of the three Norwegian verb classes. Evidently, they know how to inflect verbs.

6.2.2.1 The WL class

Since the results of all the Norwegian verb classes were high, the result of the WL verb class was of course high as well. This class is the class with the highest type frequency and the most productive class among the Norwegian verb classes. Furthermore, this is the Norwegian verb class that is most phonologically open (Simonsen & Endresen, 2001). However, the WL class was not the verb class with the highest score among the Norwegian AD patients. In fact, this is the class with the lowest score. However, the network model predicts that the result for this verb class is too high, which it is. It is important to remember that the differences between the three classes were relatively small. There has to be other explanations for the differences in the results of the three verb classes other than dissociation between grammar and lexicon since all the Norwegian verb classes got a high score among the Norwegian AD patients. What became evident with the Russian verbs and the Russian tests is that the verb classes that are phonologically more restricted as well as being productive and having high type frequency seems to be more easily processed by the AD patients. Since the score for the WL verb was high, but not the highest, and the fact that this class is phonologically more open than the other classes, seems to have an effect on the AD patients’ responses to the Norwegian test.

When the Norwegian AD patients inflected nonce verbs, they made second most generalizations to the WL class, hence they used the WL pattern productively. Applying an inflectional pattern to nonce verbs, type frequency obviously influenced their inflection, but not type frequency alone. If they were, they would have inflected most of the nonce verbs using the WL pattern. Before it is possible to say anything more about this verb class and the results obtained from the Norwegian AD patients, the other verb classes have to be analyzed as well and then the WL class can be compared to the results of these.
6.2.2.2. The WS class

For the real verbs, the WS verb class was the class that got the highest score among the Norwegian AD patients. This is also a regular verb class, but with lower type frequency and productivity than the WL class. Nevertheless, the type frequency is high, and the network model thus predicts that the score of this class is to be high as well. Both the WL and WS classes are also productive. However, one of the differences between these two classes is that the WS class is more phonologically restricted than the WL class. This seems to provide helpful information to the AD patients when processing verbs. This might explain why the WS class is easier accessible for the AD patients than the WL class.

For all five of the Norwegian AD patients the WS patterns were used most productively to inflect nonce verbs. There were differences between the Norwegian AD patients in which of the regular verb classes they used as their default pattern. However, what they all had in common was that they all inflected most of the nonce verbs either following the WS or WL patterns; hence, type frequency was an important factor and influenced their inflection of the novel verbs. The same is true for the Norwegian control group. They used the WL pattern as the most productive pattern for the nonce verbs, followed by the WS pattern.

6.2.2.3 The irregular verbs

The irregular verbs also got a high total score among the Norwegian AD patients. This was the class with the second highest score, after the WS class. Furthermore, this is the class with the lowest type frequency of the Norwegian verbs, and it is a class with low productivity. It is common to divide the irregular verbs into subgroups based on their stem vowel in the infinitive and the alternation of the stem vowel in the past tense (see Table 1). According to the type frequency of this class, it could have been expected to get a lower score compared to the two regular classes that both have high type frequency. On the other hand, the verbs in this class are irregular, and according to Bybee (1985; 1995), they stay irregular due to their high token frequency. The fact that these verbs in some respect are frequent probably makes it easier for the AD patients to process these verbs. There are also more phonological restrictions to the verbs belonging to the different sub groups of irregular verbs than for the WL class. Many of the verbs that belong to the irregular verb class in Norwegian are monosyllabic in the infinitive form. This can also aid the AD patients in the processing of the verbs belonging to this class, a pattern that is becoming more prominent as the responses from the Russian and Norwegian AD patients have been analyzed.
When the Norwegian AD patients inflected the nonce verbs, the irregular pattern was the least productive one among the three possible patterns. The difference between generalizations to this class opposed to the other two verb classes was prominent. Type frequency obviously influenced the generalizations of the nonce verbs, so when the AD patients encountered nonce verbs they applied one of the inflectional patterns with the highest type frequency. Even in the cases where the nonce verbs resembled real irregular verbs the AD patients chose the most frequent inflectional patterns in most of the cases.

6.2.2.4 A comparison of the Norwegian verb classes

The generalizations of the nonce verbs differed slightly from that of the control group. The AD patients made more generalizations to the WS class, whereas the control group made more generalizations to the WL class. Again, it could seem as though the class that is more restricted phonologically as well as being of high type frequency is the class that is easier for the AD patients to process.

It is clear that the Norwegian control group inflected the nonce verbs as predicted based on the network model. They followed the frequency “map” of real Norwegian verbs when inflecting nonce verbs and used the WL pattern most productively. In cases where the nonce verbs resemble real strong verbs, the control group most often inflected the verb as either a WL or a WS verb. After the WL class, the control group generalized nonce verbs to the WS pattern. The control group made fewer generalizations to the irregular class, a more frequent pattern “won the competition”. This is also true for the Norwegian AD patients; they also used the irregular pattern least frequently when they inflected nonce verbs.

So far we see that the network model better predicts the results from both the Russian and Norwegian tests than the declarative/procedural model. The main factor here is frequency. The pattern that is of high frequency is most often applied to novel forms. This alone cannot explain all the responses to the different tests, especially the replies of all the AD patients. However, together with phonological factors, the network model better accounts for the replies in both the Russian and the Norwegian tests.


7.0 Summary and Conclusion

The purpose of this study was to take a closer look at the language of AD patients and further investigate verbal morphology in this patient group. In order to do this, two languages were compared, Russian and Norwegian. Both the Russian and the Norwegian AD patients were tested with a Norwegian and a Russian verb test respectively. These two languages have very different verbal morphology, which makes it interesting to compare them in order to find out if this could have an effect on their language abilities, and more specifically verbal morphology. In order to analyze the responses given by the Russian and Norwegian AD patients as well as for a Russian control group and a Norwegian control group, two models based on contradicting views on language and language abilities were used. These two models were Ullmann’s declarative/procedural model and Bybee’s network model.

7.1 The Russian tests

For the replies of both the Russian and the Norwegian AD patients there were some aspects that the declarative/procedural model could not account for. The first problem with this model was the problem of applying it to Russian. There were also minor problems in applying it to Norwegian. This model presupposes a clear-cut distinction between regular and irregular verb classes. It is not possible to divide Russian verbs into these clearly defined categories, as the limits between the verb classes are gradual. One thing that is clear according to this model is that regular verbs are not supposed to cause particular problems for patients with AD. Ullmann bases this on the assumption that the memory system that controls regular verbs is not responsible for the lexicon. That AD patients have word finding problems, is a well-established fact. This is the background for Ullmann’s dual mechanism model.

The class that is the most “regular” included in the Russian test is the -aj- class. As far as the real verbs goes, the declarative/procedural model is not predicting what turned out to be the responses to this verb class. The Russian AD patients seemed to have some problems with the real -aj- verbs. They were able to use the -aj- pattern correctly, but they also made generalization errors. According to the declarative/procedural model, this should not be possible as there should not be generalization errors in regular verb classes. For the nonce verbs, the AD patients use the -aj- pattern rather frequently, but not as the most frequent pattern. Most of the nonce verbs that are based on real -aj- verbs were inflected as *-uj- verbs when the -aj- pattern was not applied. This suffix is “borrowed” from the -ova- class, another
class with high type frequency, which also have the pattern V+j. They did in some cases use the -a- pattern, which shows that this pattern can be productive.

The network model cannot alone explain the replies of the real -aj- verbs among the Russian AD patients. The score of this verb class was close to the score of the real -a- verbs, which might be surprising due to the high type frequency of the -aj- class. What seems to be important here is phonological similarities between the -a- and -aj- classes in the infinitive and past tense forms of the verbs. The infinitive and the past tense forms verb the stimuli forms of the verbs in the Russian test. This seems to confuse the AD patients, or not provide them with enough cues on how to inflect the verbs; hence, the results of these two verb classes are relatively even.

For the nonce verbs based on the -aj- class, the AD patients used this pattern rather frequently. If this pattern was not applied to the nonce verb, the Russian AD patients tended to use the *-uj- pattern. This means that they kept the default pattern of Russian. Therfore it is fair to say that they added another frequent pattern instead of the correct one; they rarely applied a low frequency pattern. Even though it is hard to decide, which verbs are irregular and which are regular, the -a- and the -aj- classes differ on many respects.

It is rather difficult to analyze the responses of the real -i- verbs according to the declarative/procedural model, as this class is hard to classify as either regular or irregular. Accordong to Ullmann’s model there are only those transformations that are fully productive that can be stored and controlled by the procedural memory system. This class has high type frequency. The results from the nonce verbs also show that this class is productive. Nevertheless, the -i- class undergoes the same morphological transformations as the -a- class; hence, they are equally irregualar, or regular, depending on how one chooses to divide the Russian verbs into regular or irregular verb classes. Based on this fact, it is reasonable to assume, based on the declarative/procedural model, that these verb classes are processed in more or less the same way, which makes it plausible that the results for the -a- and the -i- classes should be close to each other. This is not how the Russian AD patients answered. The results of these two classes clearly differ from eachother. The verb class with high type frequency was easier for the AD patients to process than the class with low type frequency. The network model predicts this result.

For the nonce verbs, there were far more generalizations to the -i- class than to the -a-class. Based on these results, it is likely that type frequency plays an important role in the processing of novel verbs. The pattern with the highest type frequency is also the pattern that
the AD patients used more productively. Based on these result, the network can better account for the results of the -a- and the -i- classes in the Russian AD patients.

Neither the Russian AD patients nor the Russian control group used the -a- pattern most frequently when they inflected nonce verbs. There were relatively few generalizations to this pattern, and this generalization is clearly lower than to the other three verb classes included in the Russian test.

It is important to mention that the generalizations of the nonce -i- verb could be due to the conjugational pattern that the -i- class belongs to, which differs from the other classes included in the test. This still does not explain why the difference between the -a- and the -i- classes are as prominent as they are.

The results of the real -i- verbs are also interesting to compare with the results of another class, namely the -aj- class. Since the -i- class got a higher score than the -aj- class on the real verbs, this is neither fully in accordance with the declarative/procedural model nor with the network model. One of the differences between the -aj- and the -i- class is that the -i- class is the only verb class in the Russian test that ends in either –it’ or –il’i, whereas the other verb classes in the test end in –at’ or –al’i, which means that they belong to different conjugational patterns. Furthermore, this means that the -i- class also differs phonologically from the three other classes. Since it seems as though the AD patients rely more on phonology than normal controls, this can explain why the -i- class got a higher score than the -aj- class despite the type frequencies of the two classes. By only having one verb class ending in –it’ and –il’i made this class stand out more phonologically. Nevertheless, the declarative/procedural model predicted that if the -i- class is irregular and computed by the declarative memory system, the result should be low regardless of conjugational pattern and phonological cues.

The -ova- class in the Russian test further confirms the fact that is seems as though AD patients rely more on phonological cues than normal controls. The AD patients used this pattern productively when they inflected nonce verbs. In the infinitive and the past tense, the marker -ova- implies which pattern the verbs logically should belong to.

For the real verbs, the -ova- class was the verb class that got the highest score among the Russian AD patients. The results of the -i- and -ova- classes are relatively even, and in the past tense test, they are about the same. However, both the -aj- and the -i- classes have higher type frequency than the -ova- class, but the -ova- class is one of the few classes in Russian that has suffix alternation. The suffix -ova- is a clear phonological marker of the class. In the present tense, this class has the default pattern in Russian, V+j (-uj-). As mentioned earlier, it
is hard to say whether this is an irregular or a regular verb class. If the -aj- class is a regular verb class, the -ova- class is not. Therefore, according to the declarative/procedural model the expected result for the -ova- class was to be low, which was not found in the present study. The network model better accounts for the results of this class. Given the fact that this class has high type frequency it should be a rather high score among the AD patients, which was found.

Having seen the results of all the Russian verb classes given by the Russian AD patients it seems as if type frequency is indeed important for the inflection of novel verbs, which was shown through the differences in the results indicating to which extent they applied different patterns to the nonce verbs. That type frequency is important is also evident for the real verbs. The classes with high type frequency were easier for the AD patients to process than low type frequency verbs. This means that the network model better predicted the results of the Russian AD patients than the declarative/procedural model. However, this is apparently not all that matters for the Russian AD patients. It seems as they rely on phonology and phonological cues more than normal controls. This was shown through the fact that the -aj-, -i-, and -ova- classes all have high type frequency, but the two classes that clearly differ from the others phonologically, namely the -i- and -ova- classes, got a higher score among the AD patients. As mentioned above, the -a- and the -aj- classes do resemble each other in the infinitive and the past tense forms, which clearly influenced the AD patients' inflection of verbs.

For the nonce verbs, the differences between the infinitive part and the past tense part of the test were not significant, but the results were better for the past tense test than for the infinitive test, except for the -a- class. The reason why the -a- class got a higher score in the infinitive test than in the past tense test could be due to the low type frequency of the -a- class compared to the other classes. When the informants got tired, the more difficult the verbs of low type frequency became since the first part of the test was the infinitive part and the second part was the past tense part. For the real verbs, the score of the infinitive and past tense parts of the test were relatively even, there were no big differences between these two parts of the test.

The results of the Russian tests show that Russian AD patients do have problems with verb inflection, and that they make more errors than a Russian control group. They make more generalization errors than a control group, as well as making other kinds of errors, for example replacing nonce verbs with real verbs. For the real verbs, the control group did not make any errors in the -aj-, -i-, and -ova- classes, but a few generalization errors in the low
type frequency -a- class. They then generalized to other more frequent patterns like the -aj- and *-uj- classes.

Based on the results of the Russian AD patients there is no reason to believe that two distinct mechanisms control grammar and lexicon. If this was the case, the -a-, the -i- and the -ova- classes should have gotten a low score, but this is not true for the -i- and -ova- classes, and the -aj- class should have the highest results of all the verbs classes. The Russian AD patients did much better on the high frequency classes than on the low frequency class. Therefore it seems as type frequency plays an important role rather than distinct processing mechanisms. There was also a clear pattern that the verb classes that had a clear phonological marker as well as having high type frequency were the classes with the highest score. Since the AD patients made fewer errors on the -ova- class indicates that the -ova- suffix is guiding the AD patients in the inflection of these verbs. The same is true for the -i- verbs. These verbs also differ among other things phonologically from the other verb classes included in the present study.

The Russian control group made fewer errors than the Russian AD patients, as well as less diverse kinds of errors. In the test without the nonce verbs, all the classes except the -a- class got a hundred percent. The -a- class was close, but there were some generalization errors to the more frequent -aj- class. Since the -aj-, -i-, and -ova- classes all got a hundred percent, this is possibly due to the type frequencies and productivity of the three verb classes. This means that the network model is able to account for the results of the normal control group as well as for the replies of the AD patients: the classes with high type frequency are easier accessible than classes with low type frequency.

7.2 The Norwegian tests

All three Norwegian verb classes got a high score among the Norwegian AD patients. Neither the regular verbs nor the irregular seemed to pose any difficulties for the informants. The Norwegian verbal system is a relatively simple verbal system, especially compared to the Russian. Still, the results from all the classes were not in accordance with what the declarative/procedural model predicted. Since the WL and WS classes are considered regular verb classes, they should both be controlled by the procedural memory according to Ullmann’s model. Hence, the AD patients should have a high total score for these verb classes. This is true. Both classes got a high total score. If, as discussed above, the WS class is not a fully productive class, the results should have been lower. I have considered this verb
class a regular verb class; hence, the declarative/procedural model predicts the results for the two Norwegian regular classes. For the irregular verb class, the situation is different. The results for this verb class should be lower than the results of the regular verb classes. This is not true. The irregular verbs got a higher score than the WL class. This implies that there are not necessarily two distinct memory systems that control the processing of regular and irregular verbs.

The network model, on the other hand can better account for the results of the Norwegian AD patients. This model predicts that the classes with high type frequency should be easier to process. Both the WL and WS classes got high scores, and they have high type frequency. As far as the irregular verb class is concerned it would, according to the network model, have been natural if this class got the lowest score due to the low type frequency of the class. This is where token frequency of the verb becomes evident. Since the verbs stay irregular, they obviously have a rather high token frequency, if Bybee’s predictions are correct. Therefore, the verbs are easily accessible to AD patients (as well as for normal controls). However, the WL class is is most phonologically open compared to the two other classes. As was shown through the results of the Russian test, it seems as though AD patient rely more on phonology than normal controls. Hence, it is plausible that this is the reason why the WL class was the verb class with the lowest score among the Norwegian AD patient as they may not be provided with enough phonological cues when processing the verbs as far as this class is concerned.

Since the WS class was the class with the highest score among the Norwegian AD patients, the same pattern that emerged from the results of the Russian test is becoming more evident also here. The WS class is as the WL class a high type frequency class. This class is more phonologically restricted, thus it provides the AD patients with more phonological cues, and the results for the class are better.

There was no clear-cut distinction between the regular and irregular verb classes, which it should have been based on the declarative/procedural model. Frequency as well as phonology better accounts for the results from the Norwegian AD patients.

It is possible that Norwegian AD patients do not have any problems with verb processing because the verbal system in itself is as easy as it is and not necessarily, because the grammar itself is well preserved.
7.3 Russian and Norwegian

Type frequency seems to be important when AD patients process verbs, and they seem largely to rely on phonological cues, which evidently help them in their processing of verbs. Both the Norwegian and Russian AD patients did best on the classes that had both high type frequency as well as being more phonologically restricted. These were the -ova- and the -i- classes in the Russian test and the WS class in the Norwegian test.

Another important fact about the processing of verbs in AD patients is that when they are introduced to nonce verbs they do in some cases replace these with real verbs. All but one of the eleven AD patients that were tested in the present study did this with some of the nonce verbs. One explanation to this can be that when they are insecure when introduced to a novel word, here a nonce verb, they rather use a real verb that in some way resembles the nonce verb (in most cases phonologically), because a real verb is more frequent to them than a nonce verb is. None of the Norwegian or Russian informants in the control groups made this error. One could think that the reason why the AD patients replaced nonce verbs with real verbs was that they looked at pictures during the test, something the control groups did not. When the AD patients replaced nonce verbs with real verbs there were far more replies that did not resemble the action in the picture. On occasion, the same Russian informant replied with two different real verbs to the same nonce verb in the infinitive part of the test and the past tense part of the test. It is therefore reason to believe that phonological resemblances was more important than the picture the AD patients were shown.

Since there are fewer verb classes in Norwegian than in Russian, the variety in what kind of verb class a Norwegian use is smaller than it is for a Russian. Due to the easier morphological verbal system, it will not be as evident that some of the classes are harder to process when the brain are impaired, in this case because of AD. In Russian, on the other hand, there are more verb classes, and if someone with Russian as their first language get AD, it is more evident that the grammar is not well preserved, but rather that there are deficits in this area as well.

Generally, the Norwegian AD patients did better than the Russian AD patients on verb inflection. The Norwegian AD patients made fewer errors, and they replaced fewer of the nonce verbs with real verbs. However, the Russian AD patients had a lower score on the MMSE than the Norwegian AD patients; hence, the Russian AD patients generally had more severe AD. Nevertheless, when the total score of the Russian AD patients were compared to the MMSE score, there was not a correlation between the test results of the MMSE test and
the verb test. Since the results from the MMSE tests and the verb tests do not have to correspond, it is reason to believe that verb inflection is infact more difficult for Russian AD patients than it is for Norwegian AD patients. This could be due to the complex morphological system in Russian compared to the less complex Norwegian verbal system.

With this new knowledge, it is possible to say that verb inflection in AD patients is to a certain degree language dependent. It is more difficult for Russian AD patients to inflect all verb classes correctly after AD than it is for a Norwegian AD patient. Frequency effects together with phonological restrictions better accounts for the results of both the Russian and the Norwegian AD patients than the declarative/procedural model with its separated grammar and lexicon, and hence there is not reason to believe that different memory systems control the processing of regular and irregular verbs. The results of both the Russian and Norwegian AD patients in the present study show that frequency affects both regular and irregular verbs.

The declarative/procedural model was not able to predict the results of the Russian and Norwegian AD patients. In some points, the declarative/procedural model is hard to understand, because it has not taken into account languages with complex verbal morphology, like Russian. Furthermore, the declarative/procedural model does not predict that there are any differences between Norwegian AD patients and normal controls on the real verbs. All three classes got a high score, as they also do in normal controls. However, the nonce verbs showed that the AD patients do use another strategy than the normal controls.

The network model better predicts the responses of both Russian and Norwegian AD patients, as well as Russian and Norwegian normal controls. The classes with high type frequency are expected to have a higher score than those with low frequency. Because of this, it can be assumed that through the results of the present study they function more as evidence for the network model than for the declarative/procedural model. More research is required to find out about how AD patients store and process regularly and irregularly inflected verbs, but the present results show that frequency effects and phonology are important for AD patients when they process verbs.

The main question I wanted to investigate further with the present study was whether verb inflection possibly could be language dependent for AD patients. The answer to this question, based on the present results, seems to be yes. For AD patients, verb inflection can be language dependent; the Russian AD patients made more errors than the Norwegian AD patients did. Even though the Russian AD patients generally had lower scores on the MMSE, there was not necessarily a correlation between the MMSE results and the test results from the verb test.
In sum, it seems as verb inflection is language dependent in AD patients. The more complex verbal morphology, the more difficult it is for AD patients. This patient group also uses other strategies than normal controls when they inflect verbs. They make more diverse kinds of errors than normal controls, and they replace nonce verbs with real verbs. AD patients do not seem to have problems with irregular verbs, but rather with verbs that are low frequency. Therefore, frequency effects and phonology are the most important factors when AD patients inflect verbs.

The present study is a multi case study, which of course make it difficult to draw clear conclusions based on the material collected. With more informants, it would be possible to say with more accuracy how AD patients inflect verbs and what factors are important in this language process. Still, the present material can tell us about tendencies in the language of AD patients that have not been possible to see based on languages with non-complex verbal morphology. By comparing Norwegian and Russian AD patients, we are one step further on the way.
Litterature


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Appendix I

The following are examples of pictures that were used in the Russian and Norwegian test material:

1) Norwegian material:
BYSE
2) Russian material:

Читали
Дюбили
## Appendix II

Translation of the real Norwegian verbs that the nonce verbs resemble:

<table>
<thead>
<tr>
<th>Norwegian</th>
<th>English</th>
<th>Norwegian</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>å hjelpe</td>
<td>to help</td>
<td>å få</td>
<td>to get</td>
</tr>
<tr>
<td>å dempe</td>
<td>to lower/attenuate</td>
<td>å stå</td>
<td>to stand</td>
</tr>
<tr>
<td>å lyse</td>
<td>to light</td>
<td>å så</td>
<td>to sow</td>
</tr>
<tr>
<td></td>
<td>up/illuminate</td>
<td>å bade</td>
<td>to take a bath/go</td>
</tr>
<tr>
<td>å fryse</td>
<td>to freeze</td>
<td></td>
<td></td>
</tr>
<tr>
<td>å nyse</td>
<td>to sneeze</td>
<td>å sprade</td>
<td>to swagger</td>
</tr>
<tr>
<td>å sove</td>
<td>to sleep</td>
<td>å bomme</td>
<td>to miss</td>
</tr>
<tr>
<td>å love</td>
<td>to promise</td>
<td>å tromme</td>
<td>to drum</td>
</tr>
<tr>
<td>å smitte</td>
<td>to contaminate</td>
<td>å suse</td>
<td>to swish</td>
</tr>
<tr>
<td>å titte</td>
<td>to look</td>
<td>å ruse</td>
<td>to intoxicate?</td>
</tr>
<tr>
<td>å sitte</td>
<td>to sit</td>
<td>å lese</td>
<td>to read</td>
</tr>
<tr>
<td>å kle</td>
<td>to dress</td>
<td>å lage</td>
<td>to make</td>
</tr>
<tr>
<td>å se</td>
<td>to see</td>
<td>å lave</td>
<td>when a lot of snow is falling</td>
</tr>
<tr>
<td>å le</td>
<td>to laugh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>å bite</td>
<td>to bite</td>
<td>å smyge</td>
<td>to snuggle</td>
</tr>
<tr>
<td>å slite</td>
<td>to struggle</td>
<td>å gape</td>
<td>to yell/to open the mouth wide open</td>
</tr>
<tr>
<td>å reparere</td>
<td>to fix/mend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>å protestere</td>
<td>to protest</td>
<td>å rape</td>
<td>to belch</td>
</tr>
<tr>
<td>å kjøpe</td>
<td>to buy</td>
<td>å gi</td>
<td>to give</td>
</tr>
<tr>
<td>å dope</td>
<td>to baptize</td>
<td>å ri</td>
<td>to ride</td>
</tr>
<tr>
<td>å løpe</td>
<td>to run</td>
<td>å vri</td>
<td>to twist</td>
</tr>
<tr>
<td>å fly</td>
<td>to fly</td>
<td>å finne</td>
<td>to find</td>
</tr>
<tr>
<td>å sy</td>
<td>to sew</td>
<td>å vinne</td>
<td>to win</td>
</tr>
<tr>
<td>å bry</td>
<td>to bother</td>
<td>å skinne</td>
<td>to shine</td>
</tr>
<tr>
<td></td>
<td>(someone)/to care</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix III:

A.A, infinitive test:

The -aj- class (the capital letters mark the stress in the verb):

Gen: -aj- → *-uj-: 7 of the 20 verbs in the -aj- class were inflected like the *-uj- class (pAdat’ (to fall, drop), hfrv; chAvkat’ (noisy chewing), lfrv; tOpat’ (trample), lfrv; tul’At’, hfnv; klAvat’, hfnv; lavkat’, lfnv; dusAt’, lfnv; kitAt’, hfnv, 1st p. sing.; kAdat’, hfnv, 1st p. sing).

Gen: -aj- → -a-: Two -aj- verbs were inflected as -a- verbs. Both verbs were lfnv (bOpat’ and okozhAt’). Okozhat’ was inflected like the real perfective -a- verb okozat’ (to manifest, show, turn out to be, find oneself). This mistake is probably not that unlikely given the fact that the two verbs are relatively similar sounding.

The -a- class:

Gen: -a- → -aj-: There were four -a- verbs that were inflected like -aj- class verbs (sh’ipAt’, lfrv (pinch, sting); glAkat’, hfnv; moxotAt’, hfnv; vipAt’, lfnv, 3rd p. pl).

Gen: -a- → *-uj-: There were six -a- verbs that were inflected like *-uj- verbs (kisAt’, hfnv; t’azAt’, lfnv; snakAt’, lfnv; gezAt’, hfnv, 3rd p. pl.; vipAt’, lfnv, 1st p. sing.; vremAt’, lfnv, 3rd p. pl.). There are almost as many -a- verbs that have the -aj- inflection as there are verbs that have the *-uj- inflection, just a few more with the *-uj-model.

The -i- class:

Gen: -i- → -aj-: There is only one -i- verb that is inflected like the -aj- model (znAvit’, hfnv, 1st p. sing.).

Gen: -i- → *-uj-: One -i-verb is inflected as a *-uj- verb (drepIt’, lfnv, 1st p. sing.).

The -ova- class:

There were no verbs inflected as another verb than -ova- verbs, but there was one verb the informant did not give an answer in the 1st p. sing. (devnovAt’, lfnv).

A.A Past tense test:

The -aj- class:

Gen: -aj- → *-uj-: There are four -aj- verbs that are inflected like the *-uj- model (chAvkal’i, lfrv (noisy chewing); klAval’i, hfnv; lAvkal’i, lfnv; dysAl’i, lfnv; plAval’i, hfrv (to swim, sail) 3rd p. pl.; tOpal’i, lfrv (trample), 3rd p. pl.; rOpan’i, lfnv, 1st p. sing.).

Gen: -aj- → -a-: The lfnv bOpan’i was in the 1st p. sing. inflected like a -a- class verb.
Past tense: For the verbs *tOpal’i*, lfrv (to trample) one of the two replies was given in the past tense sing., feminine (*tOpala*). For the lfnv *Opal’i*, one of the replies was given in the past tense pl.

Real verb: For the verb *tOpal’i* described above, the past tense form was the real verb propAst’ (disappear).

The -a- class:
Gen: -a- → -aj-: There are five a- class verbs that are inflected like the -aj- class, either in both replies of the verb, or in one of them (*sh’ipAl’i*, lfrv (to pinch), 3rd p. pl.; *vipal’i*, lfnv; *t’azal’i*, lfnv, 3rd p. pl.; *snakAl’i*, lfnv, 1st p. sing.; *vremal’i*, lfnv, 3rd p. pl.).
Gen: -a- → *-uj-: There are eight -a- class verbs that are inflected like the *-uj- class, either in one of the possible replies, or on both (*glAkal’i*, hfnv; *kisAl’i*, hfnv; *moxotAl’i*, hfnv; *gezAl’i*, hfnv; *t’azal’i*, lfnv, 1st p. sing.; *gl’azal’i*, lfnv; *snakAl’i*, lfnv, 3rd p. pl.; *vremAl’i*, lfnv, 1st p. sing.).

The -i- class:
Gen: -i- → -aj-: The hfnv *znAvil’i* is inflected like the real verb *znat’* (to know), an -aj- class verb.
Gen: -i- → *-uj-: The lfnv *drAc’il’i* is inflected like a *-uj- class verb in the 1st p. sing.
Gen: -i- → -ej-: The lfnv *nAdil’i* is inflected like a -ej- class verb in the 3rd p. pl.

Past tense: The two verbs *platil’i*, hfrv (to pay), and *nadil’i*, lfnv are inflected in the past tense in the 1st p. sing.

Real verb: As mentioned above was the hfnv verb *znAvil’i* inflected like the real verb *znat’* (to know), an -aj- class verb.

The -ova- class:
Past tense: The hfrv *prOboval’i* (to try) was in the 1st p. sing. inflected in the past tense form, feminine.

Other reply: The response in 1st p. sing. in the verb chUvstvoval’i was given as *chUvstvoval’*.

As in the infinitive test, there are also here many verbs that have been inflected like the *-uj- class.

B.B, Infinitive test:

The -aj- class:
Gen: -aj- → *-uj-: Six of the –aj- class verbs were inflected like *-uj- verbs, all of them nonce verbs (*tul’at’, *geshat’, both hfnv; *lAvkat’, *dusAt’, *bOpat’, *ropAt’, all lfnv).
The -a- class:

**Gen: -a- → -aj-**: There were two verbs that took this generalization (glAkat’, hfnv, 1\textsuperscript{st} p. sing.; vipAt’, lfnv).

**Gen: -a- → *-uj-**: Five of the nonce -a- class verbs were inflected like the *-uj- class (kisAt’, hfnv; t’azAt’, gl’asAt’, snakAt’, vremAt’, all lfnv).

The -i- class:

**Gen: -i- → *-uj-**: The lfnv drepit’ was inflected to the -uj- class.

**Real verb**: The nonce verb mentioned above was inflected like a real verb grippovAt’ (to have the flu). The hfnv tros’it’ was inflected like the real verb pros’It’ (to ask someone a favour).

The -ova- class:

**Gen: -ova- → -aj-**: The hfnv milovAt’ was in the 3\textsuperscript{rd} p. pl. inflected like an -aj- class verb.

**B.B, past tense test**:

The -aj- class:

**Gen: -aj- → *-uj-**: Four of the nonce -aj- class verbs were inflected like the *-uj- class (tul’al’i, hfnv; geshal’i, hfnv; dusal’i, lfnv; ropAl’i, lfnv).

The -a- class:

**Gen: -a- → -aj-**: Four -a- class verbs were inflected like the -aj- class (glAkal’i, hfnv; gezal’i, hfnv; vipAl’i, lfnv).

**Gen: -a- → *-uj-**: There were six nonce -a- class verbs that were inflected like *-uj- verbs (zr’Atal’i, kisAl’i, moxotAl’i, all hfnv; gl’asAl’i, snakAl’i, vremAl’i, all lfnv).

**Real verb**: One of the nonce verbs that was inflected like an – aj- class verbs, vipAl’i, was inflected like a real verb, vypAl’ivat’ (fire away at).

The -i- class:

**Gen: -i- → *-uj-**: Three of the -i- class verbs were inflected like the *-uj- class (tros’Il’i, hfnv; motOvil’i, hfnv, 1\textsuperscript{st} p. sing.; drAs’il’i, lfnv).

**Past tense**: The lfnv verb nadil’i was inflected in the past tense (in plural and feminine).

Other: The verb znakOmil’i (to introduce, to get to know) was in the 1\textsuperscript{st} p. sing. inflected like a noun (znakomaja).

**C.C, infinitive test**:

The -aj- class:

**Gen: -aj- → -a-**: Two -aj- lfnv were inflected like -a- class verbs (lAvkat’ and ropAt’).
Gen: -aj- → *-uj-: Two -aj- lfrv were inflected like *-uj- class verbs (chAvkat’ (to chew noisily), tOpat’ (to trample).

The -a- class:

Gen: -a- → -aj-: The -aj- class was the only class the -a- verbs were generalized to in this infinitive test, but almost all the nonce -a- verbs were inflected like -aj- class verbs (glAkat’, zr’atat’, kisAt’, moxotAt’, gezAt’, all hfnv; vipAt’, t’azaAt’, snakAt’(3rd p. pl.), vremAt’, all lfnv).

The -i- class:

Gen: -i- → -aj-: Two -i- class nonce verbs were inflected like -aj- class verbs (glatIt’, hfnv, 1st p. sing.; glavIt’, lfnv).

Gen: -i- → -ij-: The hfnv znAvit’ was inflected like a -ij- class verb in the 1st p. pl.

Past tense: The hfnv trosIt’ was inflected in the past tense (in plural and masculine).

The -ova- class:

Gen: -ova- → -aj-: Four of the – ova- class nonce verbs were inflected like -aj- class verbs (drObovat’ and mylovAt’, both hfnv; limovAt’ in the 1st p. pl. and morovAt’, both lfnv).

Gen: -ova- → -avaj-: The hfnv klEbovat’ was inflected like a -avaj- class verb.

Past tense: The lfnv limovAt’ was in the 3rd p. pl. inflected in the past tense.

C.C, past tense test:

The -aj- class:

Gen: -aj- → -a-: There was one -aj- verbs that was inflected like a -a- class verb, ropAl’i, lfnv.

Gen: -aj- → *-uj-: Four -aj- verbs were inflected like *-uj- class verbs (pLAvAl’i (to swim, sail), hfrv; chAvkal’i (to chew noisily), lfrv; tOpal’i (to trample), lfrv; lAvkal’i, lfnv).

The -a- class:

Gen: -a- → -aj-: Seven of the -a- verbs were inflected like -aj- verbs (glAkal’i, hfnv; zr’Atal’i, hfnv; kisAl’i, hfnv; gezAl’i, hfnv; vipAl’i, lfnv; t’azAl’i, lfnv; snakAl’i, lfnv). All these verbs are nonce verbs.

Gen: -a- → -uj-: The lfnv gl’asAl’i was inflected like a *-uj- verb.

Other: The lfrv sh’ipal’i (to pinch) was inflected like the verb schitat’ (to count, settle accounts).

The -ova- class:

Gen: -ova- → -a-: The hfnv myloval’i was in the 1st p. sing. recognized as a -a- class verb.
D.D, infinitive test:

The -aj- class:

Gen: -aj- → *-uj-: The lfnv lAvkat’ was recognized as a *-uj- verb.

Other: The hfnv kAdat’ was in the 1st p. sing. inflected like *kadAt’ju.

Infinitive: The lfnv ropAt’ was in the 1st p. sing. repeated in the infinitive.

The -a- class:

In this case there were more verbs that were recognized as -aj- class verbs that -a- class verbs.

Gen: -a- → -aj-: All in all there were twelve verbs that fall under this generalization (pr’Atat’ (to hide, conceal), hfrv; plAka’t (to cry, weep), hfrv; sh’ipAt’ (to pinch), lfrv; skakAt’ (to jump), lfrv; zr’Atat’, hfnv; kisAt’, hfnv, 3rd p. pl.; moxotAt’, hfnv; gezAt’, hfnv; vipAt’, lfnv; gl’azaAt’, lfnv, 1ts p. sing.; snakAt’, lfnv, 3rd p. pl.; vremAt’, lfnv)

Gen: -a- → *-uj-: The hfnv glAkat’ was recognized as an *-uj- class verb.

Other: In the 1st p. sing. the hfnv kisAt’ the reply was a noun in the instrumental case, plural (koshkami (cats)).

Infinitive: For the lfnv snakAt’, the reply for the 1st p. sing. was a repetition of the infinitive form.

Real verb: The lfnv t’azAt’ had a correct stem recognition, but the verb was inflected like a real verb (t’anUt’ (to pull, draw).

The -i- class:

Gen: -i- → -aj-: There were three -i- verbs that were inflected like the -aj- verbs (znAvit’, hfnv; los’it’, 3rd p. pl.; nAd’it’, lfnv).

Gen: -i- → -ij-: The lfrv lAd’it’ (To get along with) was inflected like a -ij- verb in the 1st p. sing.

Gen: -i- → *-uj-: Three verbs were generalized in this way (znakOmit’ (to acquaint, introduce), lfrv, 1st p. sing.; glakOmit’, lfnv, 1st p. sing.; glAvit’, lfnv).

Infinitive: The hfnv verb los’It’ was repeated in the infinitive in the 1st p. sing.

Real verb: There were three nonce verbs that were inflected like real verbs (znAvit’, hfnv was inflected like znat’ (to know); los’it’, hfnv was in the 3rd p. pl. inflected like letAt’ (to fly); nAd’it’, lfnv was inflected like nad’evAt’ (to put on clothes).

The -ova- class:

Gen: -ova- → -aj-: The verb riskovAt’ (to risk), lfrv, was in the 1st p. sing. inflected like a -aj- class verb.

Infinitive: For the verb riskovAt’ the reply was given in infinitive in the 3rd p. pl.
D.D, past tense test:

The -aj- class:

Gen: -aj- → -a-: The lfnv \textit{bOpal’i} was in the 1\textsuperscript{st} p. sing. inflected like a -a- class verb.

Gen: -aj- → *-uj-: The lfrv \textit{tOpal’i} (to stample) was inflected like a *-uj- verb. The lfnv \textit{bOpal’i} was inflected like a *-uj- verb in the 3\textsuperscript{rd} p. pl.

The -a- class:

Gen: -a- → -aj-: There were fourteen -a- class verbs that were inflected like -aj- verbs, either in both 1\textsuperscript{st} p. sing. or 3\textsuperscript{rd} p.pl, or one of them (\textit{pr’Atal’i} (to hide), hfrv, 1\textsuperscript{st} p. sing; \textit{xoxotAl’i} (to laugh), hfrv; \textit{plAkal’i} (to cry), hfrv; \textit{sh’ipAl’i} (to pinch), lfrv; \textit{dremAl’i} (to doze; slumber), lfrv, 3\textsuperscript{rd} p. pl; \textit{v’azAl’i} (to bind), lfrv, 3\textsuperscript{rd} p. pl; \textit{skakAl’i} (to jump), lfrv; \textit{zr’Atal’i}, hfnv; \textit{kisAl’i}, hfnv; \textit{moxotAl’i}, henv; \textit{gezAl’i}, hfnv; \textit{vipAl’i}, lfnv; \textit{t’azAl’i}, lfnv; \textit{vremAl’i}, lfnv).

Gen: -a- → *-uj-: There were four verbs that were generalized in this way, either in 1\textsuperscript{st} p. sing. or 3\textsuperscript{rd} p. pl. (\textit{pr’Atal’i} (to hide), hfrv, 3\textsuperscript{rd} p. pl; \textit{gAkal’i}, hfnv; \textit{gl’asAl’i}, lfnv; \textit{snakAl’i}, lfnv).

The -i- class:

Gen: -i- → -aj-: The lfnv glavIl’i was inflected like a -aj- verb.

Gen: -i- → -ij-: Four of the -i- verbs were inflected like -ij- verbs (\textit{lAdil’i} (to get along with), lfrv; \textit{glatIl’i}, hfnv, 3\textsuperscript{rd} p. pl; \textit{znAvil’i}, hfnv; \textit{hAdil’i}, lfnv).

The -ova- class:

Gen: -ova- → -aj-: One hfnv of the -ova- class was inflected like a -aj- verb (\textit{mylovAl’i}).

Infinitive: The lfrv \textit{zimovAl’i} (to spend the winter; hibernate) was in the 1\textsuperscript{st} p. sing. answered in the infinitive.

E.E, infinitive test:

The -aj- class:

Gen: -aj- → -a-: Three -aj- verbs were inflected like the -a- verbs (\textit{tOpat’} (to stample), lfrv; \textit{dusAt’}, lfnv, 3\textsuperscript{rd} p. pl; \textit{ropAt’}, lfnv).

Gen: -aj- → *-uj-: Four verbs were inflected like *-uj- verbs either in one of the responses for each verb, or both (\textit{chAvkat’} (to chew noisily), lfrv, 1\textsuperscript{st} p. sing; \textit{tul’At’}, hfnv; \textit{geshAt’}, hfnv, 3\textsuperscript{rd} p. pl; \textit{dusAt’}, lfnv, 1\textsuperscript{st} p. sing).

Infinitive: The lfnv \textit{bOpat’} was repeated in the infinitive in both responses of the verb.

The -a- class:
Gen: -a- → -aj-: Seven of the -a- verbs were inflected like -a- verbs in one or both responses of the verb (*pr’Al’* (to hide), hfrv, 1st p. pl; *sh’ApAl’* (to pinch), lfrv; *glAkAt’*, hfnv, 3rd p. pl; *zr’Atat’*, hfnv, 3rd p. pl; *kisAl’*, hfnv; *gezAt’*, hfnv, 1st p. sing; *vipAl’*, Ifnv).

Gen: -a- → *-uj-: as with the latter group, there were also seven verbs that were inflected like *-uj- verbs (*skAkAt’* (to jump), lfrv, 1st p. sing; *glAkAt’*, hfnv, 1st p. sing; *moxotAt’*, hfnv, 1st p. sing; *t’AzAt’*, Ifnv, 3rd p. pl; *gl’AsAt’*, Ifnv; *vremAt’*, Ifnv, 3rd p. pl).

**Infinitive:** For four of the verbs one of the two responses was given in the infinitive (*xoxotAt’* (to laugh), hfrv, 1st p. sing; *zr’Atat’*, hfnv, 1st p. sing; *gezAt’*, hfnv, 3rd p. pl; *vremAt’*, Ifnv, 1st p. sing).

The -i- class:

Gen: -i- → -aj-: The hfnv *glAtIt’* was inflected like a -aj- verb in the 1st p. sing.

Gen: -i- → -ij-: The Ifnv *nAdit’* was in the 3rd p. pl inflected like a -ij- verb in the 3rd p. pl.

Gen: -i- → *-uj-: The Ifnv *drAsit’* and *glAvIt’* were both in the 1st p. pl. inflected like *-uj- verbs.

**Infinitive:** For the hfnv *znAvit’* the response for the 1st p. sing was given in the infinitive.

**Real verb:** The hfnv *glAtIt’* was in the 1st p. sing. inflected like the real verb *glat’at’* (to swallow).

The -ova- class:

Gen: -ova- → -a-: The hfnv *drObovat’* was in the 3rd p. pl. inflected like a -a- verb.

**Real verb:** The hfnv *drObovat’* mentioned above was also in the 3rd p. pl inflected like a real -a- verb, *drob’it’* (to chop, mince).

**E.E, past tense test:**

The -aj- class:

Gen: -aj- → -a-: One verb falls under this categorization (*geshal’i*, hfnv, 3rd p. pl).

Gen: -aj- → *-uj-: Three verbs were inflected like the *-uj- class (*kAdal’i*, hfnv, 3rd p. pl; *geshAl’i*, hfnv, 1st p. sing; *lAvkal’i*, Ifnv, 3rd p. pl).

**Infinitive:** For the lfrv *kusAl’i*, the response in the 3rd p. pl was given in the infinitive.

**Past tense:** For five of the nonce verbs the response was given in the past tense i.e. repetition of the stimuli verb (*kitAl’i*, hfnv, 3rd p. pl; *dusAl’i*, Ifnv, 3rd p. pl; *bOpal’i*, Ifnv, 3rd p. pl; *okozhAl’i*, Ifnv, 3rd p. pl; *ropAl’i*, Ifnv).

The -a- class:

Gen: -a- → -aj-: Three verbs were inflected like -aj- verbs (*pr’Atal’i* (to hide), hfrv, 3rd p. pl; *sh’ipAl’i* (to pinch), lfrv; *t’AzAl’i*, Ifnv).
Gen: -a- → *-uj-: There were three verbs that were generated in this way (glAkal’i, hfnv; kisAl’i, hfnv; f’asAl’i, lfnv).

Infinitive: Two replies were given in the infinitive (plAkal’i, hfrv, 3rd p. pl; v’azal’i, lfrv, 1st p. sing).

Past tense: For four of the verbs the replies were given in the past tense form, i.e. repeated from the stimuli verb (zr’Atal’i, hfnv; moxotAl’i, hfnv; bipAl’i, lfnv, 3rd p. pl; vremAl’i, lfnv).

The -i- class:

Gen: -i- → -ij-: The hfnv znAvil’i was inflected like a -ij- class verb in the 1st p. sing.

Past tense: Three of the replies were repeated in the past tense form (lAdil’i (to get along with), lfrv, 3rd p. pl; los’Il’i, hfnv, 3rd p. pl; nAdil’i, lfnv, 3rd p. pl).

Real verb: The hfnv tros’Il’i was in the 1st p. sing inflected like the real verb tr’asti (to shake, jolt).

The -ova- class:

Infinitive: For two of the verbs the replies were given in the infinitive (probovAl’i (to try), hfrv, 3rd p. pl; riskovAl’i (to risk), lfrv).

Past tense: The hfnv drOboval’i was repeated in the past tense form.

Other: The reply in the 1st p. sing for the lfrv revnovAl’i (to be jealous) was given as a noun, rEvnost’ (jealousy).

F.F, infinitive test:

The -aj- class:

Gen: -aj- → -a-: In the 3rd p. pl two verbs were inflected like -a- class verbs (klAvat’, hfnv; dusAt’, lfnv).

Gen: -aj- → *-uj-: Eight verbs were inflected in this way (pAdat’ (to fall), hfrv, 3rd p. pl; chAvkat’ (to chew noisily), lfrv; tOpat’ (to trample), lfrv; kAdat’; hfnv, 3rd p. pl; klAvat’, hfnv, 1st p. sing; geshAt’, hfnv; dusAt’, 1st p. sing; bOpat’, lfnv).

Other/real verb: The lfnv okozhAt’ was in 3rd p. pl inflected like the real verb okAzyvat’ (to have influence on; to show). In 1st p. sing. it was inflected like the perfective verb skazAt’ (to say, talk).

The -a- class:

Gen: -a- → -aj-: Five of the verbs were inflected like -aj- class verbs (sh’ipAt’ (to pinch), lfrv; dremAt’ (to take a nap, not fall into deep sleep), lfrv; b’azAt’ (to bind), lfrv; moxotAt’, hfnv; gezAt’, hfnv).
There were eight of the verbs that were inflected in this way (skakAt' (to jump), lfrv; glAkat’, hfnv; zr’Atat’, hfnv; vipAt’, lfnv; t’azAt’, lfnv; gl’asAt’, lfnv; snakAt’, lfnv; vremAt’, lfnv).

**Infinitive:** For the hfrv rEzat’ (to cut) the reply in the 1st p. sing was given in the infinitive.

**Real verb:** The hfnv kisAt’ was inflected like the verb pisat’ (to write). The hfnv gezAt’ was inflected like bEgat’ (to run).

The -i- class:

**Gen: -i- → *-uj-:** There were six verbs that were generated this way (platIt’ (to pay), lfrv; krepIt’ (to make stronger), lfrv; glatIt’, hfnv; los’it’, hfnv, 1st p. sing; dreplIt’, lfnv, 3rd p. pl; glavIt’, lfnv).

**Infinitive:** Three verbs were given replies in the infinitive instead of the present tense (kras’it’ (to paint, color), lfrv; travIt’ (to poison, exterminate, destroy, etch, hunt, toment, badger), lfrv, 1st p. sing; tros’It’, hfnv, 1st p. sing).

**Real verb:** Four nonce verbs were inflected like real verbs (tros’It’, hfnv as pros’it’ (to ask someone to do something); znAvit’, hfnv as znat’ (to know); nAdit’, lfnv, 3rd p. pl. as naxOdit’ (to find); the lfnv drAc’it’ as draczIt’ (to pick on, bully).

The -ova- class:

**Gen: -ova- → -aj-/ real verb:** The hfnv kUvcstvovat’ was inflected like the real -aj- clas verb kUshat’ (to eat).

**F.F, past tense test:**

The -aj- class:

**Gen: -aj- → -a-:** Three verbs were inflected in this way (geshAl’i, hfnv; dusAl’i, lfnv; okozhAl’i, lfnv).

**Gen: -aj- → *-uj-:** Four verbs were generalized in this way (plAval’i (to swim; sail), hfrv; chAvkal’i (to chew noisily), lfrv; tOpal’i (to trample), lfrv; lAvkal’i, lfnv, 1st p. sing).

**Past tense:** The answer for the lfnv bOpal’i was in the 3rd p. pl repeated in the past tense.

**Real verb:** Six of the nonce verbs were mistaken for real verbs (kitAl’i, hfnv was inflected like the real verb pitAt’ (to feed; nourish; supply); kadAl’i, hfnv as pAdat’ (to fall); klAval’i hfnv as plAvat’ (to swim; sail); geshAl’i, hfnv as dyshAt’ (to breathe) dusAl’i, lfnv as plAkat’ (to cry); okozhAl’i, lfnv as okozAt’ (to manifest, show, turn out to be).

The -a- class:
Gen: -a- → -aj-: There were three verbs generated this way (sh’ipAl’i (to pinch), lfrv, 3rd p. pl; glAkal’i, hfnv, 3rd p. pl; gezAl’i, hfnv).

Gen: -a- → *-uj-: There were three verbs from the -a- class that were inflected like *-uj- class verbs (sh’ipAli (to pinch), lfrv, 1st p. sing; vipAl’i, lfnv; snakAl’i, lfnv).

Gen: -a- → -oj-: The hfnv moxotAl’i was inflected like a -oj- class verb.

Real verbs: Seven of the nonce verbs were replaced by real verbs (zr’Atal’i, hfnv as pr’Atat’ (to hide, conceal); kis’Al’, hfnv as pisat’ (to write); gezAl’i, hfnv as bEgat’ (to run); t’azAl’i, lfnv as pl’asat’ (to dance); gl’asAl’i, lfnv as pl’assat’ (to dance), 1st p. sing; snakAl’i, lfnv as smakovAt’ (to taste); vremAl’i, lfnv as dremAt’ (to doze; slumber).

The -i- class:

Gen: -i- → -aj-: The lfnv glAvil’i was inflected like a -aj- class verb in the 1st p. sing.

Gen: -i- → *-uj-: The lfnv glAvil’i was inflected like a *-uj- class in the 3rd p. pl.

Past tense: The lfnv nAdi’l’i was repeated in the past tense in the 3rd p. pl.

Real verbs: There were five of the nonce verbs that were recognized as real verbs (tros’Il’i, hfnv as pros’it’ (to ask someone a favor); glat’il’i, hfnv as plAkat’ (to cry); znAvil’i, hfnv as znakOmit’ (to introduce, get to know); loc’il’i, hfnv as nocit’ (to carry), 1st p. sing; drepl’l’i, lfnv as dremat’ (to take a nap, to not fall into deep sleep).

The -ova- class:

Gen: -ova- → *-uj-: The lfnv l’innovAl’i was in the 1st p. sing. inflected like the *-uj- class. One might ask why this is considered wrong since the -ova- class gets the suffix -uj- in the present tense. In this case the response was something in between -ova- suffix and -uj- suffix (limavUjo).

Real verb: Three of the nonce verbs recognized as real verbs (klEboval’i, hfnv as trEbovat’ (to demand); lEjstvoval’i, hfnv as dEjstvovat’ (to work; to take action; to be valid); mylovAl’i, hfnv as mal’evat’ (to paint, a negative charged word).