
I LIKE TO YERB WORDS.
WHAT?
I TAKE NOUNS AND ADJECTIVES AND USE THEM AS VERBS. REMEMBER WHEN "ACCESS" WAS A THING? NOW IT'S SOMETHING YOU DO. IT GOT VERBED.
VERBING WEIRDS LANGUAGE.
MAYBE WE CAN EVENTUALLY MAKE LANGUAGE A COMPLETE IMPEDIMENT TO UNDERSTANDING.

Living languages are in a continuous motion, adapting to the social contexts in which they are used; they take form as different registers or dialects, they appear in the written or spoken mode, and, above all, they move withtime, changing chronologically. A specific instance of chronological change occurs in the individual. When languages are acquired or lost, they adapt to the successively changing constraints of the speaker's mind and to the conditions of the social environment.

Progression and regression in language*, 1993*

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INTRODUCTION

Klimova et al. (2005):

[…] according to Organization for Economic Cooperation and Development (OECD) forecasts, in the following 35 years, almost a triple increase of population aged 80 and above and almost a double increase of people older than 65 years is expected in a current stable or slightly decreasing number of population in the productive age. Therefore, a considerable increase in the number of people with dementia is also expected in the future[1].

Alzheimer's Disease (AD) is the most common cause of dementia in the elderly. It is a neurodegenerative disease characterized by gradual loss of cognitive functions and it currently affects over 30 million people worldwide. The memory system impairment is considered its primary manifestation. Nonetheless, also the linguistic ability is affected, and AD individuals may experience an early onset of language disturbances and a more rapid decline than those associated with normal aging. Language impairments generally show up as a deficit in lexical-semantic abilities. Indeed, AD patients typically experience anomias, semantic paraphasias, difficulties in word comprehension and also in verbal fluency (Taler and Phillips, 2008 *inter alia*). Moreover, some scholars have claimed that they may also present a simplification of syntax (Altmann et al., 2001 *inter alia*) and impairment in phonological structure (Croot et al., 2000). So far, the majority of linguistic studies concerning this neurodegenerative disease have focused on the lexical-semantics and on sentence comprehension, leaving behind other linguistic domains. Indeed, only a small portion of research has investigated AD abilities on sentence and morphosyntactic production abilities. Thanks to new studies, nowadays language assessment has started to play an important role in the clinical diagnosis of different neurodegenerative diseases. Indeed, the detection of different language deficits, associated to different

[1] Klimova, B. 2015. *Alzheimer's disease and language impairments: social intervention and medical treatment*. Clinical Interventions in Aging, p. 1401

neurodegenerative diseases, has progressively improved in the last years. Nonetheless, the heterogeneity of variables considered and the way they are classified makes the comparison among studies difficult (Boschi et al., 2017). It is in this complex context that our interest for the disease has developed. Since the functioning of morphosyntax has not been deeply investigate yet, we decided to focus our attention on this linguistic domain. Indeed, the aim of our study is to better understand the relation between this neurodegenerative disease (AD) and transcategorial morphological operations such as derivation and conversion. In doing so, we administered to 20 AD patients a linguistic test (a multiple-choice filling-the-gap task) concerning complex words formed from nominal and verbal bases and resulting from the application of different morphological operations. Concerning morphological complex words, psycholinguistic theories have proposed contrasting hypotheses on how such complex items are represented and processed in the mental lexicon. A first group of theories is the well-known strong full-listing models (i.e. Butterworth, 1983). All complex items are listed in the mental lexicon and processed as whole units. On the other hand, a second group proposes the fully decompositional account (i.e. Taft, 2004), which involves an online composition of complex items, from the mental storage of component elements. *These two psycholinguistic proposals are difficult to reconcile within a coherent interpretive framework, as well as with the divergent neuropsychological and neuroimaging literature on derivational processing*[2] (i.e. Leminen et al., 2011; Badecker and Caramazza, 1991 *inter alia*). Investigating a linguistic domain still understudied, at least in Italian AD population, may shed some more light on linguistics disturbance in AD and, more precisely, on how they deal with complex items. Moreover, our study may help in understanding how morphologically complex words are represented and processed in our brain. Finally, our hope is to possibly detect a significant linguistic variable in order to differentiate AD from other neurodegenerative conditions. Our work is organized in four different chapters. The first one will be devoted to Neurodegenerative Disease. We will focus on Alzheimer's

[2] Carota, F. et al. 2006. *Decompositional Representation of Morphological Complexity: Multivariate fMRI Evidence from Italian.* Literary and Linguistic Computing. Journal of Cognitive Neuroscience, p. 2.

Disease, the core of our study, to better frame our field of investigation. In particular, we will present a review of the latest research on this topic, with a special attention on the linguistic domain. In the second chapter we will briefly present the linguistic domain we investigated in our study, namely word-formation. We will spend some more words on the theoretical analysis of conversion and suffixation, the word-formation processes we selected to examine. Moreover, we will focus on morphological and semantics properties displayed by Italian deverbal nominals and denominal verbs, the target items of our study. In the third chapter we will describe our experimental study in detail. We will start describing the design and how it was built up. We will keep on displaying the administration of the linguistic test and we will explain the aim of our study and the research questions we formulated. We will conclude the chapter presenting the analysis of the data we gathered. Finally, the last chapter will open a discussion on our results, which will be compared to previous studies on the matter or to close linguistic domains (i.e. aphasia) and to research available in the linguistic literature.

CHAPTER 1

Alzheimer's Disease: State of the Art

1.1 Preface: Neurodegenerative Diseases

Neurodegenerative diseases (henceforth, NDDs) is an umbrella term traditionally used to define a range of disorders with selective loss of neurons and different involvement of functional systems defining clinical presentation (Kovacs, 2015). The major part of neurodegenerative diseases is normally characterized by an insidious onset during adulthood. On the one hand NDDs progress at different rates, on the other hand they often manifest similar symptoms as well as several clinical, pathologic and molecular aspects, until they all progress to severe physical disability or death (Galimberti and Scarpini, 2018). Neurodegenerations includes Alzheimer's and Parkinson's diseases, common afflictions of the elders, whereas less common conditions are frontotemporal dementias, dementia with Lewy bodies, progressive supranuclear palsy, corticobasal degeneration and Huntington's disease, that cause progressive neurological dysfunctions and consequent death. For the most part NDDs produce cognitive, functional and behavioral disturbances, demanding many sacrifices to (family) caregivers and leading to institutionalization most of the time. Many of them are age-related and the increasing size of the elderly will inevitably determine an increment of patients suffering from neurodegenerative conditions until new achievement in preventing, delaying or treating these disorders are attained (Cummings et al., 2005). Under a genetic perspective many NDDs show an important family history, since a genetic factors' contribution seems relevant to disease causation and progression. Furthermore, during the past century, thanks to different silver staining techniques, it has been demonstrated that argyrophilic intra- and extracellular (i.e. plaques) structures are present in many forms of neurodegenerative diseases. This is tantamount to saying that if a NDDs is diagnosed, proteins with altered physicochemical properties should be deposited in the brain, not only accumulated in neurons but also in glial cells. Abnormalities of protein metabolism,

including protein misfolding, are increasingly recognized as central to the mechanisms of most NDDs. Accordingly, the structural conformation of proteins change, resulting in altered functions or potentially toxic intra/extra-cellular accumulation.

1.2 Classification of Neurodegenerative Diseases

A nosological classification of NDDs is based on clinical presentation, anatomical regions and different types of cell affected (Kovacs, 2015). Focusing on the clinical-anatomical point of view, clinical symptoms are triggered by the affected system and do not reflect the molecular pathological background categorically. In many cases, there is an overlap of symptoms during the progression of the disease, so clinical classification is more helpful at the beginning of the diagnostic pathway, when early clinical symptoms are evaluated. The major clinical features of NDDs are:

- Cognitive decline, dementia and alteration in high-order brain functions;
- Movement disorders;
- A combination of these symptoms.

Another classification is the so-called *neuropathological classification*, based on:

- Evaluation of the anatomical distribution of neuronal loss and reactive astrogliosis, and supplementary histological features like spongiform change of the neuropil, for example in prion diseases or vascular lesions;
- Evaluation of protein deposits in the nervous system, intracellularly or extracellularly.

By now, several different proteins seem to be associated with the manifestation of the majority of sporadic and genetic adult-onset NDDs: The MAPT[3]; Aβ, which derives from the amyloid-β precursor protein (AβPP); α-Synuclein; Prp; TDP-43 and FET proteins. NDDs is a controversial topic. Some scholars still argue that neurodegenerative diseases

[3] Microtubule-associated protein tau.

are separate clinical entities that affect different brain regions, showing different pathology and symptoms. Nevertheless, focusing on the genetic, molecular, or cellular level, many players and patterns arise repeatedly, such as early vascular dysfunction, the aggregation and spread of misfolded proteins, selective vulnerability of specific neurons, activation of immune responses, and these are just a few of the shared manifestations. So, in the light of current advances, should such pathological phenomena be consider as being generated by common mechanisms that attack different brain regions and cell types, or simply as the same steps along a shared pathway to neurodegeneration? (Nature Neuroscience, 2018)

1.3 Dementing disorders

Dementia is a non-specific clinical syndrome characterized by a state of cognitive impairment with gradual, persistent and progressive symptoms. Generally, affected people experience changes in cognition, function and behavior. As concerns the first two domains, the most frequent manifestations are *memory loss, communication and language impairments, agnosia (inability to recognize objects), apraxia (inability to perform previously learned tasks) and impaired executive function (reasoning, judgement and planning)*[4]. As for the latter, common symptoms are *agitation, apathy, aggression, psychosis, hallucinations and delusions*[5], all conditions which cause great distress not only for patients but also for their caregivers. To underly that typical clinical presentations of the disease may greatly vary among individuals and that its diagnosis requires cognitive impairments severe enough to limit and affect one's daily life activities. This syndrome can be classified into two different forms: static and progressive; a static kind of dementia can result from several different causes, i.e. brain injury, congenital defect, etc. Dementias of the progressive type, by contrast, are generated by *neurodegeneration*, especially in elderly (Kovacs, 2015). More in detail, symptoms common to the major part of dementias are:

[4] Duong, S. et al. 2017. *Dementia: What pharmacists need to know*. Canadian Pharmacists Journal, p. 18.
[5] Ivi, p. 19.

- Forgetfulness;
- Language deterioration;
- Mood changes;
- Impaired judgment;
- Loss of initiative.

Notice that there is still no universally accepted definition of "dementia" and a specific diagnosis (Kowall and Budson, 2011). Despite this, diagnostic criteria generally include memory impairment, decline in social functions, progressive deterioration, incurability, irreversibility. In addition, it is important to underline that the association between dementia and memory disorders is almost always present whereas significant amnesia is not a remarkable feature of every dementing disease. Another important aspect is the presence of functional decline, (i.e. personal hygiene, housecleaning, etc.), that it's considered a clinical market used to distinguish "possible dementia" and "normal aging" from "dementia". According to Cummings 2004[6], the term *dementia* is used to designate a syndrome of *acquired persistent intellectual impairment characterized by deterioration in at least three of the ensuing domains:*

- *Memory;*
- *Language;*
- *Visuo-spatial skills;*
- *Personality/behavior;*
- *Manipulation of acquired knowledge, including executive function.*

[6] Mandell, A.M. and Green, R.C. 2011. *Alzheimer's Disease*. The Handbook of Alzheimer's Disease and Other Dementias". Wiley-Blackwell, p. 5.

The presence of dementia in a patient is detected through a combination of different measures: a carefully history, physical and mental status examinations, significant impairment on neuropsychological tests checked according to age and education, and finally a change in test scores over a 6/12-month period (Mesulam, 2000). No definition so far proposed can be considered the final one. Many factors influence the manifestation of these disturbances, as superior premorbid intellect, greater cognitive reserve, etc. so that some decline in occupational performance cannot be identified even using the most detailed clinical assessment. In other cases, some types of dementia can show a gradual deterioration in just one cognitive domain for years before developing in something clinically easier to identify. The starting point in managing and treating dementing diseases is its recognition, which can be hindered because screening, testing, imaging and so on most of the time is economically unfeasible. In addition, the belief that cognitive loss in inevitable and a natural step experienced by all aging people, overshadows the possibility that this deterioration might be caused by a brain damage (Mandell and Green, 2011).

1.3.1 Common dementias (subtypes)

Dementia can also be used as an umbrella term to refer to a clinical syndrome of progressive cognitive decline. Its subtypes are conventionally classified according to the cause of dementia. The most common types are Alzheimer's Disease, Vascular Dementia, Lewy body Dementia and Frontotemporal Dementia. A brief explanation of the last three syndromes will be provided below, as for Alzheimer's Disease, paragraph 1.4 will be entirely devoted to its accurate description.

1.3.1.1 Vascular Dementia (VaD)

Nowadays, vascular dementia (also known as multi-infarct dementia) is considered to be the second most common form of dementia, accounting for 20% of cases approximately (Alzheimer Society of Canada, 2016). On the whole, it seems like the frequency of occurrence is higher in men than in women and strong associations have been

demonstrated with age and low education level (Lee, 2011). It normally shows up after a neural deprivation of oxygen, caused by the block or reduction of blood flow to the brain. Indeed, stroke is its most common cause. As concerns symptomatology, manifestations can vary from confusion, disorientation, difficulties in speaking and understanding speech, vision loss, etc., depending on the cerebral regions affected and the severity of the damage. Regarding memory deficits, this might not be present, while executive function (i.e. thinking, reasoning) might undergo a sudden change after the stroke (Duong et al., 2017). Moreover, researchers also recognized that VaD and Alzheimer's Disease interact and have additive effects (Leys et al., 2005) and their co-existence is common with ageing. This is the reason why a clear distinction between these two dementia manifestations has not been detected so far (Snowdon et al., 1997). Many researchers consider "mixed" dementia, a condition where AD and cerebrovascular disease coexist, to be the second most common etiology for dementia since "pure" VaD is uncommon (Patterson and Clarfield, 2003).

1.3.1.2 Lewy body Dementia (LBD)

Recognized in recent years, dementia with Lewy bodies (DLB) is a dementing disorder caused by an abnormal aggregation of alpha synuclein proteins, known as Lewy bodies (originally described in 1912 by Frederich Lewy), inside neurons. These protein agglomerations, considered the hallmark of Parkinson's disease, are concentrated throughout the cortices (Mega *et al.*, 1996). Some research demonstrated that the disturb accounts for 5% to 15% of all dementias (Bhogal et al., 2013). The most distinctive features are visual hallucinations and delusions, fluctuating cognitive impairment with variations in attention and alertness, spontaneous Parkinsonism, and neuroleptic sensitivity (McKeith et al., 1996). In addition, episodic memory impairment is pretty common and may mimic AD. The core feature required for the diagnosis is a progressive decline in cognition sufficient to interfere with daily activities. Still today, a clear-cut distinction between DLB and Alzheimer's Disease is difficult, since also pathological studies have showed the presence of Lewy bodies in at least 20% of Alzheimer's Disease

cases (Gearing et al., 1995). Finally, more than 80% of individuals diagnosed with LBD develop parkinsonism.

1.3.1.3 Frontotemporal Dementia (FTD)

Frontotemporal dementia refers to a series of degenerative disorders, such as Pick's disease and related syndromes, often manifesting focal cortical atrophy. It is considered to be the third most frequent cause of primary dementia and the second most common cause of early-onset dementia (Gallucci et al., 2008). FTD normally occurs at a younger age (40-75 years) than does Alzheimer's disease. Individuals presenting the syndrome are described as experiencing a decline in executive functions before significant memory loss. In addition, they show a language deterioration affecting fluency, naming and abstraction. Changes in personality and behavior are considered key features, occurring early in the disease. Visuospatial function is usually not affected in comparison to Alzheimer's Disease (Duong et al., 2017). To be more precise, FTD presents two distinct patterns:

1. a behavioral-led syndrome (BvFTD), presenting a progressive deterioration in social cognition (i.e. behavioral disinhibition, apathy, hyperorality, etc.);
2. a language-led syndrome, known as Primary Progressive Aphasia (PPA), which can be divided itself in three subgroups:
    a. *Semantic variant (sv-PPA), characterized by fluent speech, anomia and loss of object knowledge*
    b. *Non-fluent/agrammatic (nv-PPA), characterized by effortful speech production and orofacial apraxia*
    c. *Logopenic variant (lv-PPA) characterized by word-finding pauses, and poor sentence repetition (*Gorno-tempini *et al., 2004)*[7]

[7] Bhogal, P. et al. 2013. *The common dementias: a pictorial review*. European Society of Radiology, 23, p. 3411.

A schema reporting the primary site of dysfunction, profile, diagnosis, communication skills and behavioral attitude of the major dementia manifestations previously described is provided in the Appendix, Table 2.

1.3.2 Dementia evaluation and screening tests

As previously said, dementia is a clinical neurodegenerative syndrome that can be generated by many different causes, among them drugs, depression, metabolic disturbances, etc. It is important to highlight from the beginning that, since it is a syndrome of several possible causes, *dementia is a differential diagnostic*[8]*, not a diagnostic term*[9]. In applying the differential diagnosis, the clinician must be extremely competent in gathering personal information (patient history) and recognizing patterns of neuropsychological impairments, in order to correctly evaluate the patient under examination. Indeed, the evaluation process embraces:

1. the examination of physical status, which presents a three-party purpose. First of all, to verify the presence of any systemic disease that may aggravate, contribute to, or even cause cognitive dysfunction. Secondly, to determine whether any comorbid illness may be influencing the life quality of the individual. The last purpose is to check whether neurological signs can ease the diagnostic process (Patterson and Clarfield, 2003).
2. The evaluation of the mental status, extremely useful and integral part of dementia assessment, through short screening instruments such as the Mini-Mental State Examination (MMSE) (Folstein, Folstein and McHugh, 1975).
3. Laboratory investigations, even though not recommended for routine testing, are normally used to determine levels of proteins (i.e. tau protein, b-amyloid, etc.) or the ratio between them.

[8] Table 1, reporting differential diagnosis of the dementia syndrome, is provided in the appendix.
[9] Mandell, A.M., Green, R.C., op. cit., p. 7

4. Genetic testing, *since individuals who have a first-degree relative with Alzheimer disease have two-to fourfold increase in their risk for the disease*[10] (Van Duijn et al., 1991; Blacker and Tanzi 1998).
5. Neuroimaging, the most resource-intensive dementia investigation. It is recommended by the American Academy of Neurology (Rossor, 1994; Cory-Bloom et al., 1995; Geldmacher and Whitehouse, 1996; Knopman et al., 2001).
6. Most importantly, the first step needs to focus on personal history. Anamnesis, even though often difficult to gather for many different reasons, is a fundamental diagnostic measure, since it often discloses daily functional impairments and since the cognitive impairment is considered multifactorial. Nevertheless, it might happen that the patient himself or family members do not even notice a significant deterioration in activities of daily living (ADL). Anyway, if an adequate anamnesis can be collected, the following information must be included:

- *Present history*: investigating social skills, work, hobbies, hygiene and eating behavior, housekeeping, sleep and so on;
- *Past/Social history*: abuse of substances, medications, traumas, surgical procedure, psychiatric illness, etc.;
- *Family history*: troubles with memory loss, other cases of dementia, "senility".

Steps 1, 2 and 6 should be performed always for every individual over the age of 65 to distinguish demented from nondemented subjects (Mandell and Green, 2011).

The mental examination consists of screening tests. It seems important to underlie that all screening tests may present pros and cons, as they all should be applicated for more extensive neuropsychological testing. In addition, it is frequent that some of them privilege the evaluation of a verbal component rather than other cognitive domains, and *vice versa*. Nonetheless, they can all be combined with elements taken from other tests. Furthermore, they are all insensitive to mild cognitive and behavioral impairments. In addition, many might be cultural, educational, racial and age biased. The most common

[10] Patterson, C., Clarfield, A.M. 2003. *Diagnostic Procedures for Dementia*. Dementia. Presentations, Differential Diagnosis, and Nosology. The Johns Hopkins University Press, p. 74.

rating scale is the Mini-Mental State Examination (MMSE) (Albert, 2008; Folstein et al., 1975; Mandell et al., 1994), normally appreciated for its easy and brief administration but also its accuracy in detecting moderate dementia. On the other hand, *this test suffers from insensitivity and both floor and ceiling effects, is very language dependent, culturally insensitive, and has limited value as a method to mark cognitive changes in people with AD in short clinical trials*[11] (Bowie et al., 1999; Clark et al., 1999). Other useful tests, normally used during the diagnosis process, are the Short Portable Mental Status Questionnaire (Pfeiffer, 1975), the Montreal Cognitive Assessment (www.mocatest.org) and 7 - Minute Screen (Solomon et al., 1998). Furthermore, all these scales result at some extent inadequate, as *they should also include at least brief assessments of attention, language, praxis, visuospatial, memory, and executive functions.* Selected tests include:

• *Attention*: digit span forwards, reciting months of the year in reverse, serial subtractions.

• *Language*: object and body part naming, assessment of spontaneous conversation (fluent/non-fluent speech), auditory comprehension, reading comprehension; word-list generation and repetition (Green, 2005; Jorm et al., 2007; Knopman and Ryberg, 1989).

• *Praxis*: three or four transitive limb actions: i.e. teeth brushing, hammering, coin flipping, which are somewhat more sensitive than intransitive actions, as waving goodbye, saluting, etc. (Rapcsak, Croswell, and Rubens, 1989).

• *Visuospatial*: copy an analog clock face or a complex line drawing.

• *Executive*: clock drawing to command, proverb interpretation, similarities (e.g., between an apple and a grape, or a poem and a statue), coin switch test, etc. (Mandell, 2010).

[11] Mandell, A.M., Green, R.C., op. cit., p. 11.

• *Memory*: to capture more subtle memory deficits in case of doubts, the Drilled Word Span (Weintraub and Mesulam, 1985) and Three Words – Three Shapes (TWTS) (Weintraub, 2000) tests[12].

So, to conclude this brief introduction to diagnostic materials, it is worth saying that other ancillary testing for dementia are available. Since they would go beyond the scope of this chapter, a brief exemplification is presented by Mandel A.M. and Green R.C. in the first chapter of "The Handbook of Alzheimer's Disease and Other Dementias", the main source of information in writing this chapter on the AD *status quaestionis*. Lastly, neuroimaging tools, such as magnetic resonance imaging (MRI) or computed tomography scans (CT), are the best mean to establish the final diagnosis (Doung *et al.*, 2017).

1.4 Alzheimer's Disease (AD)

Alzheimer's disease is the most common form of dementia, accounting for 50%/60% of all dementia cases. Conventionally, it is considered a *degenerative brain disorder characterized by progressive intellectual and behavioral deterioration*[13]. In general, its wake-up call is a memory disorder with prominent visuo-spatial and language impairment but preserved social skills, at least at the beginning of the disease process. The most distinctive neuropathological markers are amyloid plaques and neurofibrillary tangles which appear at the beginning in medial temporal limbic structures until they spread to neocortex. It shows a broad age range of clinical onset, on average after age 65.

[12] Ibidem.
[13] Ivi, p. 13

1.4.1 Typical phenotype of AD

As presented by Kumfor and collaborators, the most common symptom presented by patients with AD is a marked episodic memory deficit, manifesting itself in concomitance with mild anomia, visuospatial and also executive function deficits. Typically, to meet the criteria for AD, a progressive decline in more than one cognitive domain must be present: impaired memory, in combination with either executive dysfunction, language changes or visuospatial deficits. Besides, in association with the abovementioned neurodegeneration, impairments in daily activities must be present. More specifically, as regards to memory deficits, these normally consist of rapid forgetting, reflecting a prevalent impairment in anterograde episodic memory or the incapacity to encode and/or store new memories. Episodic memory impairments are normally observable on both verbal and visuospatial episodic memory abilities. Concerning daily life, this memory trouble seems to affect the ability to recall personal autobiographical memories. It is interesting to highlight that the autobiographical memory impairment seems to have a time-gradient: normally past memories, as childhood anecdotes, are better preserved than recent information (i.e. daily agenda, objects location, etc.), that are easier lost, in compliance with Ribot's law: recent memories are more likely to be lost than the more remote memories. *Patient's awareness of memory loss can cause depression and anxiety, but this initial awareness is soon replaced by anosognosia*[14]. Not only is a pervasive episodic memory deficit detectable, but also language and/or visuospatial impairments with executive dysfunctions are also extremely common. With respect to the language domain, it is widely accepted that patient's with AD manifest a lexical/semantic deficit, namely anomia on tasks assessing confrontation naming, among others (Kumfor et al., 2017). Moreover, difficulties in verbal fluency are also commonly described, reporting a major impairment in category fluency with respect to letter/phonemic fluency (Rosser and Hodges, 1999). A more accurate delineation of linguistics impairments will be presented later on this chapter. Moving on to visuospatial deficiencies, which may also

[14] Ghezzi, L. 2018. *Diagnosis of Alzheimer's Disease Typical and Atypical Forms*. Neurodegenerative Diseases. Clinical aspects, molecular genetics and biomarkers. Springer, p. 22.

occur as a typical late manifestation in AD, they are normally evident on *relatively complex visuospatial tasks, requiring perception and extraction of visuospatial information*[15]. Furthermore, AD subjects might experience spatial disorientation and, with respect to the functional domain, show difficulties with navigation (Binetti et al., 1998). Also planning, reasoning, thinking elastically and generating new ideas, all abilities belonging to the domain of human cognition known as executive functions, are generally compromised in typical AD, even though in a minor key and later if compared to memory troubles. With disease progression, some studies also report the occurrence of dyscalculia, dressing apraxia and prosopagnosia, which worsens the already complex clinical picture. Other symptoms which might appear during the progression of the disease pertain to the neuropsychiatric domain. Wandering, irritability, disinhibition, apathy, psychosis, and affective and hyperactive behaviors are a collective of symptoms defined as "behavioral and psychological symptoms of dementia" (BPSD) (Finkel *et al.*, 1996). So, the hallmark feature of typical AD is represented by amnestic deficits, followed by language, visuospatial and executive abilities disturbances, detectable through a systematic assessment.

1.4.2 Atypical manifestation of AD

As presented above, the episodic memory impairment has always been considered the predominant clinical symptom of AD. Indeed, the first diagnostic criteria, published in 1984, established this impairment as the primary cognitive deficit observed, along with pathology typical of AD. As time goes by, it has become increasingly clear that many people, who presented the classic plaques and tangles pathology at autopsy, did not always manifest as first or dominant clinical sign a deficiency on memory domain. So, the diagnostic criteria needed to be updated to account for the atypical, non-amnestic clinical

[15] Kumfor, F. et al. 2017. *Clinical Aspects of Alzheimer's Disease*. Neurodegenerative Diseases. Pathology, Mechanisms, end Potential Therapeutic Targets. Springer, p. 38.

symptoms of AD which include language, visuospatial and executive/frontal clinical marks. Nowadays, in the literature, many different terms have been coined to describe these non-amnestic manifestation of AD. In the following sections the clinical and cognitive features, representative of the three most commonly atypical presentations of AD, will be presented concisely, in order to have a clearer picture of the possible manifestation of AD.

1.4.2.1 Logopenic Progressive Aphasia (LPA)

Recently, it has been discovered that a portion of subjects diagnosed with nonfluent primary progressive aphasia*, a progressive language disturbance in the absence of other cognitive deficits at presentation*[16], presents AD pathology. The subgroup of people presenting the disorder, normally shows deficits in word retrieval and sentence/phrase repetition. The main characteristic distinguishing this disturbance from the typical AD is changes in language abilities as the predominant clinical feature, which remain as such during the initial stages of the disease. This syndrome has been named logopenic progressive aphasia (henceforth LPA). Individuals diagnosed with LPA present a language disorder declined in anomia and sentence repetition difficulties, whereas single-word repetition seems to be relatively intact (Gorno-Tempini et al., 2008). Moreover, in the last years, studies have deeply investigated other cognitive domains in this population, to check their competences. What has been found is that memory impairment, along with a partial preservation of emotion recognition, are indicative of a diagnosis of LPA. Alike, some longitudinal studies on this matter have highlighted a rapid deterioration of other major cognitive domains, including memory, visuospatial ability and attention, within a 12-month period (Leyton et al., 2013). So, LPA can be considered as the language presentation of AD, with impairment in daily life activities requiring speech (i.e., using a telephone, asking for information, etc.)[17].

[16] Ivi, p. 41.
[17] Ghezzi, L., op. cit., p. 27.

1.4.2.2 Posterior Cortical Atrophy (PCA)

Posterior cortical atrophy (henceforth PC), also known as Benson's syndrome, is considered the visuospatial variant of AD. Concerning its clinical manifestation, individuals can show relatively different disorders, from a progressive visual loss to difficulties in analyzing just more complex visual information, with preserved basic visual abilities (Alladi et al., 2007). People suffering from this condition might also show complex visual syndromes such as Balint's syndrome, with the manifestation of optic ataxia, simultagnosia and visual disorientation or Gerstmann's syndrome, characterized by different symptoms as agraphia, acalculia, finger agnosia and left/right disorientation. Something to take into consideration is the period of onset, compared to the one of typical AD, normally appearing around the age 50/60. However, PCA seems to be reasonably rare, as just a 5% of all AD patients shows predominant visual disturbances. Thus, from the cognitive point of view, the manifestations of PCA are visuospatial deficits. In addition, patients might also show impairments in reading and writing with relatively spared episodic memory, if compared to typical manifestations of AD. Verbal tasks are also normally preserved. Finally, with the progression of the disease, a more global dementia syndrome might develop (Crutch et al., 2013).

1.4.2.3 Frontal/executive AD

This last variant of AD is considered pretty rare, since a differential diagnosis with frontotemporal dementia appears particularly difficult. If this is not enough, the clinical profile of this atypical manifestation is quite heterogeneous, varying from predominant executive dysfunction to more behavioral dominated manifestations. As a consequence, this "deviation from the standard" is still poorly understood (Ossenkoppele et al., 2015). So, deficits in executive function is the most common symptom presented by subjects with frontal AD, together with others cognitive domain typically impaired in canonical AD, which might be present or not: frontal AD might result in a better performance on

recognition than recall memory, *suggesting a deficit in strategic retrieval secondary to executive dysfunction*[18].

To recap, a brief schema reporting some of the main characteristics of typical AD is provided below.

1. AD is a degenerative brain pathology characterized by progressive intellectual and behavioral deterioration.
2. It is normally dominated by episodic memory disorder, with prominent visuospatial and language impairment.
3. Several neuropathological markers are generally visible. The most distinctive are amyloid plaques and neurofibrillary tangles, which appear initially in medial temporal limbic structures and then spread to neocortex (Braak and Braak, 1991).
4. It presents a wide age range of clinical onset, but usually after age 65;
5. Motor and primary sensory deficits are either not present or are late manifestations. (Mandell and Green, 2011)

1.4.3 Diagnosis

For over 27 years, AD clinical diagnosis has been based on criteria from two main different sources:

1. the *Diagnostic and Statistical Manual of Mental Disorders, 4th edition* (DSM IV) (American Psychiatric Association, 2000), which required both memory and deterioration in everyday activities;
2. the National Institute of Neurological and Communicative Disorders and Stroke - Alzheimer's Disease and Related Disorder Association (NINCDS-ADRDA) (McKhann et al., 1984), which did not require social function degeneration but the presence of cognitive deficits in absence of any other systemic or neurological

[18] Kumfor et al., op. cit., p. 45.

disease. Criteria provided by this institution designate three different "stages" of AD:

- DEFINITE: presenting a clinical diagnosis with pathological confirmation;
- PROBABLE: requiring a typical syndrome without histopathology;
- POSSIBLE: presenting atypical clinical features, no pathology but no other possible diagnosis (Mandell, Green, 2011).

On the whole, criteria from NINCDS-ADRDA were very good (over 90% sensitivity), even in early stages of the disease (Salmon et al., 2002), meaning that trained clinicians were almost always correct in matching clinical diagnosis with pathology. Nonetheless, many AD patients presented no "pure" plaques and tangle pathology in their brains, some had significant vascular disease and others showed abundant Lewy bodies in cortical regions even if no parkinsonism was present. Hence, it seems like the criteria were better at predicting the presence of Alzheimer's-type pathology more than identifying patients with co-morbid pathologies, resulting in a higher sensitivity than specificity (among other, Cummings, 2005b). Nonetheless, these first criteria presented in the original report of 1984 and employed for many years, in the light of new research and findings, required a major revision. A first one was published in 2007 by Dubois and collaborators'[19] work which has been followed by a successive revision in 2014 by the International Working Group (IWG) for New Research Criteria for the Diagnosis of AD. Not only has this provided a better definition of clinical phenotypes but it also has integrated biomarkers into the diagnostic process, covering the full staging of the disease. Basing on the improvement proposed, the diagnosis of AD has been simplified, *requiring the presence of an appropriate clinical AD phenotype (typical or atypical) and a pathophysiological biomarker consistent with the presence of Alzheimer's pathology*[20]. (A detailed

[19] Dubois, B. et al. 2007. *Research criteria for the diagnosis of Alzheimer's disease: Revising the NINCDS-ADRDA criteri"*. Lancet Neurology, 6: 734-746.
[20] Dubois, B. et al. 2014. *Advancing research diagnostic criteria for Alzheimer's disease: the IWG-2 criteria*. Lancet Neurology, 13: 614-29.

investigation of new proposed diagnostic criteria would go beyond the scope of the chapter (see McKhann *et al.*, 2011 and Dubois *et al.*, 2014 for discussion on this matter).

1.4.4 Pathophysiology, pathology and AD stages

Still today, a definite cause of AD has not been identified. However, the notorious "amyloid cascade" hypothesis is generally accepted as possible explanation of the disease. To give a brief illustration, AD seems to derivate from the generation and extracellular accumulation of toxic fragments, known as beta amyloid (Aβ), which damage neuronal synapses and precipitate eventually into neuritic plaques, which seems to generate inflammation, free radical formation and early on oxidative stress (Nunomura et al., 2001). This process is likely to be the causer of neurons death and neuronal network disruption. Nonetheless, the exact role of Aβ accumulation in the pathogenesis of AD is still in need of a deep explication (Duara et al., 2009). In brief, as concerns the pathology, the brain appears atrophic in frontal, parietal and temporal gyri, entorhinal cortex and hippocampus, with commensurate ventricular enlargement. Brain weight and volume are usually markedly reduced. *The major histopathological hallmarks of AD are extracellular neuritic (amyloid) plaques (NP), intracellular neurofibrillary tangles (NFT) and widespread cortical neuronal loss and synaptic destruction*[21]. AD is considered to be the prototypical "cortical dementia" and so, it shows *a neuropsychological pattern suggesting a multi-focal cortical damage, including symptoms as amnesia, aphasia, agnosia, apraxia, visuospatial impairment and dysexecutive symptoms* (Cummings and Bensons, 1992). Cortical dementias normally fit one of four "profiles" described by Mesulam (2000), differentiated among them according to their major clinical features, including progressive language, behavioral/executive and visual Impairments. Pathological AD has recently been associated with all of these profiles even though its "hallmark" syndrome is a progressive amnestic disturb, referred to as "dementia of Alzheimer type". In the

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Mandell, A.M., Green, R.C., op. cit., p. 18.

literature, the syndrome has always been described as advancing through different "stages", known as early/mild disease or stage 1, intermediate/moderate disease or stage 2 and late/severe disease, or stage 3, according to the evolution of symptoms (Cumming and Benson, 1992; Green, 2005; Mesulam, 2000). Indeed, each phase expects a specific pattern of functional deterioration, among the symptoms previously listed. It seems important to underline that the duration of a single phase is variable among individuals as well as timing and severity of dementia symptoms, with the possibility of overlapping stages. So, people pass through the stages of Alzheimer's in different ways.

Mild Alzheimer's disease (early stage)

The early stage of Alzheimer's disease is generally characterized by memory lapses (i.e. forgetting easy words or the location of objects) and problems with working memory (WM) (Müller, 2010). Nonetheless, people remain totally independent and normally participate in social activities while close friends or family members start to notice some difficulties. A medical interview should detect troubles in memory and/or concentration. Common identified difficulties are problems in retrieving the right word or name, forgetting material just read, losing or misplacing objects, increasing difficulties in planning or organization of daily activities, etc. More specifically, *in the absence of other conditions (e.g., stroke), speech intelligibility, language form (syntax, morphology, phonology), and fluency are preserved until late in the progression of AD*[22]. Generally, the earliest language trouble is a word-finding difficulty. Overall, comprehension of language appears preserved, except when it requires a lot of inferences. Moreover, the comprehension of complex discourse becomes difficult. AD people start to use non-specific placeholder nouns and verbs (i.e. "stuff", "do" etc.), many circumlocutions and start to repeat ideas, producing a discourse that has been described as "empty" of content (see Kempler, 1995; Salmon et al., 1995, *inter alia*).

[22] Müller, N., (2010). *Dementia*. The Handbook of Language and Speech Disorders. Wiley-Blackwell. Chapter 26, p. 613.

Moderate Alzheimer's disease (middle stage)

As for the second phase, this is typically considered the longest one, since it may last for many years. With the progression of the disease, the affected people will probably need a greater level of care. Generally, dementia symptoms are more pronounced, and subjects might experience greater difficulty performing daily activities, i.e. paying bills, etc. In addition, they might confuse words, get easily angry, or act unexpectedly. Symptoms, which become more noticeable, may include forgetfulness of events, incapacity to recall personal information such as the address, telephone number, etc., confusion about the place they live/are or the day of the week, an increased risk of wandering and becoming lost. As for behavioral changes, these may include suspiciousness and delusions or compulsive, repetitive behavior. So, on the whole AD people experience a worsening of all the cognitive and communicative difficulties identified in the first stage. Semantic memory begins to deteriorate, leading to a loss of concepts and words. Attentional difficulties appear and, as a consequence, also easy tasks become more demanding from a cognitive point of view. Visuo-spatial problems become more common. The language ability gradually deteriorates. Even though speech remains intelligible and they generally show no difficulties as regards syntax and morphology, *meaning and content errors become more frequent, and increasing difficulties with topic maintenance as well as reference errors such as inaccurate pronoun use may make the language output of a person with moderate AT difficult to comprehend*[23]. Finally, AD subjects start to become less aware of their linguistic troubles and less able to monitor their linguistic output. On the whole, language comprehension becomes more difficult (Bayles and Tomoeda, 2007; Kempler, 1995).

Severe Alzheimer's disease (late stage)

The final stage of AD is characterized by very severe symptoms, affecting all cognitive domains. Subjects experience the collapse of declarative memory systems as well as working memory, they lose the ability to interact with their environment, to carry on

[23] Ivi, p. 614.

conversations and, sometimes, also to control their movements. As for language and communication, there is a great variation between individuals. They might lose the use of language, experiencing mutism, present an echolalic or perseverative language output or manifest dysarthria, and so reduced intelligibility. So, the ability to say words or phrases might somehow be preserved, but a real communication becomes very difficult. In addition, significant personality changes may be present. Finally, individuals may need daily assistance for everyday activities and personal care, lose awareness of recent experiences as well as of their surroundings, experience changes in the ability to walk, sit and, maybe, swallow[24].

Before proceeding with a more detailed characterization of clinical AD manifestations, another important issue needs to be discussed. Indeed, a "prodromal period" could be added to these three stages, which is represented by the Mild Cognitive Impairment.

Mild Cognitive Impairment

The term mild cognitive impairment (henceforth MCI) normally refers to elders who show a great memory deficit, much more important than what is normally expected from people of their age. At the same time, the degree of the impairment does not meet the criteria for dementia (Petersen, 2000). *MCI generally presents with subjective memory difficulties of insidious onset*[25]. With the passing of time, the forgetfulness increases in frequency and quality with, on the contrary, social and occupational activities relatively preserved. Speed of processing and cognitive flexibility may be slightly impaired (Petersen, 2000), with respect to educational lever. The criteria for MCI include:

a. subject's frequent memory complaints (i.e. daily forgetting of important information/appointments);
b. memory impairment, showed through standardized tests;
c. otherwise normal cognitive ability;

[24] The description of the three AD stages was partially provided by the Alzheimer's Association: https://www.alz.org/alzheimers-dementia/stages.

[25] Flashman, L.A. et al. 2003. *Boundaries between Normal Aging and Dementia. Perspectives from Neuropsychological and Neuroimaging Investigations*. Dementia. Presentations, Differential Diagnosis, and Nosology. The Johns Hopkins University Press. Chapter 1, p. 5.

d. no impact on daily activities;

e. failure to meet the criteria for dementia (Flicker et al., 1991; Petersen et al., 1999).

The underlying assumption justifying the existence of this disease is that the memory impairment showed by these subjects is then abnormal. In addition, the most relevant factor is that *there is an increased likelihood of progression to dementia, in particular dementia of the Alzheimer type (DAT)*[26]. Indeed, last estimates showed a conversion rates from MCI to DAT of between 6% and 25% per year (Petersen et al., 2001). So, the possibility of progression to DAT in subjects presenting MCI is extremely high and so an early identification and diagnosis may be important (Almkvist and Winblad, 1999).

To conclude, it seems interesting to point out that, as Kempler (1995) highlighted, some language and speech deficits are generally not found in AD people (so far). For example, prosody typically remain intact, as does segmental phonology. As concerns syntax and morphology, these linguistic domains are normally preserved until very late in the disease, if other neurological conditions do not worsen the clinical case. The agrammatic deficits of non-fluent aphasia seems to be absent. In addition, turn-taking is respected in many people even in the presence of severe cognitive impairment. Finally, it seems important to repeat that *language, communication, and cognitive skills do not necessarily deteriorate at the same rate, and that therefore the multiple observable impairments do not always map evenly onto any one stage of disease progression*[27].

1.4.5 Neuropsychological profile of Alzheimer's Disease

In the past 30 years, clinical neuropsychological methods have identified the earliest and most definitive cognitive and behavioral symptoms of AD. Indeed, this awful disease can now be identified, divided in stages and tracked. Since research has primary focused on earlier stages of illness, it is now extremely clear that *biological markers can precede*

[26] Ibidem.

[27] Müller, N., op. cit., p. 614.

cognitive and behavioral symptoms by years[28]. At the beginning, AD pathology presents a selective deterioration in limbic regions, where episodic memory is controlled, leading to memory deficit as first manifestation (Braak and Braak, 1991*, inter alia*). Only after the progression of the disease, which affects other neocortical regions, other cognitive symptoms emerge. A thorough description of all neuropsychological deficits in AD would go beyond the scope of this work. So, except for the language domain, other cognitive dysfunctions will be summarily presented, to give more space to our main interest.

1.4.5.1 Memory dysfunction

Episodic memory refers to the explicit and declarative memory system used to remember particular life's episodes[29]*.* In degenerative diseases, its decline begins insidiously and progress in gradual steps. As for AD, episodic memory dysfunction is considered to be the earliest and most impaired cognitive function, since cerebral regions which subserving its functioning are normally affected at the beginning of the disease (i.e. hippocampus, amygdala, frontal lobes, etc.). Thus, deficit in the ability of learning and remembering new information is considered the clinical hallmark of AD pathology (Weintraub et al., 2012). Common manifestations include asking the same question repeatedly, telling the same story many times, forgetting important appointments and so on. In compliance with Ribot's law AD patients present anterograde amnesia, but also retrograde amnesia, since they both experience difficulties in learning new information and retrieving old ones, respectively. On the contrary, they typically manifest preservation of very old memories (i.e. infancy). In addition to rapid forgetting of information, AD individual may also experience distortion of memory and/or false memories. (Budson, 2011) Many studies have demonstrated that the episodic memory impairment showed by AD people virtually affects all modalities, i.e. auditory, visual, etc. (Salomon, 2000).

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[28] Weintraub, S. *et al.* 2012. *The neuropsychological profile of Alzheimer's Disease*. Cold Spring Harbor Perspectives in Medicine.

[29] Budson., A.E. 2011. Memory disfunction in dementia. The Handbook of Alzheimer's Disease and other dementias. Wiley-Blackwell. Chapter 11, p. 317.

1.4.5.2 Executive functioning

Executive functions are defined as *"processes that are part of a system that acts in a supervisory capacity in the overall hierarchy of brain processing and encompasses skills necessary for purposeful, goal - directed behavior*[30]*"*. In other words, these functions allow people to plan, organize, solve problems and so to take part in normal social life (i.e. mental manipulation of information, concept formation, problem-solving, cue-directed behavior). Moreover, they control sensory input, internal emotional and cognitive states and motor output (Gazzaley and D'Esposito, 2007). It is thus an umbrella term used to definite relatively diverse cognitive abilities, all of them involved somehow in the maintenance of goal-directed behaviors, such as volition, motivation, social awareness, abstraction, judgement and decision making, and so on (Budson, 2011). Troubles in executive functioning are common in dementia syndromes and can manifest a wide range of effects. As concerning AD, mild impairments in executive functioning may be present before a formal diagnosis (Albert et al., 2007, *inter alia*). Some of the symptoms that AD individuals might manifest are lack of self-awareness of memory deficit (anosognosia), agitation, aggression, depression, repetitive behaviors, impairment in decision making etc.

1.4.5.3 Behavioral deterioration

Even though AD is considered a primarily cognitive disorder, in many cases also a disruption of emotional systems is found, resulting in behavioral dysregulations. Even though emotions are difficult to define, they can be seen as relating to basic drives as aggression, hunger, libido, etc., controlled by a coordinated system which process biologically relevant stimuli and generates psychological responses and actions to them (Wright, 2011). So, it has become increasingly evident that also significant emotional and behavioral disorders are present in dementias, such as Alzheimer's disease, which are

[30] Strauss et al. 2006. *A compendium of neuropsychological tests: Administration, norms, and commentary*. Oxford University Press, p. 401.

manifested by a neuropsychiatric symptomatology. The major psychiatric symptoms are hallucinations, depression, delusions, agitation, aggression, apathy (Devanand et al., 1997, Merriam et al., 1988; Vilalta-Franch et al., 2010). The presence of these neuropsychiatric manifestations has thus negative consequences on patients and caregivers, since great changes in personality are often present and are considered to be the most distressing aspect of the disease (Fuh et al., 2001).

1.4.5.5 Visuo-spatial function

At some point within the progression of the disease, AD patients often present deficit in visuo-spatial abilities, such as perceptual disorders, dysfunction of spatial localization, topographic disorientation, etc. This disturbances in visuospatial abilities may arise from the loss of a successful interaction between some cortical information processing systems, which seem distinct from one another and relatively spared (Morrison et al., 1991). As previously said, there is a substantial heterogeneity in the symptomatology of AD individuals. Fort this reason it has been described an atypical manifestation of the syndrome, presenting visuospatial dysfunctions as its first and main manifestation: visual agnosia, constructional apraxia and some/all the features of Balint's syndrome. They might also present typical manifestations of Gerstmann's syndrome, i.e. acalcualia, agnosia, left-right disorientation, etc. (Caine, 2004). This atypical manifestation is known as "visual variant" or posterior cortical atrophy (PCA).

1.4.5.6 Language processing

Traditionally, dementia is considered a degenerative disease with affected people experiencing a global decline in cognition. As a consequence, there is nothing special to say about language deterioration. Reilly, Troche and Grossman (2011) do not support this first vision. They argue that *there is indeed something special about language processing*

in dementia and that specific linguistic processes are compromised[31]. In addition, some components of language need executive resources (i.e. working memory, inhibitory control) resulting thus vulnerable since also these domains are affected by the disease. So, despite episodic memory deficit is considered to be the hallmark of AD, language disturbance is also a core marker for this disease.

1.4.5.6.1 Phonology

Currently, dominant theories claim that phonological processing is not compromised until a very late stage of AD (Bayles and Tomoeda, 1983; Ralph, 1995). Nonetheless, many researchers have questioned this position of spared phonology competence. Indeed, some studies, investigating spoken-words recognition, have shown lexical discrimination difficulties with frequent phonological confusions (i.e. *doll* instead of *dog*). Moreover, it seems that these difficulties worsen with disease progression, becoming extremely evident for words having a great number of phonological neighbors (Eustache et al. 1995). Another competence that seems to be impaired is the one known as *talker normalization. AD individuals seem to poorly accommodate acoustic variability in their speech perception across speakers*[32] (Sommers, 1998). Other investigations have shown speech errors in a sentence repetition task, with patients producing more pseudowords errors (popped < plopped), word initial errors and phonemic substitutions than normal controls. Biassou et al., 1995, attributed these errors to a deficit in lexical-phonological retrieval. Croot and collaborators (2000) investigated 10 AD patients in different tasks: repetition, naming, connected speech. Their result in speech production showed phonological paraphasias as the main error type. As for repetition and naming, patients also made phonemic errors. In addition, they were also impaired in reciting overlearned material, such as days of the week.

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[31] Reilly, J. et al. 2011. *Language processing in Dementia*. The Handbook of Alzheimer's Disease and other dementias. Wiley-Blackwell. Chapter 12, p. 336.

[32] Ivi, p. 340.

1.4.5.6.2 Semantic memory

The model adopted by Reilly, Troche and Grossman is a two-component model of semantic memory, which bases on dynamic relations between knowledge and process (Koenig and Grossman, 2007). They claimed that conceptual representation relies on two partially neuroanatomically distinct and dissociable processes:

- stored semantic feature knowledge (content);
- dynamic integration of these stored features through categorization (process) (Koenig et al., 2007).

Thus, concrete concepts (i.e. DOG) are composed of a series of features, which might be stored in or near modality-specific regions of cortex. Semantic processing consists of *rapid categorization and binding of features from different sensory modalities with abstract propositional knowledge into a single cohesive concept*[33]. Frontal lobe regions (i.e. dorsolateral prefrontal cortex and left inferior frontal gyrus) are claimed to be the neural structures responsible for processing, active maintenance, and inhibitory control of competing concepts (Thompson-Schill et al., 1997; Wagner et al., 1998). As demonstrated by neuroimaging (i.e. FDG, PET), cerebral regions in charge of semantic processing are affected early during the progression of AD, (Zahn et al., 2006). Different hypotheses have been proposed to explain the semantic deficit showed by AD individuals:

1) a first one, based on the anatomical distribution of cortical damage in AD, claims that semantic memory deficits are the manifestation of a damage to both process and content in semantic memory;
2) Some researchers have argued for the differential weighting of either process or content (Aronoff et al., 2006; Rogers and Friedman, 2008), so moving against the first hypothesis;
3) the third hypothesis supports only a process-based impairment affecting semantic access (Bayles et al., 1991; Ober and Shenaut, 1999).

[33] Ibidem.

4) the last one supports a specific degradation of semantic content (Hornberger et al., 2009).

Evaluation in word-association and naming tasks is taken as evidence for a semantic memory deficit in AD. Indeed, patients showed dissimilar impairments in semantic category fluency (i.e. name as much animals as possible in 60 seconds) relative to letter-naming fluency (i.e. name as much words beginning with the letter "F" as possible in 60 seconds) (Adlam et al., 2006; Salmon et al., 1999). Not only do AD patients experience reduced semantic priming effects in word-stem fragment completion (e.g., cat ⟶ d-?) (Passafiume et al., 2006) but also reduced word frequency effects in free association (e.g., bride ⟶ ?) (Gollan et al., 2006). Moreover, corrupt semantic knowledge is showed in nonverbal tasks such as describing the appropriate function of a common object (Chainay et al., 2006) and sorting pictures into the appropriate category (Aronoff et al., 2006; Salmon et al., 1999). To sum, several evidences supporting the existence of core semantic knowledge deficits in AD have been proposed. Nonetheless, its organization and degradation are still controversial. This specifically applies to a category-specific semantic impairment, characterized by the loss of some semantic categories with relative sparing of others. Connected to this, both coordinate naming errors (*dog* for *cat*) and taxonomic naming errors (*animal* for *cat*) have been reported in AD (Reilly et al., 2011).

1.4.5.6.3 Naming

Concerning naming ability, different potential sources of disruption have been proposed. A first hypothesis supports the idea that perceptual deficits in AD interfere with naming at a pre-semantic stage of visual object recognition. Other theories explain naming difficulties as lexical retrieval difficulties or *"downstream" deficits that disrupt phonological encoding*[34] (Reilly et al., 2011). A careful analysis of naming error distributions reveals a superiority of semantic errors connected to phonemic or visual errors. A further hypothesis supports a semantic basis for anomia. Some studies have

[34] Ivi, p. 342

showed a strong correlation between residual conceptual knowledge and naming ability. For example, Hodges and colleagues (1996) tested the correlation between the ability of naming and the knowledge about things through a concept definition task, focusing on the quality of the definition. The majority of AD patients (76%) showed significant naming impairment in comparison to control group. 60% of test items that were correctly named were also described in a way evaluated by authors as capturing the core concept of the referent. On the contrary, significantly fewer correct definitions were produced for test items not named by AD patients (<30% correct). This correlation has also been reported in nonverbal tasks (Aronoff et al., 2006; Ralph et al., 2005). Another interesting linguistic manifestation, that is pretty contested, is a category effect. Indeed, many studies have reported a dissociation between categories in naming, with items from a particular semantic category differentially impaired. For example, AD individuals might present a double dissociation in naming manufactured artifacts and natural kinds (Gonnerman et al., 1997; Whatmough et al., 2003). Gonnerman and colleagues suppose that a cortical damage in AD results in a "crossover" naming impairment. The initial deficit includes an impairment in natural kinds, due to vulnerability of distinctive features. This first trouble later evolves toward an impairment in artifact kinds, due to greater resilience of shared features to brain damage. This dissociation natural kinds/artifacts is still in need of a definitive support from a larger investigation.

1.4.5.6.4 Grammatical processing

AD patients seem to experience also sentence comprehension difficulties. The main problem is that differentiating syntactic processing deficits from other co-morbid difficulties affecting sentence comprehension is a hard task. Some researchers claimed that a genuine syntactic deficit is apparent in AD (Grober and Bang, 1995). Others believe that many apparent syntactic deficits reflect methodological artifacts. Indeed, the grammar integrity is generally evaluated through acceptability judgments on sentence structures presenting syntactic violations (i.e. John go(es) store). This is considered an "offline" measure, requiring a patient to also exploit working memory to remember the

sentence, until a metalinguistic judgment is made. This grammatical judgment thus relies on a memory system which, as previously said, is impaired in AD. Indeed, one strong position claims that working memory deficits underlie these supposed comprehension difficulties (Waters and Caplan, 1997). Another study, carried out by Kempler and colleagues (1998), investigated this issue. They compared the performance of AD patients on offline and online tasks on grammatical ability. As offline measure they employed a sentence-picture pointing, varied by sentence type. Selected sentences differed according to their grammatical complexity, from simple structures to more complex ones. Sentences proposed presents the following structures:

1. active voice (i.e. The boy kicked the girl . . . Who kicked?);
2. active voice with conjoined noun phrases (i.e. The boy kicked the girl and the dog);
3. passive voice (i.e. The boy was kicked by the girl.);
4. active voice with a relative clause (i.e. The boy kicks the girl that chases the dog).

Finally, in all four conditions, AD patients performed worse than the control group. In addition, their performance with passive structures and active sentences with conjoined NP resulted similar. Moreover, while patients presenting classic agrammatism showed a deficit in comprehending passive structures, AD patient's performance displayed a not significant impairment on passives with respect to the active conjoined sentences. Thus, the authors supported a working memory locus in AD. Further evidence for this claim was presented by Kempler et al.'s online task, a cross-modal naming task. The dependent measure was reaction time (RT) for naming a target word when a syntactic violation was present. Both healthy controls and AD patients showed reaction time differences, namely a slower naming of the element following the verb, when this was inserted in a syntactically anomalous sentence environment. So, AD performance on this task suggested sensitivity to grammatical structure. Other studies have investigated the role of impaired verb knowledge in sentence processing. Indeed, verbs are central in sentence comprehension and production, since they dictate argument structure and thematic relations between the sentence elements. For this reason, verb deficits can impair sentence processing. Research have demonstrated a small but consistent disadvantage

for comprehension and naming of verbs relative to nouns in AD (Cappa et al., 1998; Grossman et al., 2003; Grossman and White -Devine, 1998)[35]. However, a methodological difficulty needs to be pointed out, that verbs and nouns are generally different with respect to their semantics and grammar. Thus, naming results an insufficient proof for discriminating the locus of verb impairment. To solve this problem, they tried to tease apart semantic from grammatical factors, underlying verb deficits via an online word-monitoring task. Patients task was to answer as quickly as possible when they heard a specific word (Price and Grossman, 2005). The design included a target word (represented in capital letters in these examples) appearing in different situations:

1. a verb transitivity violation context (i.e. The boy sleeps the CAT);
2. a thematic roles violation context (i.e. The milk drinks the CAT.);
3. a grammatically and semantically acceptable context (i.e. The boy kicks the CAT).

Control group responses where slower in condition 1. And 2. (Marslen-Wilson and Tyler, 1980). AD patients showed similar reactions time differences to the transitivity violation context, thus demonstrating spared sensitivity to verbs grammatical properties. On the contrary, patients did not show the same reaction time discrepancies for condition 2, suggesting an impairment concerning verb semantics. To conclude, this study showed that AD patients reported different RT in their responses according to the violation present in the sentence, suggesting impairment with semantics and not grammar.

1.4.5.6.5 Discourse processing

This domain is still in need of a deeper investigation. Nonetheless, controlled analyses of AD patients' discourse have shown impairment across different domains. Some studies have pointed out difficulties in maintaining global connectedness necessary for a cohesive storyline. Some others have claimed the presence of an impairment at the level of semantic propositional knowledge (Ehrlich et al., 1997). Anyway, common

[35] Nonetheless, the double dissociation name-verb is still unresolved, since many studies have shown a selective spare of verbs with respect to nouns in action naming VS object naming (Robinson et al., 1999; Bowles et al., 1999; Kaplan et al., 1983.)

manifestations throughout AD discourse are repetition of content, poor organization of the discourse and several circumlocutions. All these manifestations result in a speech that has frequently been described as fluent but empty (Tomoeda and Bayles, 1993).

To conclude this first chapter, we propose a brief recap and some considerations. Alzheimer's disease is considered the most common etiology for dementia, accounting for 60% or more of cases (Patterson, et al., 2003). It is characterized by a slow and progressive neurodegenerative process with many different clinical manifestations. Clinical symptoms normally include memory loss, troubles in performing daily activities, impairment of judgment, disorientation, behavioral changes, difficulty in learning, loss of language and self-care skills (Folstein et al., 1975; McKhann et al., 1984; Reisberg et al., 1982, Reisberg et al 2000; Katzman, 1986; Reisberg, 1988). From the first identification of the disease by Alois Alzheimer in 1907, many progresses have been made in all fields of study (i.e. genetics, pathophysiology, pathology, evaluation, diagnosis, treatment, etc.) Nonetheless, AD turned out to be a complex impairment from different point of views. Even though current findings have defined new putative disease mechanisms (i.e. amyloid clearance from the brain, lipid processing, etc.), these are likely to have little clinical utility in predicting disease risk. The same applies for clinically approved interventions, still in need of deeper investigations. Using DSM-IV criteria (or others such as CERAD[36] or NINCDS-ADRDA[37]), anamnesis, and mental status examination, clinicians should be able to determine whether the syndrome of dementia is present. Anyway, it might happen that the clinician cannot be sure whether the person has dementia of the Alzheimer type or a different disturbance, due to the high comorbidity of symptoms between different types of dementia. So, further testing and follow-up are necessary to achieve a differential diagnosis. Despite the validity of clinical diagnosis has substantially increased in the last years, it is made with limited certainty. Thus, it requires confirmation in postmortem examination (Reisberg et al. 1997; Small et al. 1997). As for clinical

[36] Consortium to Establish a Registry for Alzheimer's Disease.
[37] National Institute of Neurological and Communicative Disorders and Stroke -Alzheimer's Disease and Related Disorder Association.

manifestations, episodic memory deficit in now considered the hallmark of AD and so it is the first domain investigated during the diagnostic process. In recent years, also the linguistic impairment has been deeply investigated. Indeed, there is increasing evidence that language dysfunction begins several years before a definite diagnosis (Auriacombe et al., 2006), suggesting that this domain could be a possible prognostic marker and target for early therapeutic intervention. We do believe that to identify and more deeply classify the nature and degree of language impairment could help the early diagnosis of the disease and also aid to develop new therapies. These last considerations are the core reasons beyond this study.

CHAPTER 2

Word-Formation

2.1 Introduction

Word-formation is a term used to designate the formation of morphologically complex words. With the term "morphologically complex" we mean that the new words are decomposable in smaller meaningful units. These units are called morphemes (Plag, 2003). Bauer (1983, p. 30) provided the following definition of the term word-formation:

"Word formation can be defined as the production of complex forms. "Complex" is used by other scholars to mean 'produced by derivation'. Thus, word formation can be divided, in the first instance, into derivation and compounding (although there are other categories which do not fit neatly under either of these headings)".

In the literature, scholars use the term word-formation in two different ways. (i) From the one hand, it is used to specifically refer to lexeme-formation. (ii) On the other hand, it refers both to the formation of lexemes and to the formation of word-forms. Supporting the second statement one implicitly claims that the lexemes and word-forms are fundamentally created in the same way, since to form them prefixes, as well as suffixes, can be used, vowels or consonants may be changed, a single form may have two different functions, but the same processes are used to create both word-forms and lexemes. According to (ii) languages do not have different and specialized means to create lexemes and word-forms. On the contrary, scholars who use the term word-formation to refer only to lexeme-formation implicitly make a claim that the process used to form lexemes is different from the one used for word-forms (Bauer, 2008). These processes may differ for two reasons. First of all, lexemes can be created through the juxtaposition of other lexemes (i.e. EN. *foot+ball*; IT. *capo+stazione*), forming for instance a compound. This process, called composition, is never used, in English as well as in many other languages, to create word-forms. As for other languages in the world, the discussion is still open to interpretations. Secondly, these processes may also differ since

lexemes can be created *in ways that do not involve predictable formal patterns*[38]. This does not apply to word-forms. Indeed, in most of lexeme-formations, affixes are generally added to bases according to relatively predictable rules. Both the bases, and the affixes which are attached to them, are meaningful, in their own way. These ways of forming words are said to be morphological. *The morphological means used to create word-forms is called inflectional morphology. The morphological means used to create lexemes is called derivational morphology*[39]*.* Derivational morphology is the focus of our work. As far as we are concerned, we use the term word-formation to talk about coinage of new lexemes (i).

2.2 Derivational Morphology

In creating new lexemes, or complex-words, derivational morphology fulfils two major roles:

(i) it moves words from one word-class to another, the so-called transpositional function;

(ii) it forms *new words with particular regularly required meanings*[40], providing new entries to the vocabulary of one language (i.e. lexical enrichment).

Concerning transposition (i), languages including among their word-categories nouns and verbs needs a way to change one into the other. Generally, nouns derived from verbs, known as deverbal nominals, present a meaning such *as "the act of -ing", "the process of -ing" or "being -ed", "the result of -ing", "the state of being -ed"*[41] and so on (see Bauer, 1983 for a longer list concerning English). However, in some cases, it may be difficult to precisely interpret which among the different meanings is the correct one. Moreover, the interpretation that nominalizations receive may change according to different contexts. *Some nominalizations may become specialized with one or more of these readings, others*

[38] Bauer, L., (2008). *Derivational Morphology*. Language and Linguistics Compass 2/1. Blackwell Publishing, p. 197.
[39] Ibidem.
[40] Ivi, p. 207.
[41] Ibidem.

may be vague in regard to all of them[42]. As for noun to verb derivations (denominal verbs), these are more semantically varied.

(ii) The second function fulfilled by word-formation is a characteristic of all human languages, namely the potentiality to coin new words to enrich the vocabulary of one language. This process allows the denotation of types of entity that are culturally determined. So, it is very much possible to see a novel word in one language and not in another. Common meanings conveyed by new formations generally include agents, instruments, locations, diminutives, causation, etc. Moreover, the majority of these "concepts" enforce a particular word class. For example, agents and instruments are generally nouns.

2.3 Mechanisms of Word-formation

Complex words can be formed through many different mechanisms. Some operations include concatenation, that means merge together a base and an affix as in a chain (i.e. suffixation). Others are non-concatenative ways. Indeed, we can change the category of a word by simply adding nothing to the lexical base (i.e. conversion) (Plag, 2003). In this chapter we are going to focus on suffixation and conversion, since these are the mechanisms of word-formation we investigated in our experimental study. Given that a detailed description of the other existing processes of word-formation would go beyond the scope of this chapter, just a brief introduction to them will be provided.

2.2.1 Derivation

Derivation is a central mechanism of word-formation in Italian (Rainer, 2016). It can be defined as the process of creating new words by adding an affix to the root of an existing word (i.e. affixation) (Bauer, 1983). It is one of the most employed types of word-formation in all languages and it can be put in place by (i) adding a prefix to the root (prefixation, i.e. EN. *re+organize*) or (ii) a suffix (suffixation, i.e. EN. *organiz+ation*), as well

[42]Ibidem.

as (iii) adding a prefix and a suffix at the same time (circumfixation, i.e. EN. *dis+organiz+ation*). In applying the mechanism of derivation, the possible results are two: (a) a complex word presenting a new meaning, related to the one of the base and formed by changing the grammatical category of the lexical base to which the bound morpheme attaches (class-changing derivation); (b) a complex word presenting no change in its category but only a new meaning (class-maintaining derivation, i.e. IT. *ri+fare*) (Bauer, 1983). All speakers know how to form complex words merging a lexical base and a bound morpheme. Moreover, they are able to identify the meaning of a new complex word referring to the meaning of the elements forming it (compositional meaning). This process must be guided by some kind of rule and there must be a sort of system in the speakers' minds responsible for that (Plag, 2003). Indeed, the so-called word-formation rules (henceforth WFRs) are well-accepted as trigger of the process of word-formation. A WFR specifies that a bound morpheme X can be attached to a free morpheme Y and not to Z, in order to form a new complex word W. To be correctly applied, the rule must contain information about the phonology of the affix, what kind of affix it is (prefix or suffix), its semantics, and the possible base morpheme the affix can merge with.

2.2.2 Conversion

Besides the possibility to derive a new word merging together a base and an affix, as just seen in the preceding paragraph, there are also non-concatenative processes which create a new word on the basis of an already existing one. One of these processes is the so-called conversion. *Conversion can be defined as the derivation of a new word without any overt marking.*[43] According to Plag (2003), this process of word-formation presents three theoretical problems. The first one (i) is the problem of directionality, namely whether the verb is formed from the noun or the noun is created from the verb. For determining the directionality of the process there are four possible ways: (a) to look at the history of words and see which one was the first to be attested; (b) to investigate the semantic complexity of the supposed base and derived forms; (c) to look at the formal

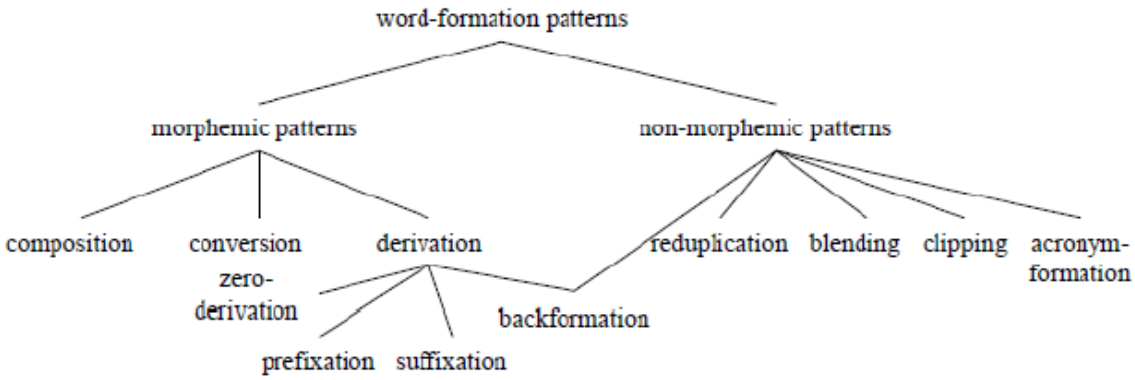
[43] Plag, I., (2003). *Word-formation in English*. Cambridge University Press, p. 134

properties of the two items and (d) to check the frequency of occurrence (see Plag, 2003 for a detailed clarification). Even though the existence of these four criteria to establish the directionality of conversion, one may encounter some difficult cases. The second issue (ii) is the problem of zero-morphs**.** According to Plag (2003), the existence of a zero-morph should not be rejected entirely. Nonetheless, the question is when it is right to postulate the existence of a zero form. Many scholars claim that its presence is justifiable only in those cases where there is evidence of an overt form (i.e. a suffix morphologically realized) that expresses exactly the same meaning or function of the null morpheme. This constraint has been called the overt analogue criterion (Sanders, 1988). According to the constraint, for each type of conversion there might exist, at least, one overt affix expressing the exact same range of meanings expressed by conversion (or zero-suffixation). In that circumstance, one could easily postulate the existence of a zero-affix. On the contrary, when this does not happen, this proposal should be rejected in toto (see Plag, 2003 for more details on the theoretical problems connected to this issue). The last issue to be discussed is (iii) the problem of the morphology-syntax boundary. One could silently assume that the word-formation process in question is governed by morphology and thus consider it as a lexical process. On the other hand, one could also claim that conversion is handled within the syntactic domain. In other words, *conversion could be defined as the use of a word with a given syntactic category in a syntactic position that it normally does not occupy. And, if it appears in such a position, it takes on the properties of those items that usually occupy this position* [44]. This syntactic interpretation of the phenomenon, however, creates new problems. Indeed, it is usually assumed that words have a clear category specification since this type of information is essential for the application of syntactic rules (i.e. positioning of items in the syntactic structure) (Plag, 2003). To solve this problem, some syntactic-view supporters (i.e. Farrell, 2001) proposed that words might be underspecified with respect to their lexical category and that the full specification is achieved when a word is positioned in a specific syntactic context.

[44] Ivi, p. 143.

Nonetheless, there is an argument that could help to better understand the of syntax-morphology boundary in conversion. As stated by Plag (2003), *the most important property that distinguishes syntactic rules and entities from morphological ones is the idiosyncrasies of morphological formations"*[45]. Generally, syntactic patterns are viewed as "regular", since they rarely present exceptions. On the contrary, converted verbs seem to present quite commonly idiosyncratic meanings and lexical gaps. This might indicate that the process in question should be lexical, and not syntactic, in nature. Since this problem could be solved in different ways, according to the different syntactic theory taken into consideration, we are not going to enter the debate. Moreover, it is far from our purposes argue for or against certain theories of syntax or the nature of the process of conversion.

2.2.3 Other Mechanisms of Word-Formation



Figure[46] 2.2.3 – Word-formation patterns

Apart from the two word-formation processes presented in the previous paragraphs, in the languages of the world other mechanisms are also available to create new complex items. One of them involves the deletion of morphological material. For example, a noun can be shortened by eliding a part of the word. This type of word-formation is called truncation or clipping (i.e. EN. *lab* < *laboratory,* IT. *bici* < *bibicletta*). Moreover, Italian

[45] Ivi, p. 145
[46] Figure taken from Müller, P.O., et al. 2015. *Word-Formation: An International Handbook of the Languages of Europe*. De Gruyter Mouton.

abundantly uses acronyms (i.e. IT. *Fiat < Fabbrica Italiana Automobili Torino*). There are also the so-called blends, resulting from the amalgamation of different parts of words (i.e. EN. *smog* < *smoke+fog*). Another well-known word-formation process is compounding, also called composition. It is defined as the juxtaposition of two words to create a new one. This definition contains two crucial assumptions regarding compounding. The first one is that a compound consists of just two elements. The second one is that these two elements are words, not morphemes (Plag, 2003). There are different patterns of compounding. The first one is (i) nominal compounding, such as a. N-N (i.e. IT. *cassa+panca, vagone+letto*), b. V-N (i.e. IT. *spazza+neve*, *batti+cuore*) and c. V-V (i.e. IT. *fuggi+fuggi*). The second one is (ii) Adjectival compounding, presenting only two productive patterns: a. A-A (i.e. IT. *politico+morale*); b. V-N (i.e. IT. *mozza+fiato*). The last one is (iii) Verbal compounding, which according to Rainer (2016) only exist as relict in Italian (i.e. N-V *capo+volgere* or A-V *bene+dire*). As for backformations and reduplications, in Italian there are no synchronically productive patterns available (Rainer, 2016).

2.4 Theoretical Premises: Nouns and Verbs

Nouns and verbs are considered as the prototypical categories, enough to be categorized as language universals. Among the reasons justifying this view, there is the claim that nouns and verbs are the crucial grammatical classes the child has to acquire (Haman, 1997). From a cognitive point of view, many scholars have claimed that these distinct categories fulfill different functions. Nouns *designate a bounded region in some domain*[47]*.* They conceptualize bounded entities. On the contrary, verbs codify relations and connection between objects already conceptualized. This is the reason why nouns and verbs can be considered as two poles of a magnetic field (Hagège, 1984). According to Lyons (1977), from a semantic point of view, prototypical nouns[48] are linguistic items designating discrete and numerable entities. Their purpose is to specify referents.

[47] Langacker, R.W. 1987. *Nouns and Verbs*. Language, 63: 58.
[48] "Physical objects are what we will call first-order entities". Lyons, 1977: 442.

Prototypical verbs[49] are predicative entities used to say something about referents. So, they establish relations between referents and denote events provided with a temporal dimension. Nonetheless, this clean semantic and cognitive distinctions are (partially) ascribable only to prototypical nouns and verbs. Indeed, complex words (i.e. deverbal nouns and denominal verbs) behave somehow differently, as we will see later on.

2.4.1 Aktionsart

Verbs are generally classified according to their inherent actionality, also known as Aktionsart. Lexical aspect is an essential characteristic of the semantics of verbs. It is strictly connected to the Aspect but, at the same time, it is totally different since the latter refers to the specific point of view adopted by the speaker, as Bertinetto pointed out (Bertinetto, 1994). Indeed, the Aktionsart codify the event type, specified according to a restricted set of relevant properties (Bertinetto, 1994). When talking about lexical aspect, an event is normally categorized according to its durativity (+/-durative), its dynamicity (+/- dynamic) and finally to its telicity (+/- telic) (Vendler, 1957; Bertinetto, 1991). The interplay of these properties designates four different actional classes:

Table 1 – Vendler's Aktionsart Classes

Class	*Dynamicity*	*Durativity*	*Telicity*
(i) stative	-	+	-
(ii) activity	+	+	-
(iii) achievement	+	-	+
(iv) accomplishment	+	+	+

Elaborating on the Vendler's classification, Smith (1991) proposed an additional actional class on the basis of the criteria previously discussed. In particular, she identified verbs presenting the features [+ dynamicity] and [+ instantaneous], but inherently atelic, such

[49] "By second-order entities we shall mean events, processes, states- of-affairs, etc., which are located in time and which, in English, are said to occur or take place, rather than to exist". Lyons, 1977: 443.

as *bussare*, *starnutire*, etc. She used the term semelfactive (also used by Verkuyl's 1993) to refer to this class of verbs.

Table 2 – Smith's adjustment of Aktionsart Classes

Class	*Dynamicity*	*Durativity*	*Telicity*
(i) stative	-	+	-
(ii) activity	+	+	-
(iii) achievement	+	-	+
(iv) accomplishment	+	+	+
(v) semelfactive	+	-	-

To check whether a verb belong to one or the other actionality class there are several syntactic tests:

(a) possibility to occur with the progressive form;

(b) possibility to occur with frame adverbial "for X time";

(c) possibility to occur with frame adverbial "in X time";

(d) possibility to occur with adverbs like vigorously, actively, etc.;

(e) possibility to occur with adverbs like quickly, slowly, etc.

A brief description of situation types is provided below.

(i) Stative Verbs

According to the classification previously seen, stative verbs express a durativity, but they do not express a change or transformation, so they lack dynamicity. Moreover, they are not telic, since they do not include an inherent endpoint. They cannot occur in a progressive form construction (i.e. *conoscere*).

(ii) Activity Verbs

They describe dynamic situations which include stretch over a certain time interval (durativity). These are atelic since they describe unbounded or open-ended processes. So, once they have started, they can keep on indefinitely (i.e. *correre*).

(iii) Achievement Verbs

Achievement verbs are depicted as dynamic situations denoting near instantaneous events. Indeed, they are over at the same time they have begun. So, they can be considered punctual events presenting an inherent endpoint (i.e. *esplodere*).

(iv) Accomplishment Verbs

This verb class is also described as expressing dynamic and long-lasting processes. Moreover, its peculiarity is that they are also inherently telic. So, they dente actions presenting a natural endpoint or *télos* (i.e. *costruire*).

(v) Semelfactive Verbs

The last class groups together dynamic verbs that are instantaneous but inherently atelic. So, they describe atelic non-durative events (i.e. *starnutire*).

So, actionality is a typical property displayed by verbs. Nonetheless, a non-prototypical type of nouns also presents this feature, namely derived nominals, which will be presented in §2.5.

2.4.2 Argument Structure

The concept of valency was firstly introduced in linguistics by Lucien Tesnière (1959), using a metaphor taken from the chemistry domain. Some atoms need to saturate their valency to acquire a molecular structure. Similarly, some verbs need their valency to be saturated by nominals and/or prepositional phrases in order to produce a grammatical sentence. The elements which saturate the valency of the verb were named by Ternière *actants*, which must occur with the verb. Except for compulsory elements, other optional items can also occur in a sentence. These were named *circonstants*. According to the number of arguments required by the verb valency, verbs can be divided in different categories: (i) zerovalent (i.e. *piovere*), (ii) monovalent (i.e. camminare), (iii) bivalent (i.e. *mangiare*) and (iv) trivalent (i.e. *regalare*). Successively, the notion of argument structure was first adopted by researchers working in the government-binding framework. According to Hale and Keyser (1999a) the term argument structure refers to *the syntactic*

configuration projected by a lexical item. It is the system of structural relations holding between heads (nuclei) and the arguments linked to them, as part of their entries in the lexicon. […] Argument structure is defined in reference to two possible relations between a head and its arguments, namely, the head-complement relation and the head-specifier relation[50].

We believe important to underlie that there is not only one conception of argument structure. Indeed, this syntactic notion varies according to different theoretical backgrounds, especially with respect to how semantics and syntax interfaces interact with each other (Levin, 2017). In Lectures on Government and Binding (1981), Chomsky proposed a formal device he called *Theta-criterion*. According to this principle, every verb project a theta grid containing information about the type of relations it entertains with its arguments. So, according to this principle, from a semantic point of view, every argument possesses a specific semantic role or, to use Chomsky's terminology, a *theta role*. The number and typology of thematic role is a still debated issue (Dowty, 1991; Gruber, 1976, *inter alia*). However, some theta roles are recognized in different frameworks, such as: agent, patient, theme, experiencer, beneficiary, instrument, etc. The argument structure is a notion generally connected to verbs. Nonetheless, also nominalizations (i.e. deverbal nominals) present a thematic grid, inherited by the verbal base from which a complex noun is derived (Grimshaw, 1990).

[50] Hale, K., Keyser, S.J. 1999a. *A Response to Fodor and Lepore, 'Impossible Words?*'. Linguistic Inquiry, 30: 453-454.

2.4.3 Complex Words in the Lexicon

Several theories concerning the lexical organization of language in the mind has assumed that the lexicon projects word-sized units to syntax. According to this view, a word is considered a complex object presenting a sound/meaning correspondence, an argument structure and is also marked according to its categorical status (grammatical category, i.e. noun, verbs etc.) (Barner and Bale, 2002). Thus, words can be stored (and so retrieved) in one of two different ways:

(i) as memorized words explicitly listed;

(ii) as words generated online by WFRs, allowing thus processes of word-formation such as derivation, etc.

This second approach is called lexicalist hypothesis (Lexicalism, see Lieber, 1992 *inter alia*).

Words are created in the lexicon, by processes distinct from the syntactic process of putting morphemes/words together. Some phonology and some structure/meaning connections are derived in the lexicon, while other aspects of phonology and other aspects of structure/meaning relations are derived in (and after) the syntax (Marantz, 1997: 201).

Other theories have been proposed against this traditional approach. Among these, Distributed Morphology (DM) questions the lexical distinction between grammatical classes such as noun and verb (Halle and Marantz, 1993, 1994; Marantz, 1997). According to this approach, lexical roots are neutral, or underspecified, with respect to their syntactic category. When items are placed in a nominal context the result is a nominalization, whilst, when a root is placed in a verbal environment it becomes a verb. (Marantz, 1997). In other words, *DM minimizes the explicit listing of special sound/meaning pairings, argument structure alternations and categorical specifications*[51].

[51] Barner, D. and Bale, A., (2002). *No nouns, no verbs: psycholinguistic arguments in favor of lexical underspecification*. Lingua 112: 773.

We will not discuss in detail these different approaches to lexical organization and where word-formation is processed (i.e. morphology, syntax) since these would go beyond the scope of our research. Nonetheless, as we will state in Chapter 3, we support a dual-route processing and retrieval of complex words. Moreover, stored roots are underspecified as regard their syntactic category.

2.5 Deverbal Nouns (Nominalization)

Nominalizations are nominal structures derived from other syntactic categories, especially from verbs (Melloni, 2011). These items are known as deverbal nominals (henceforth DVNs). In the literature, scholars have distinguished several types of DVNs. Among these, there are (i) agent (*nomina agentis*) and (ii) instrument (*nomina instrumenti*) nouns (i.e. EN. *work+er*, IT. *spazz+ino*; EN. *print+er* IT. *frulla+tore*), (iii) patient nouns (i.e. EN. *employee*,) and so on. The most frequent nominal structures are the (iv) *nomina actionis*, extremely studied for their peculiarities and behavior. All these items are morphologically complex lexemes created by conversion or by merging a name-creating suffix with a verbal base. The suffixes we are going to deal with in this work are generally known as transpositional (Beard, 1995) since they change, or transpose, the meaning of the verbal base into a different category, in this case a noun, which finally presents the same meaning (Melloni, 2011). Focusing just a moment on action nominals (henceforth ANs), it is well-known that these complex elements present a semantic ambiguity. Among the possible interpretation, deverbal Event nominals are considered particular, since they appear to inherit some verbal properties, such as the verbal meaning and the thematic relations. For this reason, they are seen as a case of mixed N-V category, challenging the general conception of syntactic categories as discrete elements within the mental lexicon. Moreover, actionality, generally defined as a verbal feature, seem to be preserved (or better inherited) in these complex nominals. This is not bizarre, since Aktionsart is a lexical property and it plays a key role in the morphological process of nominalization (Melloni, 2011).

2.5.1 Noun-Deriving Suffixes: formal and semantic properties

In the following paragraphs we will briefly present the formal and semantic properties of the suffixes we selected for our experimental study. We will start with verb-deriving suffix forming *nomina actionis*, namely "-mento", "-zione" and "-tura". We will precede with suffixes "-ino" and "-tore", forming *nomina instrumenti*. Finally, we will conclude with the suffix "torio", used to form *nomina loci*. We will mainly base our description on what presented by Grossmann and Rainer in *La Formazione delle Parole in Italiano*, (2004) and by Melloni in *Event/Result Nominals: a Morpho-Semantic Approach*, (2011).

2.5.1.1 Nomina Actionis

Comrie (1976-b) claims that ANs are *"nouns derived from verbs (verbal nouns) with the general meaning of an action or process*[52]*"*. However, Melloni pointed out that the proposed definition is somehow too narrow. Indeed, the transpositional affixes normally used to derive ANs merge with dynamic verb bases (i.e. *destruction* < *destroy*) as well as with state verb bases. In the second case, they should form state nominals (i.e. *admiration* < *admire*). It is well-known that ANs present a semantic ambiguity. Indeed, they generally display a series of (more or less) related meanings (Melloni, 2011). Among the many readings they can show, the semantic distinction between the Event and the so-called Result readings has been particularly study for its interesting syntactic behavior (See Melloni, 2011). We will not discuss the polysemy of ANs in detail, since this would go beyond the scope of our work. Nonetheless, we consider appropriate to point out this interesting matter in view of the different semantic properties of ANs suffixes we are going to present successively. Indeed, ANs are sensitive to the semantic nature of the verbal base from which they are derived, so to the Aktionsart.

[52] Comrie, B. (1976b). *The syntax of action nominals: A cross language study*. Lingua, 40: 178.

2.5.1.1.1 Suffix -zione

Forming ANs employing the suffix "-zione" is problematic for two main reasons:

(i) from the one hand, it is hard to identify the form of the derivational base. Indeed, one hypothesis selected as base the stem (i.e. *crea~~re~~ > crea+zione*). On the contrary, Scalise (1994)[53] proposed the past participle form (i.e. *concludere > conclus~~o~~ > conclus+ione*). This second proposal can better account for ANs derived from both the regular and also many irregular past participle forms (i.e. *divis~~o~~ > divis+ione*). Nonetheless, this WFR cannot explain ANs derived from the Latin perfect participle (i.e. *esecuzione*).

(ii) from the other hand, the suffix in question shows several allomorphs (i.e. "-sione"; "-ione"; "-gione").

As for the application of the suffix, "-zione" is generally in complementary distribution with the suffix "-mento". From the formal point of view, the suffix "-zione", attaches to:

i) verbs that can be monosyllabic (i.e. *sta+zione*);

ii) complex verbs, especially when presenting a learned prefix (i.e. de+composi+zione) or a learned suffix (i.e. un+ific+(a)+zione 'unification');

iii) verbs formed by a nominal base throug conversion (i.e. progett(a)+zione 'projecting').

Finally, focusing on the semantics of the suffix, ANs derived applying the suffix "-zione" are the one experiencing the major meaning extension. Indeed, they generally mean "the act of V". Nonetheless, according to Gaeta (2004, p. 316), they can also denote:

A. the result of a process, which can be a concrete (i) or an abstract (ii) object:

(i) L'*espressione* di Giovanni fu inappropriata (concrete).

(ii) L'*espressione* alla lavagna è scorretta (abstract).

B. The resulting state reached by the predicate:

(i) La *civilizzazione* è uno stadio recente nella storia dell'umanità

C. the object/instrument used to perform the dynamic situation described by the base verb:

(i) L'*illuminazione* della sala fu rimessa in funzione.

[53] To notice that the hypothesis from Scalise (1994) in some cases needs two WFRs to derive the final outcome (i.e. costitu-to > costituz > costituzione)

D. The location where the event takes place or where the action is carried out:

E. The manner in which the event is carried out:

(i) La *classificazione* dei libri in biblioteca è pessima.

F. The temporal slot in which the event take place:

(i) Durante la *rivoluzione* molti aristocratici abbandonarono la Russia.

2.5.1.1.2 Suffix -mento

The suffix "-mento", alongside with "-zione", are the two most productive suffixes used to form ANs.

Define the form of the lexical base used as starting point of the derivation process is a hard task. Indeed, different proposals have been formulated. As for verbs belonging to the first and third conjugation, the lexical base corresponds to the stem (root + thematic vowel), namely the infinitive form excluding the inflectional suffix -re (i.e. *apprezza~~re~~ > apprezza+mento*). The same only applies to verbs belonging to the second conjugation not presenting a stem with thematic vowel "e" (i.e. *riconosce~~re~~ > riconosc+i+mento).* Thornton (1990) formulated a different WFR in order to unify the lexical base for all the three Italian conjugations. She proposed to use the imperative form as lexical base [54]. As for the suffix "-mento", it prefers to merge with:

i) polysyllabic verbs (i.e. addestra+mento);

ii) verbs presenting a non-learned prefix, (i.e. ad-, in- and s-), used to form parasynthetic verbs (i.e. in+cener+(i)+mento) or a non-learned suffix (i.e. "-eggi", "+acchi-/-ucchi-", gar+eggi+(a)+mento);

iii) primitive verbs.

Finally, as for the semantics, the suffix "-mento" is the one most applied to express the basic meaning "the act of V". Nonetheless, except for the basic transpositional meaning Also, ANs derived with "-mento" suffix can present a range of semantic interpretations:

A. denoting the external argument of the verb (i.e. *accompagnamento*);

[54] We will not discuss about which proposal works better and why. For a deeper investigation on the matter see Thornton, 1990; Grossmann and Rainer, 2004.

B. the instrument used to perform the action (i.e. *aramento*);

c. the location where the event takes place (i.e. *alloggiamento*)

Moreover, we want to point out that there are some cases in which the same verbal base is selected by competing suffixes, i.e. "-zione" and "-mento", as in *aggregamento/aggregazione*, where the two outputs present the same meaning or i.e. *trattamento/trattazione* where the two outputs are linked to different meaning of the verbal base from which they are derived.

2.5.1.1.3 Suffix -tura

"-tura" is a productive suffix generally employed to denote technical activities belonging to specific fields, such as agriculture (i.e. *rifinitura*), manufacturing (i.e. *allicciatura*), book industry (i.e. *legatura*), building (i.e. *inconrniciatura*). Moreover, nowadays it is also used to form complex words belonging to a more colloquial register (i.e. *fregatura*). As for the form of the verbal base, the problems described in the previous paragraphs play a role also in this case. Thus, the verbal base can be:

a. the past participle form (i.e. *leggere > letto > lettura*);

b. the stem (i.e. *aprire > apri >apritura*);

c. the verbal root (i.e. *procedere > procedura*)

Looking at its formal properties, the suffix "-tura" prefers:

i) polysyllabic verbs (i.e. *ador(a)+tura*);

ii) verbs presenting non-learned prefixes (i.e. a+bbronz(a)+tura);

iii) verbs derived with suffixes (i.e. scen+eggi(a)+tura).

To conclude, looking at its semantics, the suffix "-tura" generally denotes professional and technical activities, such as *abbacchi(a)tura*. Moreover, it presents the semantic extension of "the result of V", which can be abstract (i.e. *accigli(a)tura*) or concrete (i.e. *cancell(a)tura*). Finally, it may also present semantic extensions such as locative (i.e. *apertura*), instrumental (i.e. *arm(a)tura*) and modal (i.e. *scrittura*).

To conclude this section on ANs suffixes, we believe important to highlight that no difference is seen among the overmentioned suffixes (Varvara, 2017). Thus, they are seen as competitors.

The noun-generator suffixes we have presented so far are seen as competitors between each other. Indeed, they can all be used to form complex items presenting a variety of readings. In his work of 2002, Gaeta compares the behavior of the suffixes "-mento" and "-zione". His analysis showed that both suffixes allow the same number and types of readings, but to different extents. Indeed, it seems that "-mento" is much less likely to present polysemy than "-zione". This is the reason why complex nominals formed selecting the suffix "-mento" are much more likely to be interpreted with the default eventive meaning. Indeed, in his work of 2004, he provided as example the doublet *divarivamento – divaricazione* where only the latter can be read as a resulting state (R nominal). Nonetheless, this distinction just presented is more an exception than a rule. The semantic closeness of these suffixes is indeed provided by examples such as *accelerazione -acceleramento*, *congelamento – congelazione*, etc. where a distinction in meaning comparable to the one presented above is not possible.

2.5.1.2 Nomina Instrumenti

Different scholars have written about the conceptual proximity between agent (which we will not deal with in this work) and instrument (among them Booij, 1986; Bisetto, 1995, Gaeta, 2012). This proximity has also been supported by the evidence that the same WFR is often used to form both complex instrument and agent nouns, in different languages. This is also the case of Italian. Generally, these outcomes are morphologically motivated denominations referring to devices which function is related to the verbal base. The specific function described by the noun is evidently given by the verbal base (i.e. *macinino* = oggetto usato per macinare). Even though the function and the area of usage are culturally and socially determined, thus not just linguistically driven, the core meaning of instrument nouns is "object that V". The term "object" is used as passe-partout word to refer to a machinery rather than a utensil or a device. It is also important to put in

evidence the possibility of some instrument suffix to be used also to form place nouns, since the semantic shift from “object that V” to “place where V” is an easy process.

2.5.1.2.1 Suffix -tore

As just specified, the polysemy agent/instrument is somehow conceptual driven. Scalise also claimed that the distinction between these two semantic outputs is not clean. Indeed, many V-tore present this double pattern agent-instrument. Moreover, the agentive reading is much more common than the instrument one, which a proportion of 1/5 for instrument outcomes. Concerning the instrument semantics of the suffix “-tore”, it normally designates devices, systems, mechanisms, etc. connected to the industrialized society, such as *condizionatore* or *irrigatore*. Nonetheless, we also find complex nouns referring to a simpler instrument, for example *bollitore* or *dosatore*.

2.5.1.2.2 Suffix -ino

The suffix “-ino, used to form *nomina agentis* from nominal or verbal bases (i.e. *posta > post+ino, spazz~~are~~ > spaz+zino*), can also select a verbal base to form instrument nouns. Both the agentive and instrumental readings from verbal bases present the same productivity (more or less). Moreover, the WFR applied to form them is exactly the same. Indeed, they both select the verbal root (i.e. *col~~are~~ > col+ino, misur~~are~~ > misur+ino*).

2.5.1.3 Nomina Loci

Concerning *nomina loci*, they generally designate circumscribed places where the action expressed by the verbal base take place. Again, also for this complex noun formation, two possible outcomes are derived applying the same WFR. Indeed, two possible readings are expressed, namely instrumental and place. We will focus on the place reading.

2.5.1.3.1 Suffix -torio

The suffix “-torio” is used to form instrument nouns from verbal bases (i.e. *colluttorio*). This procedure is directly inherited from the Latin form “-torius”, suffix used to form

deverbal adjectives, as well as instrument and place nominals. So, this form is considered the Latin, and so learned, variant of "-toio" (Tekavcié, 1980). Nonetheless, while the instrument outcomes[55] are rather rare, the second semantic reading is much more common. Some of them, directly inherited from Latin when the process to form them had already took place, are opaque and not motivated in Italian, such as *laboratorio* or *ambulatorio*. Nonetheless, these forms are well-known to every Italian speaker. There are also other autochthonous formations derived from Italian verbal bases, i.e. *dormitorio* < *dormi~~re~~i* and *sudatorio* < *suda~~re~~*. Among these, some V-torio designates the institutional place where the activity expressed by the base verb take place, such as *osservatorio* < *osserva~~re~~*.

2.5.2 Conversion

Italian has many different patterns of conversion. The resulting outcomes normally take the inflection of the category they enter. Indeed, verbs can be changed into masculine of feminine action nouns, such as *arrivo* or *conquista*. Only marginally they can also denote agent nouns (Rainer, 2016). In the following section we are going to briefly describe the different pattern we encounter in Italian conversion, making specific references to their formal and semantic characteristics. We will start from nouns formed from the present stem which will be split in two subsections (i.e. present stem in -o and present stem in -a). We will proceed with complex nouns formed from the Participle stem. Again, the paragraph will be divided in two parts (i.e. present participle stem and past participle stem). Finally, we will conclude with the athematic stem.

2.5.2.1 Present Stem

The first pattern we present is the one involving DVNs such as *acquisto, consumo*. It includes the biggest portion of DVNs. These complex items are formed taking as verbal

[55] The major part of them are adaptations of Latin forms and so not motivated in Italian.

base the present stem ending in -o and they commonly privilege verbs belonging to the first conjugation. It is important to highlight that, in many occasions, nouns converted in -o present a synonymic form derived through the suffix "-mento" (i.e. *saccheggio - saccheggiamento*). Nonetheless, the converted nouns generally present more readings with respect to the complex nouns derive through "-mento" suffix, which normally denoted just the basic verbal action (i.e. *campeggio - campeggiamento*). According to Gaeta (2004,) DVNs which are converted (as well as the ones derived through suffixation) may present semantic extensions. Indeed, they may come to represent the result of the verbal action (i.e. *accordo*), the instrument or mean used to carry out an action (i.e. *cambio*, *fermo*), the place where the action develops (i.e. *arrive, ricovero*), the person doing the action (i.e. *aiuto*), the concrete result of the action (i.e. *strappo*). The second pattern within the present stem group is the one expressed by the female form, such as *ricerca*, *conquista*. To notice that some of them are obtained by a different mechanism of word-formatio, namely truncation of the suffix "-zione" (i.e. *notifica < notificazione, verifica < verificazione*) or "-tura" (*crepa < crepatura, schiaccia < schiacciatura*).

2.5.2.2 Participle Stem

In Italian, DVNs are also formed by non-finite forms of verbs. Focusing firstly on the present participle stem, this is historically known as base from which different types of nominalizations are formed. We will not discuss about the still open problem of the origin of these constructions (i.e. conversion VS derivation) since this digression would go beyond our interests (See: Grossmann et al., 2004 for further information). This process generally forms *nomina agentis* (i.e. *manifestante <manifestare*), more or less complex *nomina instrumenti*[56] (i.e. *stampante*, *pulsante*), and words referring to chemicals (i.e. *candeggiante*). As for the past participle stem, it is also used to form complex nouns, generally *nomina actionis* which are formed from the feminine base of the past participle (i.e. *mangiata*). Concerning their semantics, action nominals formed from the feminine

[56] As Dardano (1978) pointed out, the first outcome was adjectival, successively it turned into nominal (i.e. macchina stampante > stampante).

form of the past participle stem are interpreted just as individual or instantiated events (Mayo, et al., 1995). They cannot denote the action or the process as such. Indeed, this form has the peculiarity of isolate a single portion of the process which become the focus of the attention. So, feminine past participles can isolate in the verbal continuum, generally limitless, a specific portion of the action with a specific end point. They produce an aspectual opposition between the ongoing action expressed by the verb and the single action expressed by the nominal form (generally espresso within a periphrasis such as "do X"). To say it differently, nontelic predicates are turned in inherent telic nouns (Gaeta, 2000). As a consequence, it is not a surprise that stative verbs normally do not form action nominals since they do not possess the inherent concept of process. Indeed, this form of *nomina actionis* in normally compatible just with verbs presenting the feature [+ dynamic]. In addition, ANs cannot be formed from telic verbs (i.e. achievement and accomplishment).

2.5.2.3 Athematic Stem

For our experiment we selected also six deverbal nominals (see Chapter 3) formed picking up the athematic stem. These forms can be considered lexicalized since their eventive interpretation is no more available, as for *chiusa*, *scritta* etc. Indeed, the only possible reading is a concrete meaning.

2.6 Denominal Verbs (Verbalization)

Another interesting shifting phenomenon between word classes is the creation of verbs from nouns, also known as verbalization (Comrie, 1985b). As well as DVNs, denominal verbs (henceforth DNVs) are formed through the application of different word-formation processes such as derivation, conversion, but even fewer common mechanisms like reduplication, change of pitch, etc. We will just discuss about complex verbs formed by means of derivation and conversion, the main interest of our work. Since the outcomes of these processes are determined by constraints from different linguistics domains (i.e. morphosyntactic, phonological, semantic), DNVs have been analyzed from a variety of

lexicalist and non-lexicalist viewpoints. *Independently of their structural shape, denominal verbs have in common that they denote events in which the referents of their base nouns (e.g., computer in the case of computerize) participate in a non-arbitrary way*[57]. Moreover, Malchukov (2004) has described these processes as a sort of transition from a [+noun] to a [+verb] state. The noun, from the one hand, experiences the gradual loss of nominal prototypical properties and, from the other hand, the progressive acquisition of verbal feature.

2.6.1 Verb-Deriving Suffixes

In the following paragraphs, exactly like for DVNs, we will briefly present the formal and semantic properties of the suffixes we selected for our experimental study. We will first of all exploring the formal properties of "-eggi-", "-ific-" and "-izz-"suffixes. Secondly, we will organize the description of the suffixes in question according to the semantic features presented by the nominal bases, focusing just on the properties provided by the bases of the complex verbs we chose to investigate. As previously said, we will primarily base our description on what reported in Grossmann and Rainer *La Formazione delle Parole in Italiano*, (2004).

2.6.1.1 Formal considerations

Looking at Italian, the derivation from nominal bases is a still productive procedure, nowadays applied by the means of "-eggi-", "-ific-" and "-izz-" suffixes, followed by the inflectional morpheme of the first conjugation. "-eggi-" is particularly productive in forming verbs belonging to the informal registers, overall to form intransitive verbs, as well as transitive or presenting both patterns, also from derived bases. Verbs derived with the suffix "-eggi-" correspond to the 47% of DNVs produced through derivation. Nonetheless, looking at the new formations after the 50s, the actual productivity seems rather low. The suffix "-ific-" is productive in the learned registers, especially the ones

[57] Baeskow, H., (2019). *Denominal Verbs in Morphology*. Oxford Research Encyclopedia of Linguistic

concerning the technical-scientific domain. It generally forms transitive verbs, but also the other typologies of verbs, from non-derived bases. It represents the 8% of all suffixed DNVs and also neoformations are limited. The suffix "-izz-" is productive in both learned and non-learned contexts. It is also used to form verbs belonging to the technical-scientific domain. It generally forms transitive verbs, but also the other typologies, from all type of bases. It represents the 40% of DNVs produced through suffixation and, since the novel forms after the 50's correspond to the 73% of DNVs, its productivity seems rather high.

2.6.1.2 Semantic Structure

First of all, it is important to highlight that a situation designated by a verb is generally static or dynamic. Consequently, according to the nature of the event, also DNVs can be divided, as seen in §2.4.1, in state, activity, achievement or accomplishment verbs, according to the type of event they account for. Indeed, DNVs produced by the means of suffixation can designate a great variety of situations, in which the referent expressed by the base can many play different roles. These functions may also be culturally and socially driven. Indeed, to interpret the complex verb, the encyclopedic knowledge of the speakers and the listener is extremely relevant (Clark and Clark, 1979; Aronoff, 1980). Generally, the incorporated noun is not inflected, it can refer to one or more entities of the same class and, finally, it can be present also just with its metaphoric reading (i.e. *cornificare* = *mettere le corna*). In addition, derived complex verbs present a more generic meaning with respect to corresponding analytic constructions and they often develop a secondary meaning (i.e. *borseggiare* = *rubare dalla borsa, tasche, etc*.). So, to draw some conclusions. The semantic features of the nominal base seem to be the best predictor for the semantic structure of the derived complex verb.

2.6.1.2.1 N [+ animate; + human]

If the nominal base belongs to lexical classes presenting the features [+animate] and [+human], the meaning of the derived complex verb can be interpreted in different ways. The verbalization of a telic situation forms verbs designating an event, agentive or non-

agentive, of a real or metaphoric transition of an entity X, from an origin-state to a final state. Many different DNVs of this type are characterized by the causative-inchoative alternation. The same verb can present a transitive framework with a subject (representing the external animate or inanimate cause of the transformation) and a complement. Otherwise, it can be part of an intransitive construction (sometime presenting an anti-causative clitic). Generally, these complex verbs can be paraphrased as "to make something/someone becoming like X", where the nominal base specify the resulting state. So, X will become like N or it will be turned in N, acquiring the qualities of N (i.e. *demonizzare*). For the majority, these DNVs are formed by the means of the suffix "-eggi-" but also, more rarely, by "-izz-".

2.6.1.2.2 N [- animate; + concrete]

Analyzing the semantic structure of complex verbs derived from a nominal base presenting the features [-animate] and [+concrete], it turned out that the majority of DNVs represent a dynamic situation. Different typologies of complex verbs have been distinguished according to the role played by the referent of the nominal base in the verbalized situation.

- *N result object*

The nominal base can represent the result of the event, agentive or non-agentive, designated by the verb. With the term "result", it is intended the creation or the existence of an entity (i.e. *nidificare*), or the transformation in something new of an already existing entity (i.e. *ramificare*).

(A) N part of a whole

A small class is constituted by intransitive verbs derived from names designating a part of a whole X (human body, animals, vegetables, etc.). For examples, a verb like *fiammeggiare* (*mandare fiamme*) or *ondeggiare* (*produrre onde*), can be paraphrased as "to do (emanate, produce, etc.) N".

(B) N set or member of a set

Another group of verbs designate a process referring to a relation between a group and its members. The nominal base generally refers to the result of the process o (i.e.

categorizzare) or to a set where X entities are grouped together (i.e. *antologizzare*). If N designate the set and X the member(s), complex verbs are generally paraphrased as "to turn something into/group together/arrange, etc. X creating N".

(C) Other verbs presenting N result object

This category of verbs designates a transformation event, agentive or not, showing as a result the referent of the base or something similar. Indeed, X acquires some characteristic features (material, shape, quality, etc.) of N. Generally, these verbs belong to the technical-scientific domain and can be paraphrased as "to change into/take the shape of, etc. N" like *pietrificare* or *vaporizzare*.

- *N subject*

A small number of derived complex verbs is composed by meteorological verbs, such as *lampeggiare*. These can be paraphrased as "to be/fall down/make/do N".

The other classes, such as N affected object, N localized object, N locative complement, N instrument, etc. will be not presented as their description would go beyond the scope of this dissertation. For further information see Rainer and Grossmann, 2004.

2.6.1.2.3 N [- animate; - concrete]

Complex verbs derived from an N belonging to lexical classes presenting the features [- animate] and [- concrete] can be divided in different groups according to the function played by the referent of the nominal base. For the majority, the base has the function of result object, representing thus the result of the event. Indeed, the verb can be paraphrased as "to do/undergo/produce/cause/etc. N". Many derived verbs present the causative-inchoative alternance. Moreover, the base can represent a psychological or physical state which originates from an internal/external cause (i.e. *danneggiare*). It can also represent an action, a concrete or abstract result (i.e. *pianificare*). From abstract nominal bases can be also derived intransitive verbs, that can be paraphrased as "to have/be in/feel/show N" and which verbalize non telic situations (i.e. *agonizzare*).

2.6.2 Conversion

According to Rainer (2016), *more than a half of all derived verbs in Italian are conversions, mostly of a nominal base*[58]. The major part of complex verbs formed through conversion belongs to the first conjugation (thematic vowel a), while just a small portion belongs to the third conjugation (thematic vowel i), a no more productive pattern. Researchers argued that when a complex verb is formed through conversion, specific nominal coefficients influence the meaning of the outcome. More precisely, *the Qualia Structure (which is part of the Generative Lexicon framed in Pustejovsky 1995, 1998a and b, 2001, 2003) seems to play a relevant role in derivational semantics, since the activation of a specific Quale correlates with a specific representation of the denominal verb*[59]. In addition, the semantic type of the base nominal seems to head the selection of a specific Quale. Therefore, the conversion of a noun into a verb forms a new dynamic verb neutralizing nominal inherent properties (i.e. gender, number, etc.)

2.6.2.1 Semantic Structure

Focusing on the semantic point of view, what previously said for DNVs formed through suffixation (§2.6.1.2) also applies here. Indeed, different analyses of DNVs, produced trough conversion, classify them into several groups *according to the relation of the incorporated N to the event they name*[60]. As a matter of fact, DNVs converted also represent a rather variety of situations (stative or dynamic) in which the referent expressed by the nominal base can play different roles. Again, complex verbs can be converted from different readings of the same nominal base, as well as the metaphorical one.

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[58] Rainer, F. 2016. *Italian*. Word-Formation. An International Handbook of the Languages of Europe. De Gruyter Mouton, 4: 2726.
[59] Fabrizio, C. 2013. *The meaning of a noun converted into a verb. A semantic exploration on Italian*. Rivista di Linguistica 25: 175.
[60] McIntyre, A. 2015. *Denominal verbs: An overview*. Word-Formation: An International Handbook of the Languages of Europe. De Gruyter Mouton.

2.6.2.1.1 N [- animate; + concrete]

The semantic structure of complex verbs formed by the means of conversion from a nominal base with [- animate] and [+ concrete] features by and large corresponds to the one of suffixed complex verbs.

- *N result object*

The nominal base can denote the result of the event, agentive or non-agentive, described by the complex verb. As for derived DNVs, with the term result we indicate the creation, the existence or the transformation in something new of an already existing entity. For example, there is a rather heterogeneous group of complex verbs designating the result of events presenting a different nature. These can be paraphrased as "to do/emanate, produce/build/etc. X", such as *puzzare*.

- *N affected object*

In this case, the nominal base is generally a pre-existent entity, with respect to the event described by the complex verb, which is affected by it.

(A) N localized object

Many DNVs designate an event which represent the spatial localization of two entities N and X. There are two different groups of verbs belonging to this category. The one we are interested in is display a referent of N, which corresponds to the localized object, while X is the space of localization. So, the nominal base designates an entity that is approached/warded off from X or that is put over/removed from X. Thus, these verbs can be paraphrased as "to put/strew with/provide with/give/etc. N". The referent of the nominal bases can designate many different things, among these clothes, food, cosmetics, chemical products, agricultural products, etc. (i.e. *profumare*, *concimare*).

(B) Other verbs with affected object

The nominal base presenting an affected object as semantic function can also designate an entity which is moved, taken, collected, distributed, etc. by an agent (i.e. *regalare*).

- *N locative complement*

Complex verbs belonging to this category designate the localization of two entities N and X is a space. In this case, the nominal base is the place entity where something/someone

(is) placed/moved/etc. These verbs can be paraphrased as “to place/locate/close/etc. X in/on/over N”. So, X will be placed in/on N (i.e. *parcheggiare*).

- *N Instrument*

With regard to DNVs formed by the means of suffixation, converted complex verbs belonging to this category are rather numerous. They generally designate an event where the role of the nominal referent can be interpreted as an instrument used to carry out an action or to achieve the result of the action. Indeed, the nominal base commonly designates instruments (i.e. *remare*, *spazzolare*), complex or simple devices (i.e. *telefonare*), but also parts of body used to carry out an action, weapons (i.e. *pugnalare*), means of transport (i.e. *sciare*), etc.

- *N subject*

A small portion of complex verbs form the subgroup of meteorological predicates, which can be paraphrased as “to be/fall down/etc. N” (i.e. *fioccare*, *grandinare*). They are converted from nominal bases designating weather phenomenon.

2.6.2.1.2 N [- animate; - concrete]

The nominal bases, presenting as features [- animate] and [- concrete], used to form complex verbs, generally designate the result of the event described by the verb. These can normally be paraphrased as “to do/make/cause/produce/provoke/etc. N” (i.e. *incontrare*, *baciare*). More precisely, the nominal base can designate a psychological/physical state originated from an internal/external cause (i.e. *sospirare*), a mental processing (i.e. *immaginare*), etc. Generally, from nominal bases designating abstract entities complex verbs can be derived, which can be paraphrased as “to have/be in/feel/show/etc. N” (i.e. *faticare*).

To conclude this second chapter, we have provided an overview on derivational morphology and different mechanisms of word-formation. More precisely we focused on the description the word-formation processes we investigated in our experimental study, dwelling on their formal and semantics properties. We have underlined the non-prototypical nature of complex forms, especially DVNs, which present typical verbal

features. We did not exhaustively depict the global picture about the ambiguity of ANs, since it would have gone beyond our scope. For further information on this topic, see Melloni 2007, 2011; Jezek and Melloni, 2011 *inter alia*).

CHAPTER 3

Experimental Study

3.1 Introduction

In the 1st chapter the memory system impairment was claimed to be the primary manifestation of Alzheimer's disease. Nonetheless, also the linguistic ability is somehow affected. Many studies (Kemper et al., 1993; Lyons et al., 1993; Henry, Crawford and Phillips, 2004, *inter alia*), have documented a progressive decline in language ability due to probable AD, a degenerative pattern which presents many differences with respect to the canonical decline of healthy elders. Indeed, language disturbances in AD have an earlier onset and a more rapid decline than those associated with normal aging. These linguistic changes normally reflect difficulties in accessing semantic memory (or the system where all knowledge is stored) (Kemper and Lyons, 1994). Moreover, researchers have claimed that also grammatical complexity declines, even though some of its aspects (i.e. subject-verb relations, morphology) are preserved (Kemper, Marquis and Thompson, 2001). This is why AD patients are generally described as presenting a simple sentence structure with a reduced semantic content (Kemper et al. 1993, Lyons et al., 1994). This type of production has been characterized as "empty speech" since few contents are expressed (Kempler, 1995). With the progression of the disease, language is further impaired and so reduced to short, familiar, repetitive phrases (i.e. echolalia). Eventually, AD patients might experience mutism and lapse into a state of unresponsiveness (Hamilton, 1994). Since anomia (deficit in naming ability) and sentence comprehension are considered to be the earliest and most common language symptoms in AD (Kempler, 1991; 2005, *inter alia*), its accurate description has been the major subject of much research. Indeed, as exhaustively outlined by Fyndanis et al. (2018), the majority of linguistics studies on AD focus on the lexical-semantic domain (i.e. Almor et al., 2009; Aronoff et al., 2006; Bowles, Obler, and Albert, 1987; Druks et al., 2006; Harciarek and Kertesz, 2009; Kempler et al., 1995; Kim and Thompson, 2004; Masterson et al., 2007;

inter alia) and on sentence comprehension (e.g., Rochon et al., 1994; 2000; Waters and Caplan, 2002, *inter alia*). Nowadays, only a small portion of studies have investigated AD abilities on sentence production (i.e. Altmann, 2004; Bencini et al., 2011; Kavé and Levy, 2003; Kemper, LaBarge, Ferraro, Cheung, and Storandt, 1993; Kempler, Curtiss, and Jackson, 1987) and morphosyntactic production abilities (i.e. Auclair-Ouellet, 2015). Concerning our study, the main focus is the morpho-syntax interface, as it will presented in §3.4.2. As Semenza and Mondini (2015) have clearly expressed, aphasia has offered the incredibly opportunity to better understand the organization of language system in the brain and its functioning. This cannot be done by simply looking at healthy persons' performance in language tasks. Indeed, the performance of an aphasic patient generally consists of specific patterns of preservation/ disturbances of linguistic abilities. *These patterns are believed to reflect the organization of the system*[61]. In investigating Alzheimer's syndrome, we believe this might be the same case. We hope to observe the functioning of language system from a privileged point of view and so to better understand how morphologically complex words are represented in the system and processed.

3.2 Methods

3.2.1 Participants

A total of 20 patients was recruited via the retirement home: Altavita – Ira, Istituto Di Riposo Per Anziani, Padova. The participants' group was composed by 13 women and 7 men, mean age 85 years, with an educational level ranging from Elementary School to High School. All subjects were Italian native speakers, 15 of them fluent speakers of various Veneto dialects, and were selected on the basis of their diagnostic profile:

- clinical diagnosis of (probable) Alzheimer's Disease;

[61] Semenza and Mondini, (2015). *"Word-formation in aphasia"*. Word-Formation. An international Handbook of the Languages of Europe, 3: 2155.

- pathological profile no complicated by depressive disorder;
- absence of other neurological diseases.

Another criterion of inclusion was a minimum of 3 years of education. Another relevant variable that was taken into account for the experimental study was the level of cognitive impairment of patients: different degrees of dementia, ranking from mild to severe, were included in order to catch a possible progression of linguistic impairment according to the degree of neurodegeneration. Indeed, all patients were required to score 0-30 at the Mini-Mental State Exam (MMSE), used to screen for cognitive impairment. Furthermore, since so far, a definite diagnosis of AD is still not accessible, in the testing group also other types of dementia, with a clear differential diagnosis, are included in order to see if a difference in scoring and performance was detectable between different diagnostic profiles:

- Mixed degenerative/vascular Dementia (MDVD);
- Senile Dementia (SD);
- Degenerative Dementia (DD).

Demographical and clinical data of the 20 AD/Dementia patients, ordered by age, are reported in Table 1.

Table 3.2.1 - 1 - Demographical and Clinical Data of AD Patients

Patient	*Gender*	*Age*	*Education level*	*Diagnosis*	*MMSE**
G5	F	72	High School	AD	02/30
R2	F	77	Middle School	AD	24/30
SD19	M	79	Elementary School	AD	2.7/30
G8	F	80	High School	Early Stage AD	23.7/30
M13	F	81	Elementary School	Probable AD	21.4/30
M12	M	81	High School	AD	22.1/30
M16	M	83	Middle School	DD	12.7/30

M9	F	84	Elementary School	Probable AD	19.4/30
M14	M	85	Middle School	MDVD	15.8/30
G7	M	85	High School (3 years)	AD	15.8/30
F18	F	86	Middle School	AD	08/30
T1	F	87	Elementary School (3 years)	AD	4.2/30
G3	M	87	Elementary School	AD	11.4/30
G6	F	88	Elementary School (3 years)	AD	5.2/30
F17	F	88	Elementary School	SD/AD	0/30
F11	M	89	Elementary School	AD	5.4/30
M15	F	90	Middle School	Probable AD	20/30
R10	F	91	Elementary School	Probable AD	13/30
G4	F	91	Elementary School	AD	01/30
SD20	F	96	Elementary School	AD	11/30

Note. *Score corrected for educational attainment and age.
Note. MDVD, Mixed degenerative/vascular Dementia; SD, Senile Dementia; DD, Degenerative Dementia; AD, Alzheimer's Disease

Informed consent to participate in the study was signed by all patients, autonomously, when possible, or by support administrators/ a family member.

A group of 20 neurologically unimpaired healthy participants, 10 women and 10 men, mean age 46,3, with an educational level ranking from Elementary school to PHD, was also tested as a control group. Informed consent to participate in the study was signed by all participants who decided to take part in the study autonomously. Matching the control group one by one to the patients for age, educational level, and gender was not possible. Demographical data for control group is provided in the appendix (Table 1).

3.2.2 Materials and Design

General structure of the task

For the experimental task a total of 80 items were accurately selected: 72 target items, 6 fillers and 2 warmups. All items were divided into 2 different Sessions, each one divided itself in 2 Times. Both Times are composed by the same type of items but different tokens. A summarizing schema of the distribution of items is reported in Table 2:

Table 3.2.2 – 1 – Experimental design: items

	Test Items	*Warmups*	*Fillers*	*Total Items*
S1-T1	18	2	6	26
S1-T2	18	2	6	26
S2-T1	18	2	6	26
S2-T2	18	2	6	26

Note. List of items divided per Session and Time is provided in the appendix (Table 2,3,4,5).

Test items

The test items were selected according to two general variables which consisted of two further sub-conditions:

1. The first variable considered in the choice of the test items was the syntactic category of the lexeme, i.e. whether nouns (36 items) or verbs (36 items).

2. In addition, the second considered variable was the type of morphological processes involved in the lexeme, i.e. whether conversion (18 nouns and 18 verbs) or suffixation (18 nouns and 18 verbs).

Finally, the groups obtained according to these two variables were further divided depending on the "stem/suffix" involved in the morphological processes. Hence, we obtained 18 deverbal nouns (henceforth DVNs) derived through conversion, which take the verbal stem as the base of the morphological process: (i) present stem ending in -a (3 items); (ii) present stem ending in -o (3 items); (iii) present participle stem (3 items); (iv)

past participle stem (3 items); (v) athematic stem (6 items). In addition, 18 DVNs involved suffixation

(i) N of action, with 3 different class changing suffixes: "-mento" (3 items)," -tura" (3 items), "-zione" (3items); (ii) N of place, with 1 class changing suffix: "-torio" (3 items); (iii) N of instrument, with 2 class changing suffixes: "-ino" (3 items),"-tore" (3 items). Similarly, we obtained 18 denominal verbs (henceforth DNVs) derived through conversion, selecting verbs with different valency: transitive verbs (9 items) and intransitive verbs (9 items). In addition, DVNs involved suffixation, picking up verbs with different valency and composed by different suffixes: (i) transitive verbs, affixes: "-izz-" (3 items), "-ific-" (3 items), "-eggi-" (3 items); (ii) intransitive verbs, affixes: "-izz-" (3 items), "-ific-" (3 items), "-eggi-" (3 items).

In choosing the items highly imaginative words have been used since the test item was paired with a picture. The picture support was added to facilitate the administration of the experiment to the patients. In addition, attempts were made in order to select words with a high frequency of use in written context. The frequency of the selected items was checked on the online corpus *CoLFIS (Lessico di Frequenza dell'Italiano Scritto)*. Some effort was also put in balancing at best the frequency of items per Session and Time at best.[62] The 26 items per Time have been distributed according to the following pattern:

Table 3.2.2 - 2 – Items Distribution per Time

18 test items	9 deverbal nouns; 9 denominal verbs
2 warm-ups	1 noun; 1 verb
6 fillers	3 nouns; 3 verbs

For each Time and Session the warm-ups remain invariant, whereas fillers are different in Time 1 and Time 2 but the same in both Sessions[63]. The chosen warm-ups were 1 concrete primitive noun, "mondo" and 1 primitive verb, "bere", from the II conjugation,

[62]See the appendix section for items' frequency.
[63]See the appendix for a detailed schema.

conjugated at the past participle. As for the fillers, concrete or abstract primitive nouns and primitive verbs from the 3 conjugations were chosen. The 3 verbs were conjugated at the gerundive, infinitive and past participle forms respectively (Table 3.2.2 - 3).

Table 3.2.2 - 3 – Fillers Distribution per Session and Time

S1 e S2 - Time 1	S1 e S2 - Time 2
Nouns:	Nouns:
Gelato (concrete noun)	Libro (concrete noun)
Panico (abstract noun)	Treno (concrete noun)
Domenica (abstract noun)	Estate (abstract noun)
S1 e 2S - Time 1	**S1 e S2 - Time 2**
Verbs:	Verbs:
Mangiare (I conjugation)	Volare (I conjugation)
Vendere (II conjugation)	Rompere (II conjugation)
Costruire (III conjugation)	Dormire (III conjugation)

All items have been firstly randomized by an online program[64] and manually checked to ensure that similar morphological item forms did not follow each other too closely. Only the two warm-ups were not pseudo-randomized and were placed at the beginning of the section. Every morphological, morpho-syntactic and semantic variable[65] taken into account during the selection of the target items was carefully balanced between Sessions and Times, when numbers made an even splitting possible. A summary recapitulation is reported in Table 3.2.2 – 4.

[64] https://www.random.org/lists/
[65] See the appendix for a summary schema of the experimental variables.

Table 3.2.2 - 4 - Variables Distribution per Session and Time

Sessione 1 – Time 1		Sessione 1 – Time 2	
Suffixation	*Conversion*	*Suffixation*	*Conversion*
Noun	Noun	Noun	Noun
- tura: 1	- Athematic Stem: 2	- tura: 1	- Athematic Stem: 1
- torio: 1	- Participle Stem: 2	- torio: 1	- Participle Stem: 1
- zione: 1	- Present Stem: 1	- tore: 2	- Present Stem: 2
- ino: 1		- mento: 1	
Sessione 1 – Time 1		**Sessione 1 – Time 2**	
Suffixation	*Conversion*	*Suffixation*	*Conversion*
Verb	Verb	Verb	Verb
- izz-: 2	- Transitive: 2	- izz-: 1	- Transitive: 3
- ific-: 2	- Intransitive: 2	- ific-: 1	- Intransitive: 2
- eggi-: 1		- eggi-: 2	

Sessione 2 – Time 1		Sessione 2 – Time 2	
Suffixation	*Conversion*	*Suffixation*	*Conversion*
Noun	Noun	Noun	Noun
- zione: 2	- Athematic Stem: 2	- tura: 1	- Athematic Stem: 1
- ino: 2	- Participle Stem: 2	- torio: 1	- Participle Stem: 1
	- Present Stem: 1	- tore: 1	- Present Stem: 2
Sessione 2 – Time 1		**Sessione 2 – Time 2**	
Suffixation	*Conversion*	*Suffixation*	*Conversion*
Verb	Verb	Verb	Verb
- izz-: 2	- Transitive: 2	- izz-: 1	- Transitive: 2
- ific-: 1	- Intransitive: 2	- ific-: 2	- Intransitive: 3
- eggi-: 2		- eggi-: 1	

Design

Participants have been administrated with a multiple-choice filling-the-gap task, which was picture-supported. Therefore, experimental patients were presented with a sentence including a missing word, the target item precisely, and were required to choose the item to fill the gap among 3 different possible candidates: the target item and 2 distractors created maintaining the stem of the target word and applying conversion or suffixation processes to derive the final alternative. In composing the distractors, phonologically plausible nouns and verbs were created, combining stemmas and affixes when derived through suffixation mechanism. The complete list of distractors, distributed per Session and Time, is provided in the appendix section.

Example of target item and 2 distractors randomized:

Sessione 1 T1	*Risposta del paziente*	
Test item 12	Ho visto un signore dare una _____ alla macchina ferma	a. spinzione
		b. spinta
		c. spingitura
	Commenti:	

As for the test items, all the 3 possible answers as well have been pseudorandomized for every Session and Time.

To compose the sentences, where target words are cut off, some criteria were respected:

- if the target word was a noun, the DP was always in post-verbal position;
- verbs were conjugated in gerundive, past participle and infinitive form, numerically balanced in each Time;
- the maximum number of syllables per sentence was 15/16;
- all predicates were inflected in the active voice.

Moreover, to further assist patients during the administration of the task, the sentences were supported by a picture to better orientate their choice. Indeed, the pictures can be taken as a sort of nonverbal and visual context in addition to the verbal one given by the sentence. Since AD patients are normally impaired with memory, giving them a visual

support might help them to rapidly match the correct answer with the sentence related picture and relieve the cognitive burden required by the test.

To present sentences to patients each sentence and its related picture were printed on a single sheet of paper in a large font, to make it better visible. Papers were bounded in 4 different plasticized booklets and given to patients during the examination to turn pages in order to make them feel more comfortable, as they were playing a game, in order to avoid a possible interference caused by performance anxiety.

3.2.3 Experimental Task

Patients were divided into 2 groups:

- group 1, composed by 10 participants, was tested with Session 1 – T1 and T2,
- group 2, composed by 10 participants as well, was tested with Session 2 – T1 and T2

The same divide was applied for the control group, which had undergone the MMSE before starting the experimental test. All patients of the same Session, both the patients and those in the control group, received the same items in the same order and were tested in a separate session, each one divided in two slots: Time 1 and Time 2. The first one was conducted during the morning and the second one in the afternoon, generally after lunch and a nap time for AD/Dementia patients. The time interval between the 2 administrations did not exceed 6 hours. The administration of the MMSE to pathological participants before starting the linguistic test, as it was set out in the experimental protocol, was not possible since it would have been too much demanding present them with 3 different tasks during a single day, not only from a cognitive point of view but also on a human level.

Based on the assumption that reading might have been laborious for many patients, due to a possible acquired dyslexia or visual impairments, sentences were read by the investigator with an appropriate and unmarked intonation. The testing session was not audio taped for later verification and transcription. The experimenter transcribed all

productions for each sentence during the experiment, despite the answer was one of the proposed alternatives, another related/unrelated word or a neologism, a comment when a confabulation was performed and finally a global evaluation of the patient.

Each session started with instructions followed by a short practice. The experiment consists on a Sentence Completion Task presented in a multiple-choice fashion and the participants had to select the correct nominal/verbal form, within a sentence context. So, every sentence lacks a word, the target one, and is integrated with a figure to help the patient selecting the correct word. Patients were first presented with 2 practice items, the warm-ups, and were instructed to carefully listen to the sentence, look at the related picture and finally filling in the missing word picking up one of the 3 choices proposed. The experimenter verified that all participants understood the task before they started the actual experiment. If necessary, further explanations of the test procedure were provided to the patients, as many times as needed, also during its administration. So, the items were presented one at a time, in both an oral and written modality, in random order.

As established in the administration protocol, the experimenter had to follow this procedure:

- to make the patient look at the picture;
- to carefully and properly read the sentence, paying attention to the intonation;
- once reached the gap, read the 3 alternatives proposed;
- to mark on the protocol sheet the word chosen by the patient;
- to annotate any other aspect or comment that might be interesting for the analysis.

The patients were allowed to listen the sentence and the related missing-word alternatives up to a maximum of 3 times. After the third reading, if the patient was not able to answer or had not understood the sentence, the examiner had to keep on the administration of the test.

The administration of one of the two Times of the test took within 30 minutes approximately, considering also the confabulations of many patients that was not interrupted by the experimenter.

3.3 Data coding

Before proceeding with the analysis, in order to better understand the following steps, the data coding procedure is here presented. First of all, a database was created. All information was categorized according to different labels using a spreadsheet of Microsoft Excel program. At the beginning of data processing, these labels were the ones corresponding to the variables selected during the design of the experiment and were rough enough to allow for a first systematization of the data. However, during the testing and analysis, these labels were changed, and a more fine-grained schema was used to code participants' responses. In the spreadsheet were reported input labels firstly, the ones related to the Items selected for the test, and then the same labels but referring to the outputs, namely (non)words produced by the patients, to catch a possible discrepancy between input and output. The selected tags are presented below:

1. ID - in compliance with data protection laws, to each subject an identification code was assigned. This label was selected to make the analysis more accessible and efficient. See Table 1 for further details.
2. Diagnosis - as previously said, the sample of patients analyzed was composed by people diagnosed with different type of dementia. A recap of diagnosis selected for the study is reported in Table 1.
3. MMSE - what said for "diagnosis label" also applies to MMSE, as the degree of impairment was heterogeneous within the group. See Table 1.
4. Session - the structure of the experiment foresaw two different sessions, administrated to two different groups, presenting different tokens but the same types, in terms of items. So, the values adopted for this column were: 1 and 2.

5. Time - each Session was divided into two different Times to make the administration of the task easier to manage and also more approachable for patients. The values adopted for this column were: 1 and 2.
6. Item Type - all types of items were computed in the spreadsheet: warm-ups, filler and test item.
7. Test Item Type - the adopted values were: 0 for warm-ups and fillers, deverbal and denominal.
8. Morphological Process - the adopted values were: 0 for warm-ups and fillers, suffixation and conversion.
9. Property Item - for DVNs derived through conversion, a morphological property was taken into account, namely the stem of the derivation. So, the assigned values were athematic, present stem and past stem. For deverbals derived through suffixation a semantic property was considered instead. Focusing on the complex element derived, the used labels were action, place and instrument.

   On the other hand, for both DNVs derived through conversion and suffixation the major property taken into account was their valency, i.e. transitive and intransitive.

   For warm-ups and fillers the value was 0.
10. Affix - in this column we classified the affixes used to derive deverbals ("-ino", "-mento", "-tore", "-torio", "-tura", "-zione"), and denominals ("-eggi-", "-ific-", "-izz-"). For the test items derived through conversion the value adopted was 0, as for warm-ups and fillers.
11. Verbal Answer - a distinction between verbal and manual answers was made because some patients, even though their speaking ability was preserved, in some better than in others, answered by pointing at the selected word instead of spelling it out aloud. Therefore, they adopted a manual strategy. In some cases, both V and M modality were used, resulting in a double pattern:

    - matching verbal and manual answer,
    - mismatching verbal and manual answer.

By adding these two labels, it was then possible to catch this discrepancy between the two different answer modalities. The used values were: V = Verbal, Z = manual, NR = no reply.

12. Manual Answer – the selected values were M for manual answers, Z for verbal answers and NR for no reply.
13. Verb Type - in the sentences proposed, denominals were conjugated at the gerundive, infinitive and past participle forms respectively. These are the values taken into account as well as 0 for DVNs, warm-ups and fillers.
14. Frequency of the derived item - test items frequency might be interesting with respect to the effect of frequency found in word retrieval and word production. Indeed, some theories concerning lexical retrieval in production believe that the origin of the effect of lexical frequency might be located at the level of word meaning (Kittredge, 2008).
15. Frequency of the lexical base - given that the focus of this work are complex words derived from a lexical base through different mechanisms, the frequency from which test item were generated was considered and calculated.
16. Correct Answer - in this column all the expected correct answers were listed.
17. Distractor 1 - in this column all distractors 1 were listed.
18. Distractor 2 - in this column all distractors 2 were listed.
19. Given Verbal Answer - in this column of the spreadsheet, all the productions made by patients were reported, independent of whether it was the correct answer or something different. When the manual modality was preferred, the assigned value was Z.
20. Given Manual Answer - what is stated above also applies here.
21. Correct/Wrong Verbal - to report the verbal production modality of the given answers, the adopted values were C for correct answers, D1 for distractor 1, D2 for distractor 2, W when it was spelled out something not included in the experimental design but spontaneously produced by patients (i.e. semantic paraphasias, neologisms, etc.), Z when it was adopted the alternative modality, and finally NR when no reply was given or the patients started to tell an anecdote, related or not to

the proposed sentences, situation that was faced by the administrator of the experiment in many cases.

22. Correct/Wrong Manual - what is stated above also applies here. The only value that could not be applied here is W, since by pointing at the intended word a wrong answer could not be chosen.

    Important: both labels 21 and 22 were added in order to catch a matching or mismatching answer pattern, in case both modalities were used.

The following labels were added to check whether the input and output matched. Indeed, the values were the same adopted for input labels, with some additions which will be explained in 23.

23. Answer Test Item Type - the only difference with respect to the input label was the addition of the value X to compute answers that could not be classified as denominals or deverbals and NR when no reply was produced.
24. Answer Morphological Process - during the administration of the test many patients selected or produced a word created through a derivation process different than the expected one. The values adopted are the same used in the column "Morphological Process" with two additional tags, namely X when the produced word was not derived (i.e. primitive noun or verb) and NR when no reply was given.
25. Answer Property Item - the same logic seen for the label above applies here. Some patients selected a different transcategorial affix, that could not be categorized within the property values already available. So, new tags were added such as agent, beneficiary, state and also, as previously said, X and NR.
26. Answer Suffix - the new suffix values were: "-aggio", "-aio", "-anza", "-ario", "-ato", "-iggi-", "-ore", "-trice", "-ture", but also X and NR.
27. Answer Verb Type - it was noticed that, in some cases, the input tense of DNVs was not respected when produced by AD patients. So, this label was inserted to check this possible incongruence.
28. Aktionsart - During the selection of test items, for each verb derived from a nominal base or base of the derivation, its lexical aspect was checked. By adding this column,

we could investigate the actionality of the produced complex elements and to see whether their production could be influenced by the internal structure of the base element in the case of deverbal nominals.

A recap of labels and values ultimately adopted is presented in the appendix, Table 17.

3.4 Results

3.4.1 Preliminary Discussion

The administration of the test took 2 months, approximately. After having gathered all data, we proceed with the screening and the evaluation phase. Firstly, we carried out a summary inspection of group's productions. We checked every answer sheet (see the Appendix for the protocol) in order to determine the raw score obtained during the testing session by each AD patient. In this preliminary stage we noticed that patient G7, a member of Session 1 subgroup, in the second part of the task adopted a response strategy. Generally, during the administration of Time 2, which took place in the afternoon around 2.00/2.30 pm, patients tended to be more out of focus and easily distractible, which often resulted in a lower performance. Indeed, carefully checking their replies to the proposed sentences our initial doubt was confirmed. The patient in question answered always choosing option a), starting from sentence 5 until the end of the test. Therefore, we decided to remove him from the study, in order to avoid a potential invalidation of the results. The raw scoring obtained by the tested group is reported in the following Table.

Table 3.4.1 - 1 – Patients Overall Score

ID	*Session*	*GS Time 1*	*GS Time 2*	*C Answer*	*W Answer*	*No Reply*
G5	1	10/26	03/26	13	15	24
R2	1	23/26	22/26	45	7	/
SD19	2	10/26	14/26	24	22	6

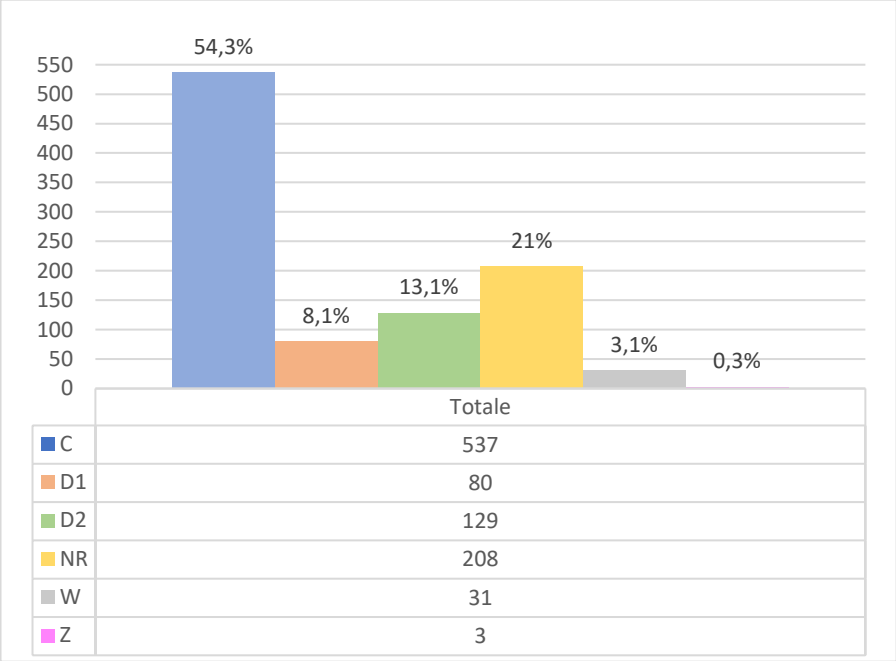
G8	1	25/26	26/26	51	1	/
M13	2	22/26	21/26	43	5	4
M12	2	22/26	24/26	46	6	/
M16	2	18/26	20/26	38	13	5
M9	2	24/26	26/26	50	2	/
M14	2	16/26	21/26	37	10	5
~~G7~~	~~1~~	~~17/26~~	~~08/26~~	~~25~~	~~27~~	~~/~~
F18	2	10/26	09/26	19	30	3
T1	1	02/26	03/26	5	9	38
G3	1	11/26	11/26	22	26	4
G6	1	13/26	13/26	26	26	/
F17	1	0/26	02/26	2	9	41
F11	2	02/26	0/26	2	1	49
M15	1	20/26	20/26	40	11	1
R10	2	15/26	14/26	29	23	/
G4	1	06/26	04/26	10	15	28
SD20	2	15/26	20/26	35	16	1
Total:	/	264/520	273/520	537	243	207
%	/	50,7%	52,5%	54,3%	24,5%	20,9%

Note. GS: Global Score, taking into account all items – W: in this case includes also Distractor 1 (D1) and Distractor 2 (D2), not only W Answer – G7: patient excluded from the study.

Looking at Table 3.4.1 - 1 above, the overall performance might seem on the average, since AD patients produced a total of 537 correct answers out of 988, corresponding to 54,3%. It is important to underline that this score considers the whole items selected for

the study, namely warm-ups, fillers and test items. A graph reporting what has just being discussed is provided below.

Graph 3.4.1 - 1 - Global Score



Legend. C = Correct Answer; D1 and D2 = Distractor 1 and 2; NR = No Reply; W = Wrong Answer; Z = Manual Modality. Difference between Distractor 1 and 2 is meaningless, as they were randomized.

In the next section, the analysis will be focused on the test items exclusively, in order to catch the correct score of the experimental objects of this work.

3.4.2 Aim of the study, Research Questions and Predictions

As previously seen in chapter one (§1.4.5.2), an individual suffering from Alzheimer's disease experiences an impairment in many different cognitive domains, normally involving episodic, semantic, prospective and working memory, executive functions, visuospatial recognition, and language. Concerning language abilities, in the past two to three decades many studies have confirmed the presence of a language deficit from the early stage of the disease. By now, naming abilities and sentence comprehension are well assumed as the first competences that appear to be problematic. Indeed, the research objects of most of the last studies are the lexical-semantic domain (Aronoff et al., 2006,

inter alia) and sentence comprehension (i.e. Waters and Caplan, 2002). Currently, only a few studies have investigated sentence production abilities and morphosyntactic production abilities of AD individuals (Fyndanis *et al.*, 2018). Nevertheless, the importance of detecting the change of language abilities, and so a language impairment, during the diagnostic procedure is internationally acknowledged. This is the reason why recent updates to AD diagnostic criteria recognized, for example, naming difficulties as an early hallmark (Rochon *et al.*, 2018). Moreover, according to the most cutting-edge publications, it seems that AD can be more sensitively detected with the assistance of a linguistic analysis than with other cognitive examinations (Szatloczkl *et al.*, 2005). Despite this, very few linguistic batteries have been developed and published to test patients for an early diagnosis of AD. Since researchers assumed that all aspects of language become affected (in different ways and at different times) as the disease progresses, looking more in detail at some linguistic domains could be a fruitful research topic. These considerations are the main reasons beyond our decision of investigating language deterioration in AD, in this work. Globally speaking the present study aimed to understand some specific aspects of language regression in AD, focusing the attention to specific language processes, namely the ones used to form new complex words from nominal and verbal bases, which stay at the crossroad of morphology, syntax, semantics and the lexicon (Kastovsky, 1977). More precisely, our main goal was to investigate complex-word-formation from different syntactic categories, in order to understand how the different mechanisms applied to derive them behave in AD patients and how these two variables interact with each other. In addition, we wanted to check whether language deterioration was somehow connected to the progression of the disease conditions. Indeed, since the investigated group included an MMSE grade ranging from 24 to 0 (mean: 11,85), we thought it might be interesting from a theoretical point of view and useful for clinical assessment to verify whether the MMSE grade is somehow connected with the type of linguistic impairment. Consequently, we might identify different stages of language impairment corresponding to different degrees of deterioration. The same applies to patient's different diagnosis, even though it is less assessable as the majority of patients were diagnosed with (probable) AD. Our final goal is to postulate, within the

generative framework, a possible explanation for the patterns observed analyzing the data collected. So, our general purpose is to better understand how the linguistic deficit works in AD and maybe its underlying nature.

By the way, before proceeding with the analysis, some base assumptions need to be taken into consideration.

1. It is first of all important to highlight that within linguistic theory a distinction between morphological operations that involve overt affixation processes versus morphological processes that adopt more covert morphological operations, such as conversion, exists (Schuster and Lahiri, 2019). This contrast between transcategorial morphological mechanisms (for this work the main interest is just conversion and suffixation) is also confirmed by research in the language acquisition domain. Native speaker children of all languages, at a given time, start to coin new words exploiting different morphological operations. Focusing on English data, children form new complex words starting from age eighteen-month, at least. The first derived words are formed applying no affix (i.e. conversion) while, at around age three, they also start to produce novel forms by adding affixes. Research has suggested that children rely on some general principles to create new complex forms. First of all, they are guided by the principle of "transparency of meaning": they use only elements which meaning they already know, as the new meaning must be accessible in part from the elements composing the new word. This could explain why they initially rely on conversion (or zero derivation for English) using roots of already known words (i.e. *to button* for "to press" [2;4]). By the time they have assigned a meaning to affixes they start employing suffixation procedure as well, to create new forms (i.e. *"crayon-er"* used *in lieu* of "painter" [3;11]) (Clark, 1982). Meanwhile, also another principle is operative, the one known as "simplicity of form": "*the fewer the changes to be made in the component elements, the easier it is to construct and produce"* (Clark, 1993). Similarly, this principle would make children select firstly conversion and only successively, once learned the meaning of some affixes, suffixation.
2. We believe that focusing on the syntactic category of the stem, on which a transcategorial operation applies, might be interesting. Indeed, in the linguistic

literature there are two opposite positions concerning the type of linguistic deficit showed by AD patients. From the one hand, several studies support a nominal deficit (Ivanova *et al., 2013;* Appell *et al., 1982, inter alia*). From the other hand, others claimed a verbal deficit (Mikyong and Thompson, 2003; Costa *et al.,* 2015, *inter alia*). In the aphasic population this verb-noun selective impairment, condition in which a brain damage affects one of the two categories, while sparing the other, is well documented (Berndt and Zingeser, 1991; Goodglass, 1993; Caramazza and Hillis, 1991; Glosser et al., 1994; Joanette and Brownell, 1990; Zingeser and Berndt, 1990). In recent years different studies inspected action naming in dementia. This task, which requires the productions of verbs, reported contradictory results. Some of them have shown an impairment in pictured actions naming and so, this task appears less preserved than naming of pictured objects (Cappa et al., 1998, Crepaldi et al., 2006, *inter alia*). On the contrary, other studies obtained the opposite result. One reason for these conflicting outcomes may be that actions vary depending on the relationship they maintain with object knowledge Indeed, as proposed by Parris and Weekes (*inter alia*), instrumental actions as "to hammer" require access to knowledge about a specific tool, while non-instrumental actions do not require this step (Parris and Weekes, 2001). An alternative hypothesis trying to explain this dissociation, is based on the findings that verbs and nouns seem to be supported by different brain structures, which might be better preserved or early affected in AD (Caramazza et al., 1994; Parris and Weekes, 2001). A third theory considers the semantic of different categories the key to solve this outstanding puzzle, considering verbs semantically more complex than nouns (Druks *et al.*, 2006). This verb/noun dissociation is an evergreen deeply debated question in all linguistics domains. Many hypotheses claim that nouns are easier than verbs, since they present a higher degree of concreteness and imageability than verbs (Chiarello et al. 1999). Indeed, nouns are generally defined as the class of words referring to entities while verbs to processes (Langacker 1987; Givón 2001). Moreover, these concepts have a different balancing of sensory and functional features (Laudana and Voghera, 2002). Furthermore, nouns and verbs could also differ for their argument structures, since

prototypical nouns do not have it. So, morphosyntactic factors are another potential source of variation between verbs and nouns. Indeed, verbs are more functionally tied to sentential processing than nouns. All the numerous factors overmentioned would draw the same conclusion that verb processing should be more difficult (or more vulnerable) than noun processing. Nonetheless, a patient describer by Hillis and Caramazza (1995), shows the opposite pattern, namely a more marked impairment for nouns than verbs in spoken production. Nonetheless there are several exceptions to this lesion-deficit pattern, the existence of a double-dissociation deficit between these two syntactic categories in aphasia (and other clinical conditions) provides good evidence that different brain mechanisms are involved in the production of words of each category (Shapiro et al, 2005). So, an investigation into this name-verb, or verb-name, dissociation could shed light on this intriguing topic, not only concerning the AD population but more globally within language pathologies.

3. It is well assumed that nominalization and verbalization are two different operations involving different mechanisms. Not only do they involve a complex process of transcategorization where, from the one hand, verbal properties are lost and from the other nominal properties are acquired, and *vice versa*, but the outcome of these processes may be quite different and gives rise to intracategorial gradience, producing outcomes with different behaviors (Bekaert and Enghels, 2019).

4. Concerning the last point just discussed, it is important to draw attention to another relevant factor. One of the most interesting properties of nominalizations, in particular Action Nominals (ANs), is their semantic ambiguity. Indeed, they often present a cluster of (more or less) related meanings. Among the possible different interpretations, the semantic distinction between the Action/Event and Result readings is one of the most studied because of its curious syntactic behavior:

- E nominals can denote both *stricto sensu* events, namely dynamic situations, and states. They seem to retain some verbal properties, i.e. verbal meaning and theta

relations. So, they are normally interpreted as a case of mixed N-V category and, as such, they challenge the basic conception of syntactic categories as discrete elements;

- R nominals normally behave like pure nouns, although they can take optional complements, corresponding to the LCS (Lexical Conceptual Structure) participants in the state/event described by their base V (Melloni, 2011).

Behaving like different objects and given their structural ambiguity, it seems interesting to test the production of AD patients, to verify if their production is somehow influenced by a possible name/verb selective deficit or a semantic-syntactic impairment.

Basing on these previous research objects and theories, we formulated the following research questions and predictions.

1. Considering the transcategorial morphological operations involved in the experimental study, namely conversion and derivation, how do AD patients deal with these mechanisms?

As previously said, a difference in processing between the two morphological mechanisms investigated is well established in the literature, considering conversion an easier mechanism than suffixation. Indeed, *conversion is defined as the morphological process by which a word is formed without any explicit derivational mark*[66], i.e. butter > to butter. This is also well attested in language acquisition domain where these two-conflicting mechanisms of word-formation are operative. Two positions can be used to make a prediction on AD word-formation processes. (I) Clark and co. (e.g. Clark, 1981, Clark and Berman, 1984, Clark, 1993), as already mentioned, have postulated the principles of formal simplicity, semantic transparency, and frequency and productivity. (II) Dressler (1985, 1987)'s theory of Natural Morphology which bases his assumptions on different universal naturalness parameters (i.e. morphotactic and morphosemantic

[66] Pavesi, M. 1998. "*Same word, same idea". Conversion as a word-formation process*. International Review of Applied Linguistics in Language Teaching (IRAL), p. 213.

transparency/iconicity). From the one hand, there is an overlap between the predictions derived from Clark's acquisitional principles and Dressler's universal parameters. Nonetheless, some other predictions, about which word-formation processes will be preferred in language acquisition, have turned out to be in conflict. This is exactly the case of conversion, indeed. For example, in Second Language Acquisition (SLA), language learners show a preference for simple, unmarked forms, at the initial stages of development. This is why conversion, a morphologically simple process, can be assumed to occur frequently, especially among early lexical innovations. This prediction in SLA is perfectly in line with the principle of formal simplicity postulated by Clark in first language acquisition (1981, 1993). The acquisitional principle states that word-formation processes which do not modify the base are favored at the beginning. Indeed, conversion is an extremely easy process, since the base on which the process applies does not undergo any change, except for acquiring the inflection of the new grammatical class. Thus, conversion is also a highly economic operation (Haiman, 1983). Basing our hypothesis on Clark's acquisitional principle, we can easily claim that if AD patients depend more on the simplicity and economic principles, they should prefer the morphological mechanism of conversion. (II) Dressler's theory of Natural Morphology (i.e. Dressler, 1987) claims that conversion is acquired later, due to its unnaturalness along several parameters. To make it short: conversion lacks iconicity, since there is not a morphological change which mirrors the changes occurred in the meaning and grammatical class of the base word. Furthermore, this transcategorial process is further characterized by semantic ambiguity: the same form presents different meanings. According to Dressler, this process can be contrasted with a more iconic and transparent mechanism, such as derivation. This morphological operation involves the application of an affix to a base. This process is at the same time more iconic and transparent compared to conversion: a) the change in meaning and grammatical class is morphologically manifested, b) the *compositionality of meaning of the derived word (the meaning of the base + that of the morphological process) is unambiguously mirrored by the*

compositionality and analyzability of its form (the form of the base + that of the affix)[67]. Following Dressler's framework, we can hypothesize that, if AD patients rely more on the transparency and iconicity parameters, they should produce more complex words applying the transcategorial mechanism of suffixation, which plenty respect the scale of naturalness. We consider legit to formulate our predictions on the basis of these principles since a parallelism between language deterioration and language acquisition is present in linguistic literature. Indeed, in 1941, Jakobson proposed that, when adults lose their language ability after a neurological damage, the order of loss can be considered a mirror of language acquisition in childhood. This is the well-known regression hypothesis: linguistic distinctions that appear later in development are more vulnerable to early loss[68]. This first approach was successively reconsidered on the basis of further evidences showing that this relationship between acquisition and degradation is much more complex than what was once thought to be.

2. Does the lexical base, nominal or verbal, on which morphological operations (i.e. derivation, conversion) apply, have an impact on AD patients' performance?

The name-verb dichotomy impairment is extensively studied and described in the aphasic literature. Indeed, nowadays there is a great deal of evidence that nouns and verbs dissociate in aphasia (Caramazza and Hillis, 1991, 1995, *inter alia*) and that the direction of the dissociation (N > V or N < V) depends on the locus of the lesion in the brain (Damasio and Tranel, 1993; Perani et al., 1999). In 1973, a study conducted by Irigaray (1973) revealed that *in the spontaneous speech of dementia patients more verbs were retained than nouns, similar to the pattern found for aphasic patients with posterior focal damage.*[69] Further studies have shown that also people diagnosed with AD might present

[67] Ivi, p. 214.
[68] The idea of loss as mirroring language acquisition patterns was not new when Jakobson formulated the hypothesis. Discussion on this topic would go beyond the scope of our research (See Seliger and Vado, 1991. *First language attrition*, for an introduction on the matter and Hyltenstam and Viberg, 1993. *Progression and regression in language*, for contrasting opinions.
[69] Druks et al., (2006). *"Is action naming better preserved (than object naming) in Alzheimer's disease and why should we ask?"*. Brain and Language, 98: 332

a verb-noun (or noun-verb) dissociation, since investigated subjects performed well at naming action pictures (Bowles, Obler and Albert, 1987, *inter alia*) or object pictures (Robinson et al., 1996, *inter alia*) according to the task administrated and the scope of the research group. Theories trying to explain this dichotomy focused on semantic and syntactic factors, So, it might be predicted that patients should show a more severe impairment in forming complex nouns or complex verbs according to the nature of the underlying trouble. This should be linked to the cerebral region more affected by the neuron degeneration, as found in aphasia.

3. How do the two considered variables, namely the diverse lexical bases and the morphological mechanisms applying on them, interact with each other?

Based on the current literature it is hard to make a real prediction for the third research question. To my knowledge, there are no studies investigating if, from a cognitive point of view, names are easier converted or easier derived in verbs and *vice versa,* so far. Furthermore, it may well be the case that this depends on the damage, i.e. the degree of cognitive deterioration, as seen for the previous research questions.

4. Looking at conversion, how do AD patients deal with the different morphological bases that are taken as the starting point of the morphological operation?

During the selection of test items formed through the morphological mechanism of conversion, we chose also verbs presenting a root allomorphy. These items are complex nominals derived from the athematic stem. In psycholinguistics domain, storage and processing models of complex word-formation, named dual-route mechanism, have been proposed. These models assume that words are accessed in some cases from the mental lexicon, as whole-units, and in other cases as decomposed smaller units, that is in terms of their component morphemes. A dual-route model for past tense processing, in which the lexicon is used to access to irregular forms and the other way, the rule system, computes regular inflected forms, was proposed by Ullman *et al.* (1997). In addition, they reported a case of better performance in inflecting English regular verbs than irregular forms in patients diagnosed with AD. According to the authors, this result was viewed as

a proof that rule-based lexical knowledge was intact, while rote-learned morphological knowledge was impaired. On the basis of these findings, we claim that AD patients, if presenting difficulties in accessing the lexicon to retrieve whole forms, including the irregular ones, should privileged the other way and so assemble the complex word, picking up regular forms.

5. Looking at the derivational morphological process, how do AD patients employ the suffixes selected to compose complex word forms, concerning their inherent semantic content and their morphological restrictions?

If we take into consideration a dual-route model, in which from the one hand words are stored as whole units in the lexicon and, from the other hand, words can be formed combining smaller units (i.e. morphemes), WFRs should be stored in this second way. So, we predict that if AD people are impaired in accessing the lexicon to retrieve whole forms, and WFRs are really stored together with their component elements, in choosing the second path they should create complex words applying WFRs an so compose only new forms which respect them. AD patients should produce unattested but possible Italian-like words.

Finally, based on the variables selected during the building of the test and the previous assumptions, it can be predicted the adoption of two different patterns by patients:

- The first one classifiable as “easy processing”: patients might adopt a strategy to answer the test, always using the same mechanism of suffixation to derive complex test items, maybe also reducing the diversification of suffixes selected to alleviate the cognitive load;
- The second one, identifiable as “grammatical impairment” where no suffixation procedure is adopted, as the problem might be located at the morpho-syntax interface.

3.4.3 Result Analysis

In a second phase, we carried out a systematic analysis of the answers given by the 19 patients finally selected. In this detailed observation of collected data, we payed particular attention exclusively to test items, as the focus of this research are denominals and deverbals.

A summary of the total number of Test Items, schematized according to their underlying properties, is reported in Table 3.4.3 - 1(a) and Table 3.4.3 - 1(b):

Table 3.4.3 - 1(a) - Deverbal Ns Variables Total Number

Test Item Type	*Morphological Process*	*Property Item*	*Suffix*	*Total*
Deverbal Ns	/	/	/	*342*
Deverbal Ns	Conversion	/	/	171
Deverbal Ns	Conversion	Athematic	/	57
Deverbal Ns	Conversion	Present stem	/	57
Deverbal Ns	Conversion	Participle stem	/	57
Deverbal Ns	Suffixation	/	/	171
Deverbal Ns	Suffixation	Action	/	86
Deverbal Ns	Suffixation	Action	-zione	29
Deverbal Ns	Suffixation	Action	-meno	29
Deverbal Ns	Suffixation	Action	-tura	28
Deverbal Ns	Suffixation	Instrument	/	57
Deverbal Ns	Suffixation	Instrument	-ino	29
Deverbal Ns	Suffixation	Instrument	-tore	28
Deverbal Ns	Suffixation	Place	/	28
Deverbal Ns	Suffixation	Place	-torio	28

Table 3.4.1 - 1(b) - Denominal Vs Variables Total Number

Test Item Type	*Morphological Process*	*Property Item*	*Suffix*	*Total*
Denominal Vs	/	/	/	***342***
Denominal Vs	Conversion	/	/	171
Denominal Vs	Conversion	Transitive	/	85
Denominal Vs	Conversion	Intransitive	/	86
Denominal Vs	Suffixation	/	/	171
Denominal Vs	Suffixation	Transitive	/	86
Denominal Vs	Suffixation	Transitive	-eggi-	29
Denominal Vs	Suffixation	Transitive	-ific-	29
Denominal Vs	Suffixation	Transitive	-izz-	28
Denominal Vs	Suffixation	Intransitive	/	85
Denominal Vs	Suffixation	Intransitive	-eggi-	28
Denominal Vs	Suffixation	Intransitive	-ific-	28
Denominal Vs	Suffixation	Intransitive	-izz-	29

Note. A brief recap of overall number of Test Items is provided in the appendix, Table 16.

For every variable considered during the makeup of the experimental design, we decided to proceed as follows:

1. We focused on group performance:

- Firstly, we checked the global score, accounting for all possible answers given by AD patients (C, D1, D2, W, X, NR);
- then, we looked at correct replies (C) only.

2. We concentrated on individual productions' patterns of correct answers.
3. We analyzed wrong answers (according to the issue investigated by the research question).

Moreover, we analyzed *in primis* morphological variables, while semantic variables in a second moment. In the following pages data resulting from the analysis of the linguistic outcomes are presented as previously specified.

3.4.3.1 Verbal Modality VS Manual Modality

In answering the test, AD patients adopted two different modalities, i.e. verbal answer and manual answer. Final score is presented in Table 3.4.3-2.

Table 3.4.3.1 - 1 - Modality Global Score

V Modality	*M Modality*	*Score*	*Global Score*	*%*
NR	NR	147	147	21,5%
✔	/	531	531	77,6%
✔	✔	5*	5	0,8%
/	✔	2	2	0,3%
Total: 684				

Note. NR: no reply; *V-M:3 matching; 2 mismatching. Items considered: Test Items only.
In this case all items were computed.

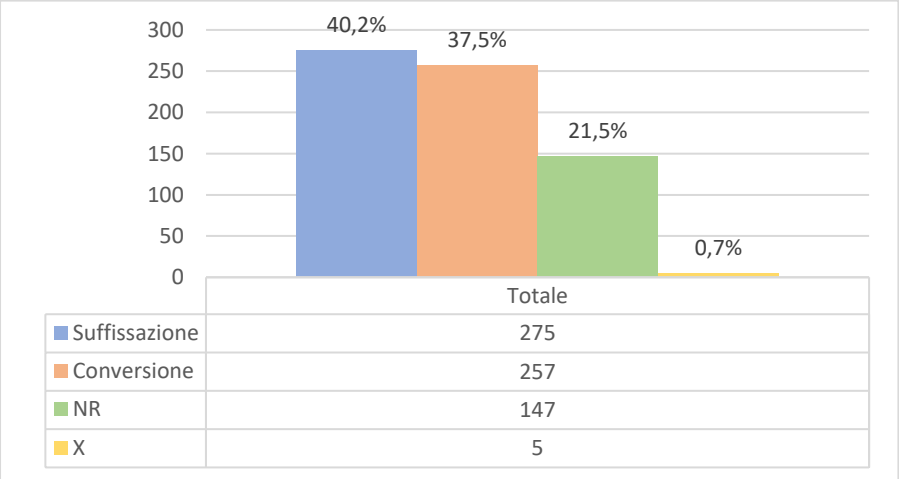
Overall, AD patients preferred the verbal modality. Manual modality was inconsistently employed in 7 cases, 5 of them in association with the verbal one. When both modalities were employed, in 3 out of 5 cases the two answers matched, whereas in the remaining 2 cases the answers mismatched. We believe it is important to underly that, when the manual modality was employed, the reason underlying its adoption cannot be due to articulatory difficulties in speaking. Indeed, some patients mispronounced some of the proposed words, but they did not opt for the manual modality to avoid spelling difficulties.

3.4.3.2 Conversion VS Suffixation

The foci of our first research question are the transcategorial morphological operations involved in the formation of complex words (i.e. conversion and derivation). More precisely, we were interested in how the investigated subjects dealt with them. Since the investigated processes are two, we carried out the analysis in a contrastive way, looking at both morphological mechanisms at once to make clear the distinct patterns, if it was the case.

Group result is presented in Graph 3.4.3.2 - 1.

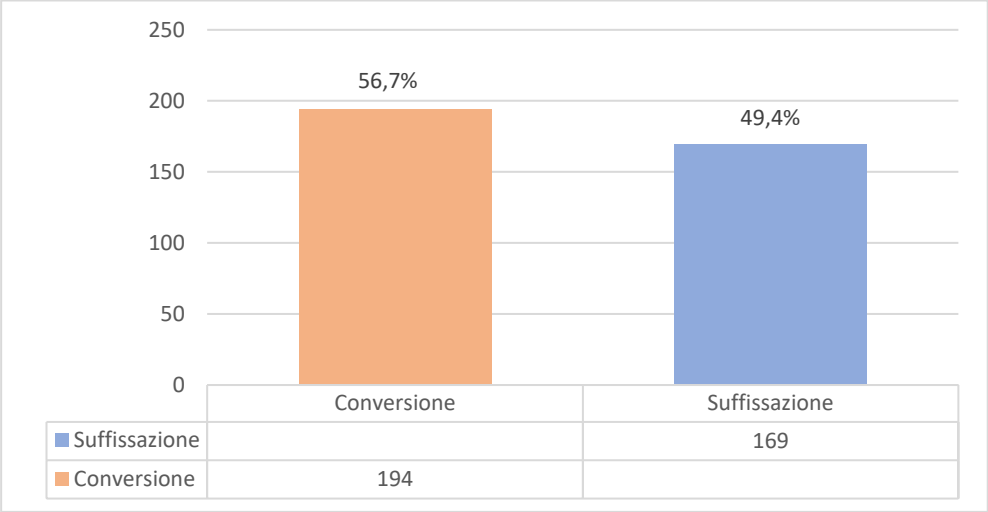
Graph 3.4.3.2 - 1 - Suffixation VS Conversion - All Answers (C, D1, D2, W)



Considering all answer typologies (C, D1, D2, W) the difference between the two mechanisms of word-formation is not significant as both morphological mechanisms of transcategorization were abundantly used by AD patients to answer the test. Actually, what arise from this table is that patients selected one of the proposed alternatives (or spelled out a novel word) more steadily, instead of giving no answer at all.

Focusing the attention on the correct answers, the global score obtained by the investigated group is presented in bar chart 3.4.3.2 – 2.

Graph 3.4.3.2 - 2 - Suffixation VS Conversion - Correct Answers



The graph shows that, even though the difference of application between the two mechanisms of word-formation seems not so relevant, AD patients exploited suffixation less than conversion. Indeed, its final score is slightly under the chance level. This picture matches the previous graph since the major employment of suffixation reported ahead was actually used to derive complex items that we considered nonwords or pseudowords (i.e. novel words such as *sosta* + *tura*).

Finally, Table 3.4.3.2 - 1 considers correct answers per single patient.

Table 3.4.3.2 - 1 - Suffixation VS Conversion, Individual Patterns – Correct Answers

ID	*Conversion*	*%*	*Suffixation*	*%*	*Total*
F17	1	100%	0	0%	1
G4	4	66,7%	2	33,3%	6
G5	6	60%	4	40%	10
SD19	8	53,3%	7	46,7%	15
T1	3	75%	1	25%	4
G6	7	43,7%	9	56,3%	16
F11	0	0%	1	100%	1

F18	8	72,7%	3	27,2%	11
SD20	14	63,6%	8	36,4%	22
G3	5	35,7%	9	64,3%	14
M16	14	**50%**	14	**50%**	38
R10	10	45,5%	12	54,5%	22
M14	15	55,6%	12	44,4%	27
M9	18	51,4%	17	48,6%	35
M15	16	64%	9	36%	25
M13	16	57,1%	12	42,9%	28
M12	17	54,8%	14	45,2%	31
G8	17	48,6%	18	51,4%	35
R2	15	46,9%	17	53,1%	32

The table above presents an overview of the individual performance. By and large, the individual application of morphological processes used for producing correct answers confirms the group's trend. However, it is noticeable that patients can be regrouped in 3 different sets, which represent the distinct patterns adopted to answer the test:

a. the green group, composed by patients who adopted both mechanisms of complex word-formation in a well-balanced way;
b. the blue group, which performance leant towards one type of word-formation, i.e. suffixation;
c. the yellow group, in which the other mechanism, namely conversion, was favored.

So, the first set (green group) is composed by one single patient, who performed fifty-fifty, showing no preference in applying one or the other transcategorial process of word-formation. The patient in question is M16, with an MMSE score corresponding to 12,7/30. The second set includes 6/19 subjects (blue group: G6, F11, G3, R10, G8, R2) who applied

the transcategorial mechanism of suffixation in a more consistent way. It is important to highlight that, within this set, patient F11 stands out from the others as he produced exclusively 1 lexical item through suffixation, the deverbal noun *lavorazione*. Last but not least, the third group includes 12/19 patients (yellow group: F17, G4, G5, SD19, T1, F18, SD20, M14, M9, M15, M13, M12) who experienced fewer difficulties in applying the morphological process of conversion. Even in this case one subject, namely patient F17, produced only 1 complex word through conversion, the denominal verb *fotografare*. Looking at their MMSE scores, we noticed that the variation in cognitive deterioration between the two major groups is too much heterogenous to shed light on the adoption of these two distinct patterns.

Table 3.4.3.2 - 2 – MMSE score per Morphological Process Pattern

G1 - Yellow Group Conversion Pattern		*G2 - Blue Group Suffixation Pattern*		*G3 – Green Group 50/50*	
MMSE	*Patient*	*MMSE*	*Patient*	*MMSE*	*Patient*
0	F17	5,2	G6	12,7	M16
1	G4	5,4	F11		
2	G5	11,4	G3		
2,7	SD19	13	R10		
4,2	T1	23,7	G8		
10,2	F18	24	R2		
11	SD20				
15,8	M14				
19,4	M9				
20	M15				
21,4	M13				
22,1	M12				

Therefore, to recapitulate, it goes without saying that, from the one hand, there are two outsider subjects which present the exact opposite pattern, as both adopted either one of the two possible mechanisms of complex word-formation. From the other hand, considering the remaining subjects, even though both typologies of complex word-formation were applied, the majority of them preferred for the mechanism of conversion,

supporting the group's trend. Finally, just one patient performed in a balanced fashion, showing no preference at all.

Let's now focus, just for a moment, on wrong answers (in this case this word is used as an umbrella term including D1, D2, and W replies). We looked at ill-formed items to check which types of errors were made and also to figure out which mechanism of complex word-formation was the one most used.

Table 3.4.3.2 - 3 - Morphological process, Input VS Output – Global

Morpho Process	OUTPUT			
INPUT	*Conversion*	*Suffixation*	*X*	*Total*
Conversion	19	57	3	79
Suffixation	44	48	3	95
Total	63	105*	5	173

Note. *It is important to highlight that one production presents a double answer since both modalities were employed. Indeed, patients SD19 produced *colino* verbally, but he pointed the target word (C).

As this table clearly shows, it is worth noting that, globally, the word-formation mechanism more employed in composing ill-formed words is suffixation (105/173), both when the correct rule of word-formation required it (48/95) or not (57/79). Nonetheless, AD patients also performed the opposite pattern in a fairly consistent way. Indeed, they created 44/95 ill-formed items applying conversion in lieu of suffixation. We decided to check out in which circumstances these distinct patterns were performed and, when derivation was applied, which suffix was employed in the majority of cases.

First of all, we focused on conversion as the input operation of word-formation. AD patients produced 19/79 incorrect complex words applying the correct process but picking up the wrong base. They produced also other types of errors. Data is presented in Table 3.4.3.2 – 4, in the next page.

Table 3.4.3.2 - 4 – Morphological Process, Input Conversion VS Output Conversion

INPUT: Conversion	OUTPUT: Conversion				
	Intransitive	*Participle Stem*	*Present Stem*	*Transitive*	*Total*
DENOMINAL	7			5	12
faticato	fraticato				1
fotografare				fotare	1
grandinando	grandando				1
incontrato				incontreto	1
pugnalato				pugnaleto	3
puzzare	tossire				1
remando	remolando[70]				1
sciando	sciato				2
telefonato	telenato				1
DEVERBAL		5	2		7
battente		bassante			1
comando		comandato			1
dormita		dormata			1
pulsante			pulso		2
stampante		talmante			1
stretta		trettata			1
Total	7	5	2	5	19

Overall, the most frequent error type made by our patients are (i) morphological paraphasias, declined into 2 different phenomena: (a) substitution and (b) insertion of morphological material (i.e. (a) *dormata* < *dormita* and (b) *remolando* <*remando*). In addition, they sporadically produced (ii) neologisms (i.e. *talmante* < *stampante*, *bassante* < *battente*, *trettata* < *stretta*), (iii) phonemic paraphasias, more precisely (a) phonemic insertion and (b) deletion (i.e. (a) *fraticato* < *faticato*, (b) *telenato* < *telefonato*) and (iv) a single verbal paraphasia (*tossire* < *puzzare*). In the Appendix, Table 20 reports all ill-formed productions classified per error type. We want to highlight one particular case. One patient produced *fotare* instead of *fotografare*. We believe that the wrong output could have been generated applying the mechanism of conversion on the wrong lexical

[70] We might think that *remolando* could have been produced applying suffixation and selecting "-ol-" as verbal suffix. This suffix occurs in some morphological and semantic transparent verbs, but it is no more productive.

base, namely *foto* instead of *fotografia*. Indeed, *foto*[71] might be easier to retrieve, considering its higher frequency of use: 351 hits VS 181. Focusing on deverbal nominals, in 4/7 cases a different base was selected to form the complex items. In two cases it was produced *pulso* < *pulsante*, from the present stem ending in -o, *comandato* < *commando*, from the participle stem and *trettata* < *stretta* as well, which present, besides, a neologism as lexical base. In the remaining cases, errors are attributable to morphological paraphasias. *dormata* < *dormita* and *bassante* < *battente*[72] show a preference for the feminine allomorph of -ato and for -ante, both belonging to the first conjugation. Thus, they applied a regularization strategy. Finally, *talmante* < *stampante* is a neologism, probably produced through analogy.

57/79 complex words well-formed through conversion were created selecting the competing mechanism of word-formation instead. Productions are presented in the following Table.

Table 3.4.3. 2 - 5 – Morphological Process, Input Conversion VS Output Suffixation

INPUT: Conversion	OUTPUT: Suffixation									
	-aggio	*-anza*	*-ato*	*-eggi-*	*-ific-*	*-izz-*	*-trice*	*-tura*	*-zione*	*Total*
DENOMINAL				6	2	9				17
baciata						2				2
concimare						2				2
faticato						2				2
fioccando				2						2
immaginando					1					1
parcheggiando						2				2
pettinando				1						1
pugnalato						1				1
regalato				1						1
remando				2						2
sospirato					1					1

[71] Clipping: his is not exactly a process used to form a novel word since the outcome of the process is normally considered a diaphasic variant of an already existent word.
[72] It also shows a phonemic paraphasia.

	-aggio	*-anza*	*-ato*	*-eggi-*	*-ific-*	*-izz-*	*-trice*	*-tura*	*-zione*	
DEVERBAL	4	1	1				4	24	6	40
arrivo	3									3
cinta								4		4
comando	1		1							2
crescita									1	1
domanda								1	1	2
dormita									1	1
mangiata								2	1	3
ricerca								5		5
ricovero		1								1
scritta								3		3
sosta								2		2
spinta								3	2	5
stampante							4			4
stretta								4		4
Total	4	1	1	6	2	9	4	24	6	57

The majority of novel complex items was formed by adding new morphological material to a verbal or nominal base, thus applying derivation in lieu of conversion. Exceptionally, AD patients also produced two neologisms (i.e. *cimentizzare* < *concimare* and *condeggiato* < *commando)*. We noticed seven DVNs which stand out among the others. Indeed, AD patients, in producing them, performed at the same time a morphological substitution and insertion. First of all, we found *spingi + tura,* produced instead of *spinta (*3/5 casea). Not only was it formed by adding morphological material but also the affix was applied to the regular base of the verb. The same applies for the 4/4 cases of *stringi + tura,* instead of *stretta*. On the whole, focusing on deverbals, the most produced suffixes, which were used in lieu of applying conversion, are all ascribable to the action semantic category, thus used to create action names. Suffix "-tura" was applied in 24/40 cases, "-zione" was used 6/40 times and "-aggio" was employed on 4/40 occasions. The remaining ill-formed productions were formed picking up two state suffixes, "-anza" and "-ato", and the agentive/instrumental suffix "-trice", four times. Looking at DNVs, all suffixes proposed in the experimental design were used to compose ill-formed items. Patients produced "-izz-" and "-eggi-" 9 and 6/17 times respectively, while "-ific-" just in

two occasions. Actually, the number of productions per suffix respect their current productivity.

Secondly, we focused on suffixation as the input process of word formation. AD patients produced 44/95 items wrongly, applying conversion process instead. Data is presented in the table below.

Table 3.4.3. 2 - 6 – Morphological Process, Input Suffixation VS Output Conversion

INPUT: Suffixation	OUTPUT: Conversion					
	Athematic	*Intransitive*	*Participle Stem*	*Present Stem*	*Transitive*	*Total*
DENOMINAL		19			16	35
-eggi		5			1	6
fiammeggiando		fiammando				1
lampeggiando		lampando				1
ondeggiare		ondare				3
sorseggiare					sorsare	1
-ific		5			7	12
cornificare					cornare	2
pianificare					pianare	2
pietrificare					pietrare	2
					petrare	1
prolificato		prolifato				2
ramificato		ramato				2
		mericato				1
-izz		9			8	17
agonizzare		agonare				1
demonizzando					demoniando	4
fraternizzare		fratellare				3
		fraternare				2
polemizzare		polemicare				3
scandalizzare					scandalare	1
vaporizzata					vaporata	3
	Athematic	*Intransitive*	*Participle Stem*	*Present Stem*	*Transitive*	
DEVERBAL	1		4	4		9
-ino			1			1
temperino			temperante			1
-mento			2	4		6
cambiamento				cambio		2
				cambia		1

nutrimento			nutrito			2
spostamento				sposto		1
-tura	1					1
scrittura	scriva					1
-zione			1			1
costruzione			costruita			1
Total	1	19	4	4	16	44

Morphological deletion turns out to be the most produced paraphasia output error, resulting in the elision of the suffix used to correctly compose the complex word (i.e. *nutrito* < *nutrimento*). Other unsteady errors were: (i) 1 neologism (*mericato* < *ramificato*), (ii) 1 phonemic deletion (*prolifato* < *prolificato*), and finally (iii) 5 cases of morphological substitution. In producing these outcomes AD patients selected either a different verbal base, i.e. *temperante* < *temperino*, picking up the present participle stem, or a different nominal base, i.e. *fratellare*[73] < *fraternizzare*. Firstly, focusing on DNVs, the suffix "-izz-", corresponding to the most productive one among the other taken into account, is the least used (17/35), followed by "-ific-" (12/35) and "-eggi-" (6/35). It is worth analyzing the item *prolificare*. Indeed, the 2 ill-formed productions (i.e. *prolifato*), cannot be completely considered the result of a conversion. We believe that most probably a part of the suffix "-ific-" was elided, resulting in a phonemic paraphasia as previously said. As concerning DVNs, participle and present stems are the most selected bases on which conversion procedure was applied to compose ill-formed complex items. Only 1 item selected the athematic stem. To conclude, this excerpt highlights that DNVs are the test items which were more abundantly derived through conversion, even though the correct mechanism of word-formation to be applied was suffixation.

Finally, 48/95 items were ill-produced applying the correct transcategorial mechanism of word-formation (i.e. suffixation) but attaching the wrong affix to the nominal or verbal base. Data is reported in Table 3.4.3.2 – 7, in the two following pages. Overall, we classified all outputs as novel words since their entry is not present in the Italian lexicon.

[73] Derived from the noun "fratello" (brother).

Nonetheless, they can be considered a possible competitor for the already existing word as the morphophonological aspects and the semantics of the WFRs are nearly always respected in creating these new items. On the whole, morphological substitutions (i.e. *lavoratura* < *lavorazione*) were produced more abundantly than any other type of error since a different suffix, with respect to the one normally employed, was picked up to create the complex word. The remaining items present (i) 5 phonemic paraphasias (i.e. *conversatorio* < *conservatorio*), (ii) 2 cases in association with morphological substitution (i.e. *profileggiato* <*prolofocato*), and (iii) 2 neologisms: *condoniatura* < *condizionatore* and *balandizzare* < *scandalizzare*. Focusing firstly on DNVs, suffix "-ific-" (12/24), is the one most employed to compose ill-formed items through the correct mechanism. It is interesting notice that in the previous section "-ific-" suffix was the less used to produce correct complex words. It is followed by "-izz-" (7/24) and "-eggi-" (4/24). Finally, in one case a patient also produced "-iggi-", probably a phonemic paraphasia. Looking at DVNs, the most employed suffix is (i) "-aio" (6/24) used to replace suffixes "-ino", "-tore" and "-torio". It is followed by (ii) "-tura" (5/24) employed in lieu of "-tore" and "-zione", (iii) "-tore" (4/24) selected instead of "-ino" and finally (iv) "-mento" (3/24) used to replace "-zione". The other suffixes, namely "-aggio", "-ario", "-ore", "-zione" and "-ture" were produced just one time each. A recapitulative Table of suffixes is presented in the Appendix.

INPUT: Suffixation	OUTPUT: Suffixation														
	-aggio	-aio	-ario	-eggi-	-ific-	-iggi-	-izz-	-mento	-ore	-tore	-torio	-tura	-ture	-zione	Total
DENOMINAL				4	12	1	7								24
-eggi					5	1	2								8
corteggiare					2										2
fiammeggiando					1										1
lampeggiando						1	2								3
sorseggiare					2										2
-ific				3	2		2								7
cornificare							1								1
nidificando					2										2
pianificare				1											1
pietrificare							1								1
prolificato				2											2
-izz				1	5		3								9
agonizzare				1											1
demonizzando					2										2
polemizzare					1		1								2
scandalizzare							2								2
vaporizzata					2										2
	-aggio	-aio	-ario	-eggi-	-ific-	-iggi-	-izz-	-mento	-ore	-tore	-torio	-tura	-ture	-zione	
DEVERBAL	1	6	1					3	1	4	1	5	1	1	24
-ino		3								4					7
colino		2								1					3
misurino		1								3					4

-mento	1														1
	-aggio	-aio	-ario	-eggi-	-ific-	-iggi-	-izz-	-mento	-ore	-tore	-torio	-tura	-ture	-zione	
spostamento	1														1
-tore		2							1			1			4
bollitore									1						1
condizionatore		1										1			2
distributore		1													1
-torio		1	1								1				3
conservatorio			1								1				2
laboratorio		1													1
-tura												1	1	1	3
bruciatura														1	1
rottura												1	1		2
-zione								3				3			6
adorazione								2							2
lavorazione								1				3			4
Total	1	6	1	4	12	1	7	3	1	4	1	5	1	1	48

Table 3.4.3. 2 - 7 – Morphological Process, Input Suffixation VS Output Suffixation

Finally, we focused on the items we classified as "X". This label was introduced to indicate that some subjects spelled out a (non)word that we could not classify as deverbal or denominal. Items produced are reported in the following Table.

Table 3.4.3. 2 - 8 – Morphological Process, Input Conversion VS Output X

Morphological Process: Input	X: Output					
	amare	*cimitero*	*comprato*	*condiscione*	*ufficio*	*Total*
Conversion	0	1	1	0	0	2
cinta		1				1
regalato			1			1
Suffixation	1	0	0	1	1	3
pianificare	1					1
condizionatore				1		1
ambulatorio					1	1
Total	1	1	1	1	1	5

These are the words we could not classify according to the morphological process applied to produce them. Indeed, they are all primitive nouns or verbs. To produce them, AD patients performed (i) semantic (i.e. *ufficio*, *comprato*) or (ii) verbal (i.e. *amare*, *cimitero*) paraphasias, and finally (iii) a neologism (i.e. *condiscione*).

Drawing some conclusions, we noticed that patients' ill-formed productions were mostly produced applying the transcategorial derivational process of suffixation, and so, not only favoring a more transparent mechanism of complex word-formation but also a more transparent outcome. We believe it might be interesting to have a look at suffixes employed to form novel words and which one among the many proposed within the experimental design, is the most selected. We will focus on derivation and competing suffixes in §3.4.3.6.

To conclude this unit, conversion turned out to be the transcategorial morphological process applied to produce correct outcomes in a more consistent way. This is supported by data found in group, as well as, individual productions. The major employment of suffixation, showed in the first graph of this section, can be explained by highlighting the tendency of subjects to produce ill-formed words applying the mechanism of derivation.

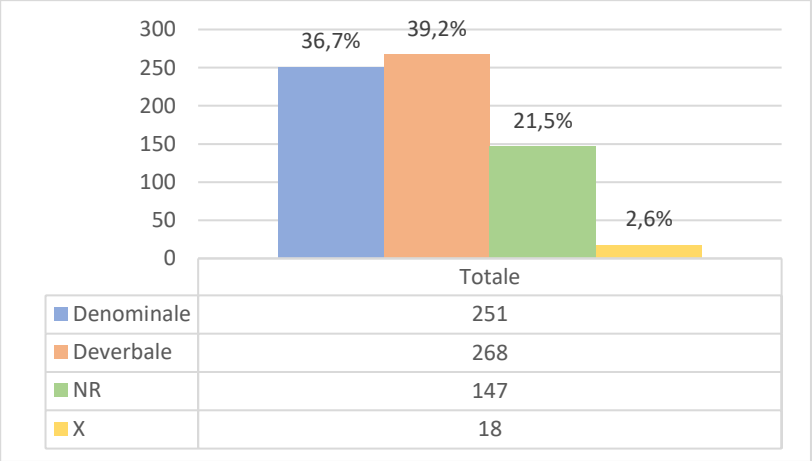
Finally, we can point out another interesting issue. More DVNs than DNVs were ill-formed applying suffixation instead of conversion, thus creating a more transparent noun with respect to a more transparent verb, since conversion is the mechanism more employed to create complex verbs. We will discuss this pattern later on this work.

3.4.3.3 Denominal Verbs VS Deverbal Nominals

The second research question concerns the category of the base manipulated by transcategorial morphological mechanisms. We wonder whether the nominal or verbal lexical base on which derivational morphological operations apply, has an impact on AD patients' performance. As for the previous research question, both base categories will be discussed simultaneously to make a possible comparison more accessible.

Taking into account all answers given by our AD patients (C, D1, D2, W, X and NR), the global production is presented in Graph 3.4.3.3 - 1.

Graph 3.4.3.3 - 1 - Deverbal VS Denominal – All Answers



Data reported above show a slight difference in production between denominals and deverbals, with the latter produced a little more. It is important to highlight again that this score is taking into account all given answers, so also productions that cannot be exactly considered correct outcomes, since both D1/D2 and W productions must be considered somehow incorrect. By the way, while the major part of W answers can be

solely analyzed as nonwords, D1/D2 are nonwords as well, but just because they are not part of the Italian lexicon. So, it might be interesting to evaluate and study them more in deep. Indeed, a qualitative analysis of the errors produced by the AD group will be reported subsequently. In addition, it is also worth looking at X productions, namely nonwords that could not be classified as denominal or deverbal. Data is presented in the following table.

Table 3.4.3.3 - 1 – Test Item Type: Neologisms and Semantic/ Verbal Paraphasias

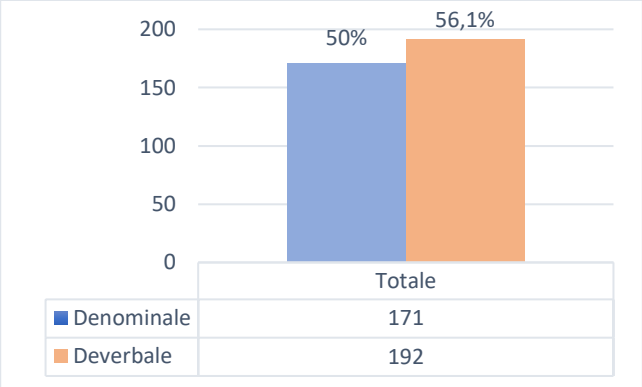
Input	*Test Item Type*	*Output*	*Output Item Type*
condizionatore	Deverbale	**condi[ʃ]one**	X
concimare	Denominale	**cimentizzare**	X
telefonato	Denominale	**telenato**	X
faticato	Denominale	**fraticato**	X
prolificato	Denominale	**profileggiato**	X
condizionatore	Deverbale	**condoniatura**	X
cinta	Deverbale	**cimitero**	X
demonizzando	Denominale	**demoficando**	X
pianificare	Denominale	**amare**	X
stampante	Deverbale	**talmante**	X
stretta	Deverbale	**trettata**	X
ramificato	Denominale	**mericato**	X
comando	Deverbale	**condeggiato**	X
scandalizzare	Denominale	**balandizzare**	X
sorseggiare	Denominale	**sortificare**	X
regalato	Denominale	**comprato**	X
battente	Deverbale	**bassante**	X
ambulatorio	Deverbale	**ufficio**	X

Table 3.4.3.3 - 1 shows eighteen novel words produced by our AD patients. Mostly, the verbal or nominal is somehow corrupted. On reason behind the corruption is the production of phonemic paraphasias (i.e. *telenato* < *telefonato*). In other cases, the impossibility of retrieving from the mental lexicon the correct root resulted in the composition of a neologistic root (i.e. *balandizzare* < *scandalizzare*). Finally, we could not

classify some other outcomes as either deverbal or denominal since a verbal paraphasia was performed (i.e. *ufficio* < *ambulatorio*).

Moving on and focusing the attention on correct answers only (C), the resulting pattern looks the same: DNVs' production accounts for 50% of the total potential denominals (171/342), while the percentage of the deverbal nominals produced corresponds to 56,1% (192/342). In this case as well, DVNs were produced slightly more, with respect to DNVs. Results are reported in the bar chart 3.4.3.3 - 2.

Graph 3.4.3.3 - 2 - Deverbal VS Denominal – C Answers



Looking at these results, the category of the lexical base from which the complex element is formed seems to play no role and thus it does not seem to have an effect on AD patients' performance. Anyway, it is noteworthy that DNVs production is at chance level. From the other hand, both denominal and deverbal productions appear impaired if compared to control group results, whose performance is at ceiling.

The previous graphs were analyzing group's production, seen as a whole. As we reported above, the lexical base type manipulated by morphological derivational operations seems to have no impact on subjects' production, at least at the group level. Therefore, it is worth checking individual performances to see if the patterns correspond to the ones resulting from group analysis.

Table 3.4.3.3 - 2 - Denominal and Deverbal, Individual Patterns – C Answers

ID	*Denominal*	*%*	*Deverbal*	*%*	*Total*
F17	1	100%	0	0%	1
G4	4	66,7%	2	33,3%	6
G5	8	80%	2	20%	10
SD19	7	46,7%	8	53,3%	15
T1	1	25%	3	75%	4
G6	7	43,7%	9	56,3%	16
F11	0	0%	1	100%	1
F18	3	27,2%	8	72,7%	11
SD20	11	50%	11	50%	22
G3	7	50%	7	50%	14
M16	13	46,4%	15	53,6%	28
R10	11	50%	11	50%	22
M14	12	44,4%	15	55,6%	27
M9	17	48,6%	18	51,4%	35
M15	8	32%	17	68%	25
M13	12	42,9%	16	57,1%	28
M12	15	48,4%	16	51,6%	31
G8	18	51,4%	17	48,6%	35
R2	16	50%	16	50%	32

As this table clearly shows, only two subjects produced just one type of complex word. Patient F17 produced one denominal verb while patient F11, on the contrary, produced one deverbal noun. This result suggests that they could present a different impairment, declined in an opposite pattern: name retrieval VS verb retrieval difficulty. It is worth

noting that these two patients are the same which applied either one of the two transcategorial morphological operation of complex word-formation, issue addressed in the previous section.

As concerning the remaining subjects, 3/17 experienced more difficulties in producing DVNs. By the way, while in two out of three cases the difference in production between deverbal and denominal is minor (patients G4 and G8), the discrepancy in patient G5 appears to be more significant, as she produced eight denominals VS two deverbals. 10/17 subjects gave a poorer performance as regards to DNVs. In this case too, while in seven out of ten subjects (patient M12, M13, M9, M14, M16, G6, and D19) the difference is not that sharp, in the remaining 3 cases (patient T1, F18 and M15) things are different and the discrepancy is more evident. As concerning the remaining subjects (patient R2, R10, G3, and SD20), their performance was perfectly balanced between the two item types.

Therefore, patients can naturally be divided into three different groups, according to the trend of their performance:

1. the first group is composed by four subjects (yellow group: patient F17, G4, G5 and G8) who favored the application of the transcategorial mechanisms of word-formation on a nominal base. It is important to highlight that within these subjects, one deviate since her performance counts the production of just one denominal verb VS zero DVNs;
2. the second set groups together eleven patients (blue group: patient SD19, T1, G6, F11, F18, M16, M14, M9, M15, M13 and M12) presenting the exact opposite pattern with respect to the first group. They showed a better performance on deverbal nominal items. Even in this case, one performance diverges from the others since patient F11 produced only one deverbal noun;
3. finally, the last group consists of four subjects (green group: patient SD20, G3, R10, R2) presenting a well-balanced performance and so preferring none of the 2 different lexical bases.

We also checked whether the MMSE score of AD patients matched with the three individuated patterns. The result is reposted in Table 3.4.3.3 -3.

Table 3.4.3.3 - 3 – MMSE score per Base Pattern

G1 – Yellow Group N base Pattern		*G2 – Blue Group V base Pattern*		*G3 – Green Group 50/50*	
MMSE	*Patient*	*MMSE*	*Patient*	*MMSE*	*Patient*
0	F17	2,7	SD19	11	SD20
1	G4	4,2	T1	11,4	G3
2	G5	5,2	G6	13	R10
23,7	G8*	5,4	F11	24	R2
		10,2	F18		
		12,7	M16		
		15,8	M14		
		19,4	M9		
		20	M15		
		21,4	M13		
		22,1	M12		

Note. The only error made by patient G8 is "stampatrice". Moreover, she expressed a doubt about the possibility that the correct word could be "stampante", but finally chose the D2. However, she performed almost at ceiling.

As for the different patterns we individuated in answering the first research question, also in this case the MMSE score seems to not shed light on why AD patients adopted either one or the other patterns. Producing more DNVs or DVNs does not appear to be influenced by the degree of cognitive deterioration.

Before concluding this second section, we want to focus on the four patients whose performance deviated from the one adopted by the majority of the group. Concerning subject F17, her only production corresponds to *fotografare*. Checking the productions of the other three patients, available in the table below, we noticed that the item in question was produced just by patient G8.

Table 3.4.3.3 - 4 – Patient F17, G4, G5 and G8 Correct Answers

PATIENT	*Deverbal*	*Denominal*	*Total*
F17 - MMSE: 0	0	1	1
fotografare		1	
G4 - MMSE: 1	2	4	6
fiammeggiando		1	1

viaggiando		1	1
regalato		1	1
baciata		1	1
ambulatorio	1		1
battente	1		1
G5 - MMSE: 2	2	8	10
temperino	1		1
sospirato		1	1
viaggiando		1	1
ondeggiare		1	1
stampante	1		1
regalato		1	1
vaporizzata		1	1
sciando		1	1
baciata		1	1
sorseggiare		1	1
G8 - MMSE: 23,7	17	18	35
stretta	1		1
rottura	1		1
pulsante	1		1
ambulatorio	1		1
scrittura	1		1
arrivo	1		1
adorazione	1		1
baciata		1	1
regalato		1	1
battente	1		1
sciando		1	1
bollitore	1		1
sospirato		1	1
cambiamento	1		1
vaporizzata		1	1
comando	1		1
polemizzare		1	1
distributore	1		1
ramificato		1	1
fiammeggiando		1	1
ricerca	1		1
fioccando		1	1
scandalizzare		1	1
fotografare		1	1
scritta	1		1
incontrato		1	1
sorseggiare		1	1
laboratorio	1		1

spinta	1		1
nidificando		1	1
temperino	1		1
ondeggiare		1	1
viaggiando		1	1
parcheggiando		1	1
pianificare		1	1
Total	21	30	51

Looking at their MMSE score, we think that the only production of patient F17 (MMSE: 0) could have been performed randomly. The item under assessment is without doubt easier to retrieve than other items present in the experimental study, but this did not play any role. Our interpretation is also confirmed by the other patients of Session 1. The production of the item in question is reported in the following Table.

Table 3.4.3.3 - 5 – Input: *fotografare* – Error Pattern

ID	*MMSE*	*Session*	*Correct Answer*	*Error*	*Diagnosis*
F17	0	1	fotografare		SD/AD
G4	1	1		NR	AD
G5	2	1		NR	AD
T1	4,2	1		NR	AD
G6	5,2	1	fotografare		AD
G3	11,4	1		fotare	AD
M15	20	1	fotografare		PAD
G8	23,7	1	fotografare		EAD
R2	24	1	fotografare		AD

Note. SD = Senile Dementia; PAD = Probable AD; EAD = Early AD

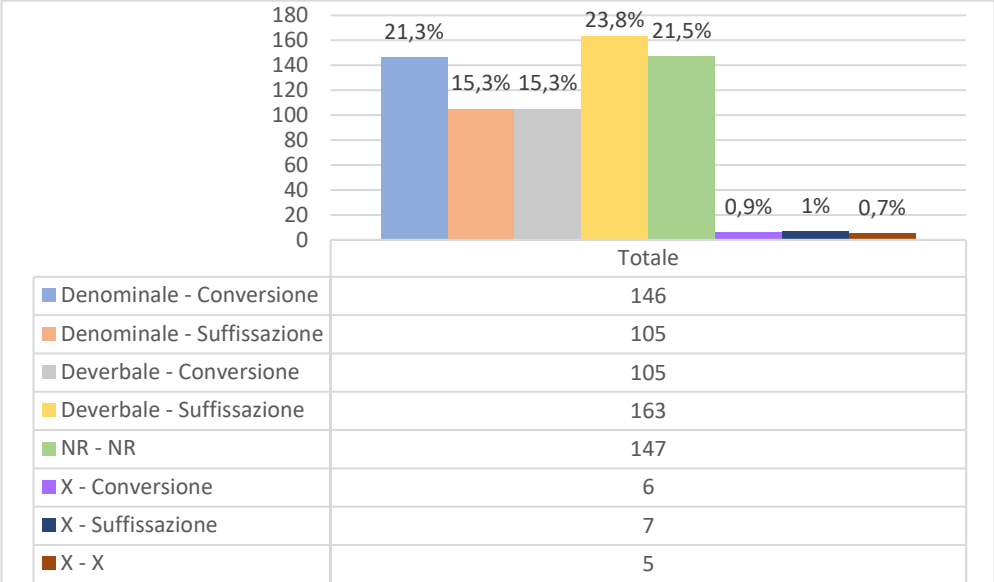
In conclusion, the trend found at the group level is also supported by single performances. 11/19 patients produced the same pattern, achieving a better result in applying the transcategorial mechanisms of complex word-formation on verbal bases. This might be interpreted as indicative of a less difficulty in retrieving verbal bases than nominal ones or, at least, in managing and modifying them.

3.4.3.4 Morphological variables in interaction

The third research question concerns how the two variables investigated in §3.4.3.2 and §3.4.3.3, namely the diverse lexical bases and the two derivational morphological mechanisms applying on them, interact with each other.

Starting from the global score, data in showed in Graph 3.4.3.4 -1.

Graph 3.4.3.4 - 1 - Variables in Interaction – All Answers



	Totale
Denominale - Conversione	146
Denominale - Suffissazione	105
Deverbale - Conversione	105
Deverbale - Suffissazione	163
NR - NR	147
X - Conversione	6
X - Suffissazione	7
X - X	5

A we can see from the graph above AD patients produced more DVNs applying suffixation. On the contrary, for producing DNVs, they privileged the transcategorial mechanism of conversion. The other productions are: (i) X – Conversion, meaning that a nonidentifiable base was used to create a complex element through conversion; (ii) X – Suffixation, to indicate that a nonword was used as a lexical base on which suffixation was applied; (iii) X – X are items that could not be classified as either deverbal/denominal nor as formed through a transcategorial operation of complex word-formation. The Tables in the following page present the aforementioned unclassifiable productions.

Table 3.4.3.4 - 1 – Neologisms (Base) – Morphological Process Output: Conversion

Lexical Base INPUT	Lexical Base OUTPUT	Morpho Process INPUT	Morpho Process OUTPUT	CORRECT WORD	OUTCOME
Nominal	X	Conversion	Conversion	telefonato	**telenato**
Nominal	X	Conversion	Conversion	faticato	**fraticato**
Verbal	X	Conversion	Conversion	stampante	**talmante**
Verbal	X	Conversion	Conversion	stretta	**trettata**
Nominal	X	Suffixation	Conversion	ramificato	**mericato**
Verbal	X	Conversion	Conversion	battente	**bassante**

Table 3.4.3.4 - 2 – Neologisms (Base) Morphological Process Output: Suffixation

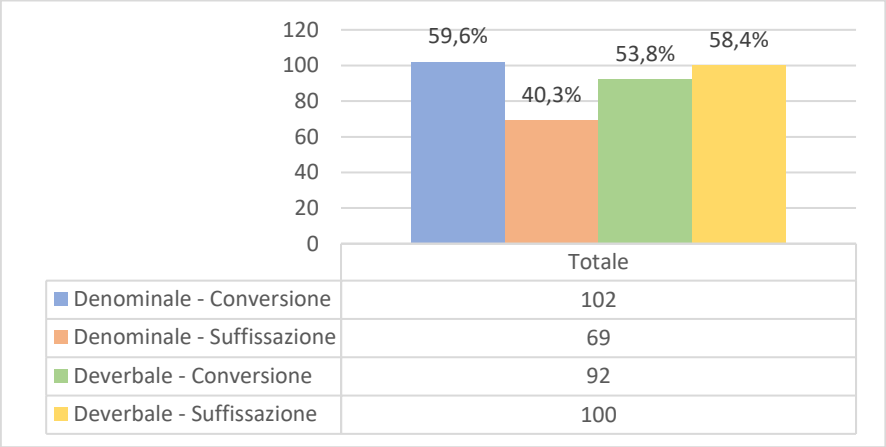
Lexical Base INPUT	*Lexical Base OUTPUT*	*Morpho Process INPUT*	*Morpho Process OUTPUT*	*CORRECT WORD*	*OUTCOME*
Nominal	X	Conversion	Suffixation	concimare	**cimentizzare**
Nominal	X	Suffixation	Suffixation	prolificato	**profileggiato**
Verbal	X	Suffixation	Suffixation	condizionatore	**condoniatura**
Nominal	X	Suffixation	Suffixation	demonizzando	**demoficando**
Verbal	X	Conversion	Suffixation	comando	**condeggiato**
Nominal	X	Suffixation	Suffixation	scandalizzare	**balandizzare**
Nominal	X	Suffixation	Suffixation	sorseggiare	**sortificare**

Table 3.4.3.4 - 3 – Neologism (Base) – No Morphological Process

Lexical Base INPUT	*Lexical Base OUTPUT*	*Morpho Process INPUT*	*Morpho Process OUTPUT*	*CORRECT WORD*	*OUTCOME*
Verbal	X	Suffixation	X	condizionatore	**condiscione**
Verba	X	Conversion	X	cinta	**cimitero**
Nominal	X	Suffixation	X	pianificare	**amare**
Verba	X	Suffixation	X	ambulatorio	**ufficio**
Nominal	X	Conversion	X	regalato	**comprato**

Successively, looking at deverbals and denominals separately, we checked which morphological transcategorial process was correctly applied to derive these complex elements. Findings are reported in the graph in the next page.

Graph 3.4.3.4 - 2 - Variables in Interaction – C Answers



Graph 3.4.3.4 - 2 shows that the majority of DNVs were composed through conversion. Conversely, suffixation was applied more consistently to form DVNs. So, AD patients produced 59,6% (102/171) of denominals through conversion and only 40,3% (69/171) through suffixation. As concerning DVNs, the most applied derivational process is suffixation, as it was used 58,4% of the times (100/171) while conversion was applied 53,8% of the times (92/171).

Consequently, the questions arisen from the previous findings are the following:

1. Why do AD patients experience fewer difficulties in forming denominal verbs through conversion and deverbal nominals through suffixation?

2. Why does the derivation of denominal verbs through suffixation seem to be the only mechanism seriously impaired in comparison to the other patterns?

The previous bar chart is considering all C answers at a group level. It is thus interesting to check also patients' individual patterns. The data is presented in the following Table.

Table 3.4.3.4 - 4 – Variables in Interaction, Individual Patterns – C Answers

Patient		*Denominals*		*Deverbals*	
MMSE	*ID*	*Conversion*	*Suffixation*	*Conversion*	*Suffixation*
0	F17	1	0	0	0
1	G4	3	1	1	1

2	G5	**5**	3	1	1
2,7	SD19	**5**	2	3	**5**
4,2	T1	**1**	0	2	1
5,2	G6	**4**	3	3	**6**
5,4	F11	0	0	0	1
10,2	F18	**2**	1	6	2
11	SD20	**7**	4	7	4
11,4	G3	**4**	3	1	**6**
12,7	M16	**6**	7	8	7
13	R10	5	6	5	**6**
15,8	M14	**8**	4	7	**8**
19,4	M9	**9**	8	9	9
20	M15	**8**	0	8	**9**
21,4	M13	**8**	4	8	8
22,1	M12	**9**	6	8	8
23,7	G8	9	9	8	**9**
24	R2	8	8	7	**9**
Total		**102**	**69**	92	100
Total		171		192	

Exactly as in the preceding sections (§3.4.3.2 and §3.4.3.3), patients F17 and F11 turned out to be once again the two outsiders within the group, since their performance is significantly different from that of the remaining patients. Indeed, the first-mentioned subject produced exclusively 1 denominal verb, applying the transcategorial mechanism of conversion. The second one, conversely, generated 1 deverbal noun applying suffixation. It is worth highlighting how these two patterns perfectly mirror the general

trend found at group and patient levels. Actually, DNVs are generally formed through conversion while DVNs through suffixation in a more consistent way. As concerns the remaining patients, the following discussion will firstly focus on denominals and secondly on deverbals. The majority of AD patients produced complex verbs applying the transcategorial mechanism of conversion more consistently (14/19). One subject (1/19) only produced more DNVs through suffixation. As for the last two patients (2/19), they exhibited an equal performance in both domains. As regards DVNs, findings revealed the adoption of the opposite trend. Suffixation turned out to be the most applied mechanism of complex word-formation (8/19 patients) while just four patients (4/19) preferred word-formation through conversion. The other five patients (5/19) showed a well-balanced performance. Before proceeding with the last two research questions, another relevant issue needs to be addressed. Indeed, it is appropriate to underline that the two overmentioned patterns (i.e. DNVs – Conversion VS DVNs – Suffixation) were performed regardless of the state of the outcome, being it a correct word or an ill-formed item. The only exception we found is within the suffixation domain. Indeed, when input and output process of word-formation matched, the final score resulting was equivalent for DVNs and DNVs. Data is reported in the following Tables.

Table 3.4.3.4 - 4 – Ill-formed Words per Item Type and Morphological Process – Global

ILL-FORMED ITEMS					
Denominals			*Deverbals*		
Morpho Process INPUT	*Morpho Process OUTPUT*	*Tot.*	*Morpho Process INPUT*	*Morpho Process OUTPUT*	*Tot.*
Conversion	Conversion	12	Conversion	Conversion	7
Conversion	Suffixation	17	Conversion	Suffixation	40
Suffixation	Conversion	35	Suffixation	Conversion	9
Suffixation	Suffixation	24	Suffixation	Suffixation	24

Table 3.4.3.4 - 5 – Correct Words per Item Type and Morphological Process – Global

CORRECT PRODUCTIONS			
Denominals		*Deverbals*	
Morpho Process	*Tot.*	*Morpho Process*	*Tot.*
Conversion	102	Conversion	92
Suffixation	69	Suffixation	100

Table 3.4.3.4 - 6 briefly recaps what we found so far.

Table 3.4.3.4 - 6 – Recap of Findings: Q1, Q2 and Q3

	Suffixation	*Conversion*	
Tot.	169	194	Tot.
Denominal	69	102	171
Deverbal	100	92	192

The analysis we carried out to answer the first research question showed that the transcategorial morphological process of conversion was the most employed process that produces correct outcomes. The second investigated issue pointed out that patients demonstrated fewer difficulties in processing DVNs. Nonetheless, in answering the third research question, we found that AD patients privileged the application of conversion to form DNVs whereas DVNs were mostly produced applying suffixation.

3.4.3.5 Verbal Stems and Suffixes

The aim of the last two research questions is to investigate more in detail the following two aspects:

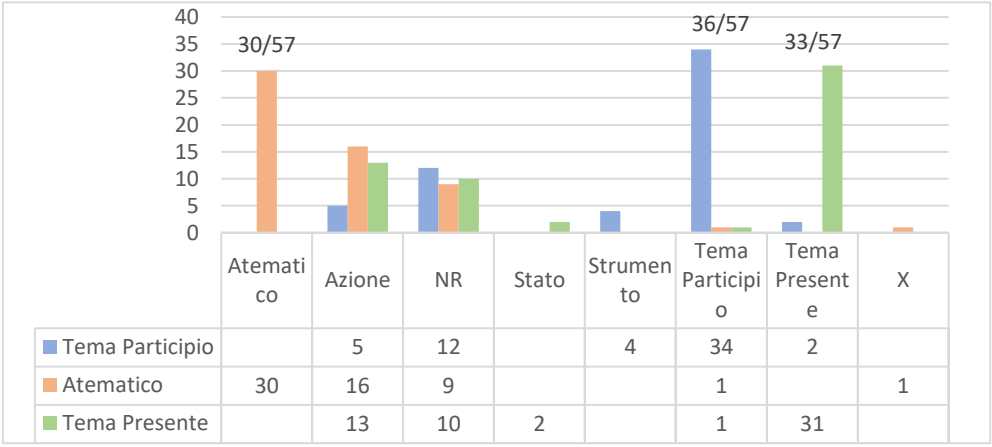
1. with respect to the morphological operation of conversion, how do patients deal with the different verbal bases, taken as the starting point for the transcategorial operation;
2. regarding the process of derivation, how do patients employ suffixes to compose complex word forms, concerning the formal restrictions and the core semantics (fox affixes), both required by WFRs.

All properties of input and output items, and related scores, are schematized in Table 25, available in the appendix.

3.4.3.5.1 Verbal Stems

Focusing firstly on the global production of the investigated group, data is presented in Graph 3.4.3.5 - 1, in the next page.

Graph 3.4.3.5 - 1 – Verbal Stems, All Answers

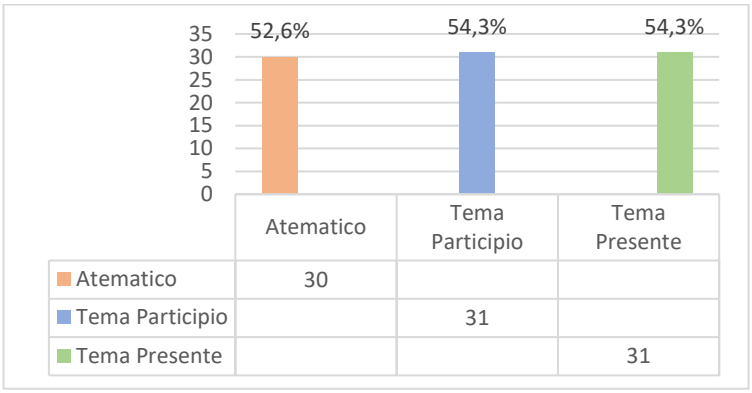


	Atematico	Azione	NR	Stato	Strumento	Tema Participio	Tema Presente	X
Tema Participio		5	12		4	34	2	
Atematico	30	16	9			1		1
Tema Presente		13	10	2		1	31	

The participle stem appears to be the most employed verbal base (36/57). It is followed by the present stem (33/57) and finally by the athematic stem (30/57). Besides, the bar chart highlights a phenomenon already discussed in the previous sections. Indeed, AD patients wrongly applied the transcategorial morphological mechanism of derivation quite frequently (40/45) to form complex items.

Considering only correct productions, the resultant pattern is basically the same as the one just presented. In the next page, Graph 3.4.3.5 – 2 provides the correct score.

Graph 3.4.3.5 - 2 – Verbal Stems, C Answers



	Atematico	Tema Participio	Tema Presente
Atematico	30		
Tema Participio		31	
Tema Presente			31

The three stems selected during the set-up of the test design were abundantly employed to form complex nouns, revealing no difference in their application and a final score just above chance level.

Finally, focusing on individual performances, the aim of the analysis was to check whether there was a difference in production between the three different stems. Data is reported in the table below.

Table 3.4.3.5 -1 – Verbal Stems, Individual Patterns – C Answers

Patient		*Conversion - Deverbals*			
MMSE	*ID*	*Athematic*	*Participle Stem*	*Present Stem*	*Total*
0	F17	0	0	0	**0**
1	G4	0	1	0	**1**
2	G5	0	1	0	**1**
2,7	SD19	2	1	0	**3**
4,2	T1	2	0	0	**2**
5,2	G6	0	2	1	**3**
5,4	F11	0	0	0	**0**
10,2	F18	3	1	2	**6**
11	SD20	2	2	3	**7**
11,4	G3	0	1	0	**1**
12,7	M16	2	3	3	**8**
13	R10	2	2	1	**5**
15,8	M14	2	2	3	**7**
19,4	M9	3	3	3	**9**
20	M15	3	2	3	**8**
21,4	M13	2	3	3	**8**
22,1	M12	2	3	3	**8**
23,7	G8	3	2	3	**8**
24	R2	2	2	3	**7**
Total		30	31	31	**92**

This table presents all the different patterns adopted by the nineteen AD patients, showing an extremely heterogeneous picture. Once again, it appears extremely clear that the two deviant performances belong to patients F17 and F11, the ones displaying a peculiar pattern also in the previous section. Indeed, they show no performance at all as

regards the application of conversion mechanism on verbal bases, since they both applied just suffixation. The remaining patients, presented below according to their final score, produced dissimilar patterns, not easily combinable.

a. Subjects producing one outcome only (3/19, the green group composed by patients G3, G4, G5) exclusively employed the participle stem. Looking at their single production, it is evident that there is no correspondence as concerns the item in question:

Conversion, Deverbal – S1	
G4 – MMSE: 1	
battente	1
G3 – MMSE: 11,4	
pulsante	1
G5 – MMSE: 2	
stampante	1

b. The light blue patient, namely T1, produced two outcomes employing the athematic stem only.
c. Subjects producing three outcomes, in this case two patients (the light-yellow group, namely SD19 and G6), differ according to the stem never selected. The first one preferred the athematic stem (2/3) but also employed the participle one (1/3) ignoring the present stem. The second one never employed the athematic stem, privileging the participle stem (2/3) and the present stem (1/3).
d. Only the Tiffany blue patient, namely R10, produced five items, showing no preference between the athematic and participle stems (2/3 in both cases), and picking up the present stem just once.
e. Again, only the blue patient, namely F18, selected in frequency order, the athematic stem (3/3), the present stem (2/3) and finally the participle stem, just once;
f. the three patients which produced seven correct answers (the orange group, namely SD20, M14, R2), present all the same pattern, namely present stem produced in 3/3 cases while athematic and participle stems in 2/3 cases. Checking their answers, we noticed that one subject belonged to Session 1 (R1), while the two others to Session

2 (M14, SD20). The production of the latter differs just for one item, as we schematized in the following tables:

Conversion, Deverbal – S1	
R2 – MMSE: 24	*7*
arrivo	1
battente	1
comando	1
pulsante	1
ricerca	1
scritta	1
stretta	1

Conversion, Deverbal – S2			
M14 – MMSE: 15,8	*7*	*SD20 – MMSE: 11*	*7*
chiusa	1	chiusa	1
crescita	1	crescita	1
domanda	1	domanda	1
dormita	1	mangiata	1
mossa	1	mossa	1
ricovero	1	ricovero	1
sosta	1	sosta	1

g. On the contrary, the five subjects who correctly performed 8/9 items (the purple group, namely M16, M15, M13, M12, G8) present two distinct patterns: the first group, composed by two patients (G8, M15), shows no difference in performance between the athematic and the present stem (3/3) VS participle stem (2/3) and, in addition, produced exactly the same items:

Conversion, Deverbal – S1			
G8 – MMSE: 23,7	*8*	*M15 – MMSE: 20*	*8*
arrivo	1	arrivo	1
battente	1	battente	1
comando	1	comando	1
pulsante	1	pulsante	1
ricerca	1	ricerca	1
scritta	1	scritta	1
spinta	1	spinta	1
stretta	1	stretta	1

In the second group, including three patients (M13, M12, M16), participle and present stems were correctly employed all the times, whereas the athematic stem just in 2/3 cases. All subjects produced the same outcomes:

Conversion, Deverbal – S2					
M13 – MMSE: 21,4	*8*	*M12 – MMSE: 22,1*	*8*	*M16 – MMSE: 12,7*	*8*
chiusa	1	chiusa	1	chiusa	1
crescita	1	crescita	1	crescita	1
domanda	1	domanda	1	domanda	1
dormita	1	dormita	1	dormita	1
mangiata	1	mangiata	1	mangiata	1
mossa	1	mossa	1	mossa	1
ricovero	1	ricovero	1	ricovero	1
sosta	1	sosta	1	sosta	1

h. Finally, only the red patient, namely M9, correctly produced all 9 complex items, showing no preference at all as regard the verbal stem typology.

It is also worth having a look at errors. As previously said, a small portion of ill-formed words where formed applying the correct transcategorial mechanism but selecting the wrong base. The remaining outcomes were formed applying the competing mechanism of derivation. Data is reported in the following table.

Table 3.4.3.5 - 2 – Ill-formed Words, Input: Conversion - Output: Conversion/Suffixation

OUTPUT	*Conversion*		*Suffixation*			
INPUT	*Participle Stem*	*Present Stem*	*Action*	*State*	*Instrument*	*Total*
Athematic	1		16			17
Cinta			cintura			4
Scritta			scrittura			3
Spinta			spingitura			3
			spinzione			2
Stretta	trettata		stringitura			5
Participle Stem	3	2	5		4	14
battente	bassante					1
crescita			crescizione			1
dormita	dormata		dormizione			2
mangiata			mangiatura			2
			mangiazione			1
pulsante		pulso				2
stampante	talmante				stampatrice	5

Present Stem	1		13	2		16
arrivo			arrivaggio			3
comando	comandato		comandaggio	condeggiato		3
domanda			domandazione			1
			domandatura			1
ricerca			ricercatura			5
ricovero				ricoveranza		1
sosta			sostatura			2
Total	5	2	34	2	4	47

First of all, concerning ill-formed words created applying the correct mechanism, a major part can be classified as neologisms. *Stretta* was produced picking up a novel base, at the participle form, producing *trettata*. *Dormita* was over-regularized taking the inflectional morpheme of the first conjugation, resulting in *dormata*. The same applies to *battente* which presents, also, a neologism as its base, *bassante*. Instead of *pulsante* two AD patients produced the present stem ending in -o, resulting in *pulso* and in lieu of *comando* one patient produced the participle stem *comandato*. Finally, the only production showing the "correct stem" is *stampante* which nevertheless presents a neologism as its lexical base, namely *talmante*. Secondly, examining ill-formed outcomes produced through the derivational mechanism, the resulting picture seems at first glance interesting. Four items that should have been produced selecting the athematic stem were produced picking up the action suffix instead, for the majority employing the suffix "-tura" but also "-zione", even though just on two occasions. Instead of *cinta* and *scritta*, it was produced *cintura* and *scrittura,* which are both already lexical entries of the Italian mental lexicon. AD patients produced two different outcomes instead of *spinta*, namely *spingitura* and *spinzione*. To create the first one the suffix "-tura" was applied to the regular stem while the second outcome was formed combining the irregular verbal form with the suffix "-zione". What said for *spingitura* applies also for *stringitura < stretta*. As concerns the participle stem, items were mostly produced through the combination with an action suffix, namely "-zione" and "-tura". The only complex-word created selecting an instrument suffix is *stampatrice < stampante*. Finally, focusing on the present stem, items were generated applying action suffixes, as the never-mentioned "-aggio", but also

"-zione" and "-tura". Moreover, in two cases, also two state suffixes were selected: "-anza" and "-ato". It might be eye-opening to check the MMSE score of patients who produced ill-formed words picking up the regular/irregular verbal stem used as the base of the transcategorial morphological derivation. Data is displayed in the next table.

Table 3.4.3.5 - 3 – Regular VS Irregular Stem Production

INPUT	*OUTPUT*
Conversion	*Suffixation*
Athematic	Action
MMSE: 1	
spinta	spinzione
stretta	**stringitura**
MMSE: 2	
spinta	spinzione
stretta	**stringitura**
MMSE: 5,2	
spinta	**spingitura**
stretta	**stringitura**
MMSE: 11,4	
spinta	**spingitura**
stretta	**stringitura**
MMSE: 24	
spinta	**spingitura**

It seems like patients with extremely different MMSE scores selected the regular stem as verbal base on which apply the transcategorial suffix to create a new complex noun. In addition, the action suffix "-tura" required the regular base while the other competing suffix "-zione" combined with the irregular form. Thus, our findings seem to provide evidence that a correlation between the degree of neurodegeneration, represented by the MMSE score, and the type of production performed by AD patients is not present, at least in our group and in the linguistics domain we investigated.

To conclude, as previously discussed, the overall analysis revealed that AD patients showed no differences in processing the verbal stems selected for the experimental design. All of them were abundantly used to form correct complex nouns. Furthermore,

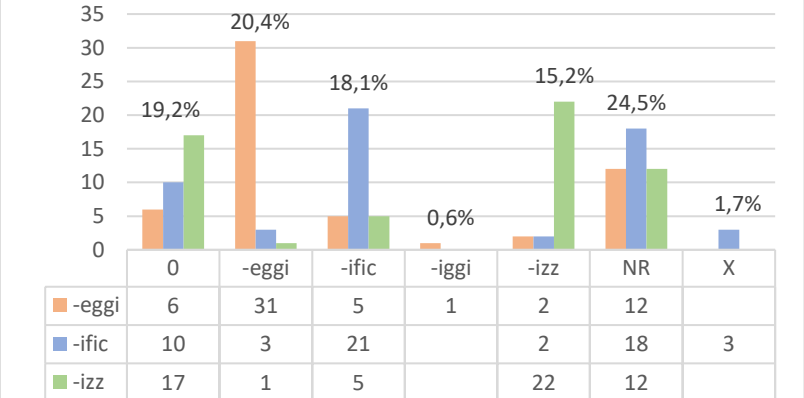
we found some difficulties in drawing some conclusions about the patient's individual performance, since the resulting patterns are extremely heterogeneous. This may be also due to the limited number of items per patient. Regarding ill-formed outcomes, the outcomes created through the transcategorial mechanism of conversion revealed that the athematic stem was never picked up as substituting lexical base, while both participle (5/47) and present (2/47) stem were selected, even though inconsistently. Indeed, on the contrary, AD patients undoubtedly experienced less difficulties in applying the competing word-formation mechanism (40/45), which produced more transparent complex words.

3.4.3.5.2 Suffixes

Before proceeding with the analysis, we want to point out that in this case, as regards individual productions, the data were extremely heterogeneous to identify specific production patterns. Moreover, items were not even perfectly balanced between the two sessions. So, we decided to analyze data painstakingly, starting from deverbals and concluding with denominals, looking at formal and semantic properties of suffixes. The aim of this analysis was to check whether, in producing novel words, AD patients respected the morpho-semantics of WFRs normally required.

Starting from the global score, data is presented in the following graphs. To make the analysis more accessible we divided our findings according to the lexical base on which the suffixation was applied.

Graph 3.4.3.6 - 1 – Denominal Suffixes, All Answers



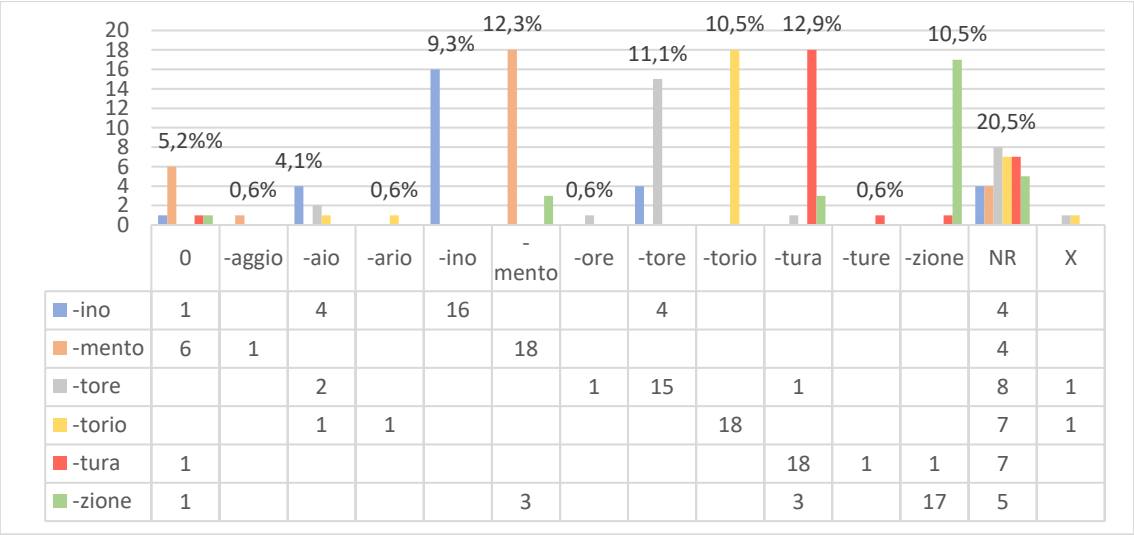
	0	-eggi	-ific	-iggi	-izz	NR	X
-eggi	6	31	5	1	2	12	
-ific	10	3	21		2	18	3
-izz	17	1	5		22	12	

Note. 0 = Conversion

Table 3.4.3.6 - 1 displays a quite omegeneous production of the 3 proposed verb-forming morphemes. “-eggi-” was employed 35/171 times, while “-ific-” and “-izz-” 31/171 and 26/171 corrispectly. We want to underly that patients also applied the competing mechanism of word-formation in 33 cases. Furthermore, the 3 trascategorial morphemes were differently substituted:“-izz-” in 17/33 cases, -ific- 10/33 times and finally “-eggi-” used to create 6/33 ill-formed words.

With regar to deverbal transcategorial affixes, the graph in the next page reports all concerning data. In the left row, all experimental suffixex are listed while, in the top line, all productions and suffixes selected by our AD patients are outlined.

Graph 3.4.3.6 - 2 – Deverbal Suffixes, All Answers

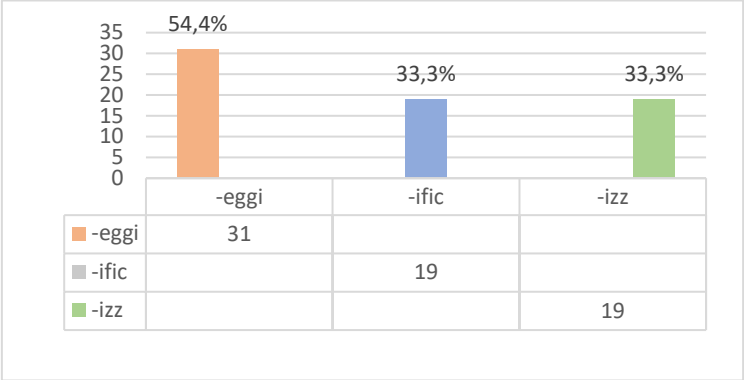


	0	-aggio	-aio	-ario	-ino	-mento	-ore	-tore	-torio	-tura	-ture	-zione	NR	X
-ino	1		4		16			4					4	
-mento	6	1				18							4	
-tore			2				1	15		1			8	1
-torio			1	1					18				7	1
-tura	1									18	1	1	7	
-zione	1					3				3		17	5	

Graph 3.4.3.6 - 2 displays the global production of all experimental suffixes. The six selected suffixes are positioned on the left row. Additional suffixes were introduced via distractor 1 and/or 2, presented in a multiple-choice fashion. As it is clearly showed by the table, suffixes “-tura”, “-mento”, and “-torio” are the transcategorial morphemes most produced by AD patients. The first two belong to the action semantic domain, while the last one is normally used to create *nomina loci*. Interestingly, in this case the competing mechanism of word-formation was used just in nine cases, as previously reported in the §3.4.3.4.

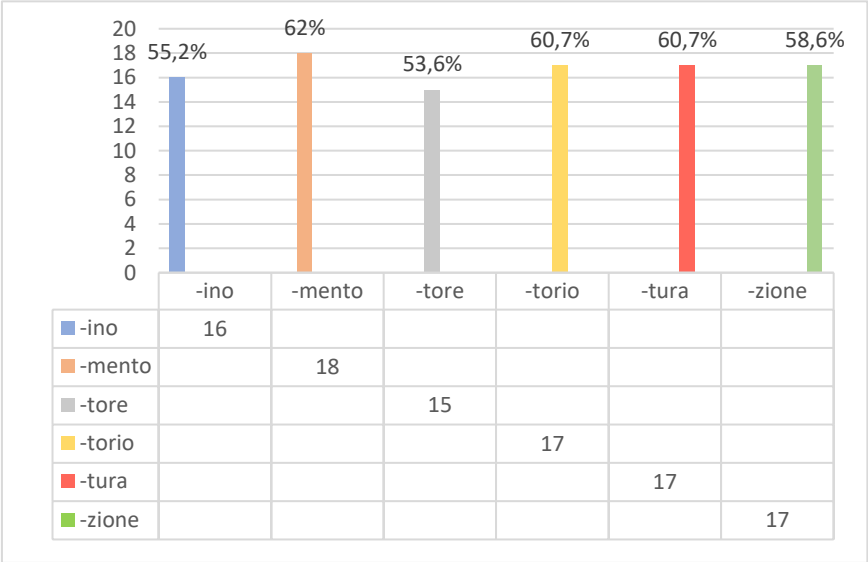
Looking at the correct productions, also in this case data is presented separated graphs.

Graph 3.4.3.6 - 3 – Denominal Suffixes, C Answers



Regarding the employment of denominal suffixes, "-eggi-" is the most employed (31/57), followed by the remaining two reporting the same final score, significantly under the chance level.

Graph 3.4.3.6 - 4 – Deverbal Suffixes, C Answers



Looking at deverbal transcategorial morphemes, on the whole AD patients used all suffixes consistently, showing no difficulties in their adoption. Again, suffixes from the action semantic domain are the most employed, alongside with the suffix "-tore". As stated at the beginning of this section, a deeper analysis of the patients' individual performance is not provided as the resulting patterns are too disparate to be arranged in

a coherent way. As concerns ill-formed productions, the data are presented below, starting from DVNs (action, instrument and place suffixes) and ending with DNVs.

3.4.3.5.2.1 Deverbal nouns

As previously mentioned in §3.4.2, the aim of the last research question is to more deeply investigate the employment of the diverse suffixes used to compose complex (non)words by AD subjects. We specifically focused on their internal semantic but also on their morphological restrictions. Action, place and instrument suffixes selected for the experiment, which respectively form action, locative and instrument nouns, generally apply on a verbal syntactic category. As seen in chapter 2 (§2.3.1), in many languages more than one affix is available to create a complex element, giving rise to a possible competition between words. This is exactly the case of Italian action nominals.

1. ACTION

As seen in §2.3.1.1, ANs, also known as event-denoting nouns, are nouns derived from a verbal base which present an event meaning, where the event embraces every kind of eventuality (Vendler, 1957; Bach, 1986). Suffixes available to form ANs are rather numerous. The morpho-phonetic properties of complex nouns in "-mento" and "-zione" have been analyzed by Thornton (1990, 1991) while nouns in "-tura" have been studied by Gaeta (2004). In many of his works (2002, 2004, 2009) he primarily focused on the description of their morphosyntactic and semantic properties (a detailed exemplification of these properties is given in the Chapter 2, §2.3.1.1.1, §2.3.1.1.2, §2.3.1.1.3). Gaeta also considered the inheritance of the Aktionsart of the base verb and analyzes cases in which it is modified, actually supporting the idea that transcategorial suffixes can partially modify the Aktionsart of the base verb. On the contrary, Melloni (2011) claimed that the actional features of the base verbs are never modified by deverbal suffixes. In many of her works (Melloni, 2006, 2007, 2008; on this topic see also Ježek, 2011), she investigates more in deep the polysemy of these suffixes which, as already said, can acquire different non-eventive readings. So, considering these assumptions, we looked at AD patients' performance to see what emerges from their productions. Subjects produced novel

words combining stems and affixes that were proposed by the experimenter but also picking up new affixes. Results are reported in Table 3.4.3.6 – 1.

Table 3.4.3.6 - 1 – Input: Action Suffixes, All Answers

INPUT	OUTPUT							
Suffixes	*Conversion*	*-aggio*	*-mento*	*-tura*	*-ture*	*-zione*	*NR*	*Total*
-mento	6	1	**18**				4	29
-tura	1			**18**	1	1	7	28
-zione	1		3	3		**17**	5	29
Total	**8**	**1**	**21**	**21**	**1**	**18**	**16**	**86**
		Total Action: 62						

The Table above shows the employment of the different affixes used to create complex ANs. We want to highlight that their application is ascribable to the action semantic domain exclusively and all three action suffixes were consistently employed, as previously said. In addition, within the 62 "action" productions 52 items are correct words, while the remaining 10 productions are D1, D2 and W replies. In 8 cases AD patients applied the competing mechanism of word-formation. Focusing on ill-formed words, the data are presented in the table below.

Table 3.4.3.6 - 2 - Input: Action Suffixes, Ill-formed words

INPUT	OUTPUT						
Suffixes	*Conversion*	*-aggio*	*-mento*	*-tura*	*-ture*	*-zione*	*Tot.*
-mento	**6**	**1**					**7**
cambiamento	cambio	cambiaggio					2
	cambia						1
nutrimento	nutrito						2
spostamento	sposto	spostaggio					2
-tura	**1**			**1**	**1**	**1**	**4**
bruciatura						bruciazione	1
rottura				rompitura	rotture		2
scrittura	scriva						1
-zione	**1**		**3**	**3**			**7**
adorazione			adoramento				2
costruzione	costruita						1
lavorazione			lavoramento	lavoratura			4
Total	**8**	**1**	**3**	**4**	**1**	**1**	**18**

First of all, focusing on conversion, AD subjects selected the present stem as base in 5 out of 8 cases, producing *cambio*/*cambia*, *sposto* and finally *scriva*. They also picked the participle stem 3 times, generating *nutrito* and *costruita*. The remaining 10 ill-formed productions exhibited the correct mechanism of word-formation. Patients selected the wrong suffix among those in competition and so respecting the semantic domain of *nomina actionis*.

Drawing some conclusions about the employment of action class suffixes, we noticed that the semantic domain variable was always respected when patients produced an ill-formed item. In addition, the outcomes deviating from the target word are considered novel words. Indeed, they are not part of the Italian mental lexicon. However, we can consider them as potential correct word since they respect WFRs normally applied to form them from both the formal and semantic point of view.

2. INSTRUMENT

As regards *nomina instrumenti*, it is important to keep in mind the premises discussed in chapter 2 (§2.3.1.2). To briefly recap, in some cases the same morphological material can denote both agents and instruments. This accident has to be considered a case of polysemy since a pattern of semantic extension is justifiable in terms of cognitive contiguity among the two considered conceptual categories (Dressler 1980, 1986). This is exactly the case of the suffix -tore, since it can be used to form bot agent and instrumental complex nouns (i.e. *allenatore*, *frullatore*).

Patients produced ill-formed items combining stems and affixes from the designated semantic domain, but also from a different one. Results are reported in Table 3.4.3.6 - 3.

Table 3.4.3.6 - 3 – Input: Instrument Suffixes, All Answers

INPUT	OUTPUT								
Suffix	*Conversion*	*-aio*	*-ino*	*-ore*	*-tore*	*-tura*	*NR*	*X*	*Total*
-ino	1	4	16		4		4		29
-tore		2		1	15	1	8	1	28
Total	1	6	16	1	19	1	12	1	57

Overall, the major part of instrument nouns corresponds to correct productions, 31 out of 57 (54,38%). The remaining 14 ill-formed items are presented in Table 3.4.3.6 - 4.

Table 3.4.3.6 - 4 - Input: Instrument Suffixes, Ill-formed words

INPUT	OUTPUT						
Suffixies	*Conversion*	*-aio*	*-ore*	*-tore*	*-tura*	*X*	*Tot.*
-ino	1	4		4			9
colino		colaio		colitore			4
misurino		misuraio		misuratore			4
temperino	temperante						1
-tore		2	1		1	1	5
bollitore			bollore				1
condizionatore		condizionaio			condoniatura	condiscione	3
distributore		distributaio					1
Total	1	6	1	4	1	1	14

Let's us focus first on the suffix "-ino". The competing instrument morpheme "-tore" was selected to create *colitore* and *misuratore*. As concerning the first ill-formed production, the item does not belong to the Italian lexicon. On the contrary, the outcome *misuratore* does exist:

mi̇suratóre s. m. [der. di misurare)]. – 1. (f. -trice) non com. a. Chi misura, chi è incaricato di particolari misurazioni. b. In senso fig., conoscitore, giudice: non è uomo che sia di sé vero e giusto m. (Dante). 2. Nel linguaggio scient. e tecn., il termine, seguito dalla specificazione di una grandezza da misurare, indica strumenti o apparecchi di misurazione nei casi in cui non esista una denominazione propria dello strumento o apparecchio: m. di livello, m. dell'indice di modulazione. In partic., in elettrotecnica, m. universale, lo stesso che analizzatore; in astronomia, m. di lastre, strumento ausiliario della fotografia celeste, più noto col nome di macromicrometro; in idraulica, edificio m., manufatto atto a misurare la portata di un canale, detto più spesso modellatore (v.).[74]

As it is possible to see from the definition provided by the online dictionary Treccani, the second available meaning for *misuratore* designates an instrument, more specifically a technical and scientific tool. Thus, both patient's productions respected the suffix semantic domain: the first one is not attested as lexical entry, but it can be considered a potential well-formed word, as the suffix "-ino" is normally used to form instrument nouns. The second one is, as a matter of fact, a lexical entry of the Italian vocabulary but

[74] Vocabolario Treccani, online version: http://www.treccani.it/vocabolario/

normally used in a scientific and specialized context, so not the one provided by the experimental sentence:

"Ho visto che il cuoco usa un misurino per preparare i dolci"

"I saw that the cook is using a measuring cup to bake biscuits"

Contrary to what has just been discussed, *colaio* and *misuraio* are both ill-formed productions created violating the WFR. Indeed, the suffix "-aio[75]" attaches to nominal bases and never to adjectival or verbal one (Grossmann and Rainer, 2004). In addition, the core semantics of the suffix is agentive and thus it is used to form *nomina agentis* or *nomina loci* as second option.

Finally, the item *temperino* was produced as *temperante*, applying the transcategorial mechanism of conversion and selecting the participle stem, probably by analogy with the word *stampante*, designating an instrument as well.

As regards the second transcategorial suffix used to derive instrument nouns, once again a denominal morpheme was selected in its place, to create the ill-formed words *condizionaio* and *distributaio*. Concerning the production *bollore* < *bollitore*, the outcome could be analyzed in different ways:

1. firstly, as the result of a phonemic paraphasia, which caused the deletion of the phonemes [i] and [t];
2. another possible interpretation is that an allomorph of the suffix -tore was selected and attached to the athematic stem;
3. the last possible interpretation is that a semantic paraphasia was produced since the outcome *bollore* is an existing lexical entry, belonging to the same lexical domain of the input item.

The last two productions, *condoniatura* and *condiscione*, can be both classified as neologisms, the first being derived from an X base and combined with the action suffix "-tura".

[75] It goes back from Latin "arius". It is still present in many examples, but it has become nearly unproductive (Rainer, 2016)

To conclude, we noticed that some outcomes were formed complying with the WFRs but selecting the competing suffix. However, our results also showed that a denominal "agent-generator" suffix was used to create complex instrument nouns, violating both formal and semantic requirements. The resulting ill-formed productions in this case can be analyzed only as illegal formations. So, while the suffix "-tore" was always correctly used to form novel complex items, on the other hand, the employment of the suffix "-aio" only produced agrammatical constructions. Thus, we can state that the use of this suffix results impaired.

3. PLACE

The last category of suffixes taken into account for this experimental study is the one used to create complex nouns of place, aka *nomina loci*. Table X summarizes patients' responses when the test item contained "-torio" as a suffix to create *nomina loci*.

Table 3.4.3.6 - 5 – Input: Place Suffixes, All Answers

INPUT	OUTPUT					
Suffix	*-aio*	*-ario*	*-torio*	*NR*	*X*	*Total*
-torio	1	1	18	7	1	28
Total	1	1	18	7	1	28

Table 3.4.3.6 - 5 shows that patients consistently, and for the most part correctly, employed the suffix "-torio" (18/28). Errors were marginally produced (4/28). Similarly to what we saw in the previous section, in 2/28 cases patients selected suffixes that cannot attach to a verbal base, namely "-aio/-ario": instead of *laboratorio*, patients produced *laboraio* ("-aio" suffix); instead of *conservatorio*, patients produced *conservario* ("-ario" suffix). In addition, instead of *ambulatorio*, in 1/28 cases patients produced *ufficio.* As briefly mentioned in the *nomina instrumenti* paragraph, "-aio" is a denominal suffix used to derive complex nouns. It is abundantly employed as an agentive suffix, thus used to derive names of professions (i.e. *calzolaio*). In addition, only combining with a nominal base, it can be used to derive names indicating a place where what is designated by the lexical base is contained or stored (i.e. *granaio*) and also, in isolated cases, objects (i.e. *vespaio*) (Schwarze, 2001). Exceptions to nominal bases are extremely rare: only one

adverbial base is present in *dirimpettaio* (DISC, 1869). As concerning verbal bases, it seems they are not used. A borderline case is *lavandaio*, pointed out by Lo Duca 1990a, 73, and finally interpreted by the DISC as derived from a nominal base, namely *lavanda*, *atto del lavare* (the action of washing)[76]. The suffix "-ario", is the learned variant of "-aio" and its distribution is rather modest. Normally, as its non-learned counterpart, it applies on a nominal base. The only recognized exception is its possibility to combine with a verbal base, originating a special class of "nominalized person", namely names of beneficiary. This option generally applies to regular verbs of the first conjugation, which present a ditransitive structure. This syntactic implication has a relevant consequence on the semantic of the derived form, as it realizes the indirect object of the corresponding sentence structure. So, the "-ario" suffix expresses the person (or the thing) to whom the subject of the base verb acts on. Finally, focusing on patients' productions, *laboraio* might respect both the semantics and formal requirements. Indeed, the input word designates a place, as it might do also the output. In addition, also the formal requisite of a nominal base might be respected as the outcome could be derived from the Latin noun "*labor*". In fairness, the only thing that does not quite fit is the meaning, as the outcome might be better interpreted as an agent rather than a place. As for *conservario*, the outcome is potentially formed respecting the WFR as the suffix "-ario" applies to regular verbal bases from the first conjugation, like *conservare*, but as concerns the ditransitive structure the questioned verb is categorizable as a bivalent verb, missing the indirect complement that should be expressed by the complex nouns derive with the suffix "-ario".

Recapitulating, the only place suffix selected for the experiment was mostly used in a correct way, showing nothing but two ill-formed complex words. These two isolated outcomes cannot be considered completely coherent or possible Italian new formations since the WFRs to derive them were only partially respected. A brief recap of the zoom in on suffixes formal requirements and semantics is presented hereunder:

[76] Lo Duca, M.,G. (2004a). *"Nomi di agente",* in Grossmann and Rainer, pp. 191-218, 351-364.

1. as concerns action suffix group, patients produced new complex words classifiable as potential correct words, since both formal and semantics properties were respected in deriving them. Indeed, the only "error" produced is the selection of the wrong suffix, which is actually one of the competitors within the action semantic class;
2. as for *nomina instrumenti* and *nomina loci*, the resulting picture is somehow harder to explain as a denominal suffix was selected to derive a small part of both complex noun types, even though inconsistently, violating the restriction on the category of the lexical base.

Checking which patients produced these 7 erroneous word-forms, it seems like their cognitive decline is mostly at the same middle-low level:

Table 3.4.3.6 - 6 – MMSE, Ill-formed Productions with "-aio" and "-ario" suffixes

OUTPUT: Suffix	*-aio*	*-ario*	*Total*
MMSE: 5,2	1		1
laboratorio	laboraio		1
MMSE: 10,2	2	1	3
colino	colaio		1
condizionatore	condizionaio		1
conservatorio		conservatario	1
MMSE: 11	1		1
misurino	misuraio		1
MMSE: 11,4	1		1
distributore	distributaio		1
MMSE: 12,7	1		1
colino	colaio		1
Total	6	1	7

To conclude the analysis of the gathered data, concerning the last research question, what emerged is that AD patients produced many novel word-forms. The majority of them can be considered as legal combinations of meaningful parts of real words, i.e. *brucia + zion*e instead of *brucia + tura*. A small part of them, on the contrary, are generated from the combination of meaningless and meaningful parts, like *condonia +*

tura, where "tura" is a real nominal suffix, belonging to the action domain. This outcome was produced instead of the *nomina instrumenti condizionatore*. Despite the unintelligibility of the word due to the inappropriate combination of phonemes (nonetheless a legal combination), it can be assumed that this derivational neologism is morphologically well-formed according to the morpho-phonological rules of Italian. So far, these phenomena have never been deeply investigated in AD populations and only relatively in aphasic ones. On the basis of presented data, we may conclude that our patients still have a working mechanism for creating polymorphemic words online, but this process might be employed just when retrieval of a whole word fails. The only productions still in need of a deeper analysis are the unattested forms combining meaningful parts of real words, but violating a formal condition required by Italian WFRs, i.e. *condizion + aio*. Therefore, we claim that AD patients might retain the set of morphological rules sufficient for creating real, as well as, novel words despite an impairment in word-finding ability. So, WFRs might be represented in the brain separately with respect to the words stored as a whole.

3.4.3.5.2.2 Denominal Verbs

The last issue investigates the morphological derivation of nouns into verbs. In this domain things are fuzzier, as a systematic review of the core semantic values of denominal suffixes is harder to find in the literature. Nonetheless, as base assumption is taken what reported by Luigi Talamo in *"Derivatario"*. A recap is presented below. Finally, data will be presented focusing singularly on the 3 derivational suffixes selected for the experiment, starting with the suffix "-eggi-", keeping on with "-ific-" and ending with "-izz-".

For the description of verbal suffixes core semantic, Talamo proposed the label Verb Process Oriented (henceforth VPO), including verbs indicating a process oriented towards/from something or to/from someone. He presented two different types of VPO:

1. simple: the entity from which or towards what the verbal action moves or is addressed is not part of the verbal morphology. This verb class normally regroups

prefixed verbs, already lexicalized or in process of lexicalization, whose meaning is close to the base verb (i.e. *deridere* = *ridere di* - to mock);

2. with an embedded object.

The second type of VPO can be further divided into:

a. VPO with an indirect object: the embedded object is the one from which the process comes from or moves towards (i.e. place or, as in classical grammars, complement of movement to a place);
b. VPO with a direct object: the embedded object is the object on which the verbal process applies on, namely the direct object. Finally, a. and b. can be additionally categorized in subgroups, where X stands for the embedded object.

1) CAUSATIVE[77]: "make X" or "cause to become X";
2) INCHOATIVE: "become X";
3) LOCATIVE: "make something go to/in/on X"
4) ORNATIVE: "make X go to/in/on something/provide with"
5) PERFORMATIVE: "do X"
6) PRIVATIVE: "remove X"
7) SIMILATIVE: "do/act/make in the manner of or like X"
8) INSTRUMENTAL: "use X"

The classification of suffixed Italian verb into VPO its original from Talamo. As concerning the other labels, as causative etc., these were taken from Plag (1999) and adopted also by Lieber (2005) for the classification of English DNVs formed through suffixation.

A. -EGGI-

The morpheme in question is classifiable as a denominal suffix used to generate new verb lexical entries. Regarding its semantics, it presents a double-meaning pattern:

[77] In Lieber (2005) reporting Plag's terminology, the label Causative is followed by Resultative: "make into X", differentiation to be taken into consideration.

1. Regular: verb process-oriented (henceforth: VOP): similative, performative - evaluative (pejorative);
2. Irregular: VPO: inchoative, privative, instrumental.

Table 3.4.3.6 - 7 – Input: Suffix "-eggi-", All Answers

INPUT	OUTPUT						
Suffix	*0*	*-eggi-*	*-ific-*	*-iggi-*	*-izz-*	*NR*	*Total*
-eggi-	6	**31**	5	1	2	12	57

The table above shows suffix "-eggi-" global production. On the whole the transcategorial morpheme employment is correct, in a steady way. Errors are slightly more than nonresponses and were produced not only picking up the others transcategorial suffixes proposed, but also applying the competing mechanism of word-formation, i.e. conversion.

Table 3.4.3.6 - 8 – Input: Suffix "-eggi-", Ill-formed Productions

INPUT	OUTPUT				
Suffix	*0*	*-ific-*	*-iggi-*	*-izz-*	*Total*
corteggiare		cortificare			2
fiammeggiando	fiammare	fiammificare			2
lampeggiando	lampare		lampiggiare	lampizzare	4
ondeggiare	ondare				3
sorseggiare	sorsare	sorsificare			3
Total	6	5	1	2	14

Focusing on ill-formed productions, 6/14 were produced through conversion mechanism resulting in virtual words, since from a formal point of view these (non)words were correctly generated. Regarding the adoption of the correct operation of word-formation, "-iggi-" is analyzable as a phonemic paraphasia. The remaining formations fit somehow the semantics of the new suffixes applied on the noun base, resulting correct from both the formal, as well as, the semantic point of view. Sometimes a slight shift in meaning is

present. However, this shift is acceptable as it matches to the context introduced by the sentence:

Test Item	Semantics of -eggi-	Output	Semantics of -ific-	Semantics of -izz-
corteggiare	Performative: do X "fare la corte"	**cortificare**	**Irregular** Performative: do X	/
fiammeggiando	Performative: do X "mandare fiamme"	**fiammificando**	**Irregular** Performative: do X	/
lampeggiando	Performative: do X "emettere lampi"	**lampizzando**	/	Causative: make X, cause to become X "emettere lampi"
sorseggiare	Performative: do X "fare un sorso"	**sorsificare**	**Irregular** Performative: do X	/

B. -IFIC-

As for "-ific-" transcategorial suffix, the core semantics identified is presented below:

Regular: VPO: causative, incoative;

Irregular: VPO: performative, ornative, locative.

Table 3.4.3.6 - 9 – Input: Suffix "-ific-", All Answers

INPUT	OUTPUT						
Suffix	*0*	*-eggi*	*-ific*	*-izz*	*NR*	*X*	*Total*
-ific	10	3	**21**	2	18	3	57

As concerns the suffix "-ific-", ill-formed converted words are slightly more here than in the preceding section (10/57). In addition, the correct employment of the suffix appears to be impaired, as it was used just in 36,8% of cases. Non answers Are relatively high while a focus on errors is presented in Table 3.4.3.6 - 10.

Table 3.4.3.6 - 10 – Input: Suffix "-ific-", Ill-formed Productions

INPUT	OUTPUT					
SUFFIX: -ific-	*0*	*-eggi*	*-ific*	*-izz*	*X*	*Total*
cornificare	cornare			cornizzare		3
nidificando			nidificato			2
pianificare	pianare	pianeggiare			amare	4
pietrificare	pietrare petrare			pietrizzare		4
prolificato	prolifato	prolifeggiato profileggiato				4
ramificato	ramato				mericato	3
Total	11	3	2	2	2	20

Starting with the X productions, the first one, *amare*, is a verbal paraphasia, since it has no semantic connection with the target word. The other one, *mericato*, is a neologism. The remaining outcomes, as in the previous section, can be classified as unattested well-formed words, as the selection of the alternative verbal suffix satisfy the core semantics expressed by the target item.

Test Item	Semantics of -ific-	Output	Semantics of -eggi-	Semantics of -izz-
cornificare	Performative: do X "fare le corna"	**cornizzare**	/	Causative: make X, cause to become X "rendere cornuto" - metaforico
pianificare	Performative: do X "fare un piano"	**pianeggiare**	Performative: do X "fare un piano"	/
pietrificare	Causative: make X, cause to become X "trasformare in pietra"	**pietrizzare**	/	Causative: make X, cause to become X "rendere pietra"
prolificato	Performative: do X "Fare la prole, generare figli"	**prolifeggiare**	Performative: do X "Fare la prole, generare figli"	/

C. -IZZ-

The last verbal morpheme to be analyzed is "-izz-", which is described as having a single semantic pattern:

Regular: VPO: causative

Irregular: -

Table 3.4.3.6 - 11 – Input: Suffix "-izz-", All Answers

INPUT	OUTPUT					
Suffix	*0*	*-eggi-*	*-ific-*	*-izz-*	*NR*	*Total*
-izz-	17	1	5	22	12	57

Looking at the global production, it seems that conversion mechanism was used as alternative morphological operation at a fairly high rate, with respect to the preceding suffixes. As for the other outcomes, alternative suffixes where employed limitedly, as reported in the table above.

Table 3.4.3.6 - 12 – Input: Suffix "-izz-", Ill-formed Productions

INPUT	OUTPUT				
SUFFIX: -izz-	*0*	*-eggi-*	*-ific-*	*-izz*	*Total*
agonizzare	agonare	agoneggiare			2
demonizzando	demoniando		demonificando demoficando		6
fraternizzare	fraternare fratellare				2 3
polemizzare	polemicare		polemificare	polezzare	5
scandalizzare	scandalare			scandizzare balandizzare	3
vaporizzata	vaporata		vaporificata		5
Total	17	1	5	3	26

Focusing on erroneous outcomes, in three cases the correct suffix was employed but the resulting words was categorized as W since *polezzare* and *scandizzare* can be interpreted

as phonemic paraphasias while *balandizzare* as a neologism (on the base). The remaining productions can be analyzed again as unattested words which respect the semantic of the input word.

Test Item	Semantics of -izz-	Output	Semantics of -eggi-	Semantics of -ific-
agonizzare	Causative: make X, cause to become X "essere in agonia"	**agoneggiare**	?	/
demonizzando	Causative: make X, cause to become X "far apparire come demoniaco"	**demonificano**	/	Causative: make X, cause to become X
polemizzare	Causative: make X, cause to become X "fare polemica"	**polemificare**	/	Causative: make X, cause to become X
vaporizzata	Causative: make X, cause to become X "trasformare in vapore"	**vaporificata**	/	Causative: make X, cause to become X

To conclude this last section of data analysis, what we concluded for deverbal productions can be also extended to the denominal domain. Indeed, on the whole, it seems that patients produced novel word-forms resulting from legal combinations of meaningful parts of attested words, as well as, from the "fusion" of unattested bases with real suffixes, resulting in neologisms, even though less frequently. Another relevant factor to take into account is the adoption of the competing mechanism of word-formation, which in this case applied more frequently in comparison to deverbal complex word-formations.

CHAPTER 4

Results Discussion

The last chapter of this work is devoted to the discussion of the results. First of all, a brief recap of the findings, organized per research question, is provided. We will focus on the four patterns we investigated in Chapter 3, namely Group Global Production, Group Correct Production Individual Level Production and Errors' Pattern. Successively, we will compare the results with our predictions, to check whether AD patients performed as we expected or not. Finally, we will discuss our findings making references to what is found in the literature and with previous studies. We will specifically focus on AD studies, when possible. Otherwise, we will look at other language disorders, such as aphasia, or other linguistics fields.

4.1 Research Question 1

Our first research question is was:

Q1 - Considering the transcategorial morphological operations involved in the experimental study, namely conversion and derivation, how do AD patients deal with these mechanisms?

As for this initial interrogative, we noticed that the morphological operation applied to derive the complex test items is partially not consistent in the first three patterns we investigated.

4.1.1 Group Global Production

Considering all possible answers given by AD patients, errors included, suffixation resulted to be the word-formation mechanism most widely applied.

Table – 4.1.1 – Group Global Production, Q1

Word-Formation Process	*Final Score*	*%*
Suffixation	275	40,2%
Conversion	257	37,5%
NR	147	21,5%
X	6	0,7%

4.1.2 Group Correct Production

On the contrary, computing correct productions only, the findings showed a predominant employment of conversion. In addition, while conversion was applied more than half of times, suffixation resulted slightly below the chance level.

Table 4.1.2 – Group Correct Production, Q1

Word-Formation Process	*Final Score*	*%*
Suffixation	169	49,4%
Conversion	194	56,7%

4.1.3 Individual Level Production

Finally, looking at the individual productions, conversion results again the mechanism employed by the majority of patients.

Table 4.1.3 – Individual Level Production, Q1

Word-Formation Process	*Patients*	*Total*
Conversion	F17, G4, G5, SD19, T1, F18, SD20, M14, M9, M15, M13, M12	12
Suffixation	F11, G6, 63, R10, G8, R2	6
50-50	M16	1

4.1.4 Errors' Pattern

Focusing now on the errors produced, Table 4.1.4 presents the global picture.

Table 4.1.4 – Errors' Pattern, Q1

Morpho Process	*OUTPUT*			
INPUT	*Conversion*	*Suffixation*	*X*	*Total*
Conversion	19	57	3	79
Suffixation	44	48	3	95
Total	63	105*	6	174

Note. *It is important to highlight that one production presents a double answer since both modalities were employed. Indeed, patients SD19 produced *colino* verbally, but he pointed the target word (C).

The results provided in this Table match with the findings presented in §4.1.1 on Group Global Production. Indeed, the fact that suffixation turned out to be the more employed mechanism of word-formation now can be easily explained. The difference between

suffixation global score in Table 4.1.1 (275) and suffixation score in Table 4.1.2 (169) is 106. Excluding the correct answer produced manually[78], which was counted in §4.1.1, the final result is exactly 105. Thus, these 105 formations are errors made by our 19 AD patients. In 57/105 cases, patients applied derivation instead of conversion, producing a more transparent and iconic output. In the remaining cases, they applied the correct mechanism but select the wrong suffix among those in competition. On the whole, AD patients experienced fewer difficulties in producing correct items applying the transcategorial mechanism of conversion. However, we consider remarkable the wide application of suffixation to compose novel words.

4.2 Research Question 2

Our second research question is:

Q2 - Does the lexical base, nominal or verbal, on which morphological operations (i.e. derivation, conversion) apply, have an impact on AD patients' performance?

As far as the second interrogative concerns, we found that the findings are consistent in the first three patterns examined in chapter 3, which are briefly recapitulated below.

4.2.1 Group Global Production

When we looked at the global score, we found that AD patients produced more nouns from a verbal base than verbs created from a nominal base.

Table 4.2.1 – Group Global Production, Q2

Item Type	*Final Score*	*%*
Denominal Verbs	251	36,7%
Deverbal Nouns	268	39,2%
NR	147	21,5%
X	19	2,6%

4.2.2 Group Correct Production

Results found in §4.2.1 applies also for correct productions.

[78] This is one of the cases in which a patient produced a double response, for the same item, in which verbal and manual modality mismatched.

4.2.2 Group Correct Production, Q2

Item Type	*Final Score*	*%*
Denominal Verbs	251	50%
Deverbal Nouns	268	56,1%

The findings revealed that denominal verb production is exactly at chance level while deverbal nominal one is slightly over it.

4.2.3 Individual Level Production

Again, the individuated pattern is congruent with the findings presented in the two preceding sections. Indeed, the majority of AD patients formed more DVNs than DNVs, as reported in Table 4.2.3.

Table 4.2.3 – Individual Level Production, Q2

Item Type	*Patients*	*Total*
Deverbal Nominals	SD19, T1, G6, F11, F18, M16, M14, M9, M15, M13, M12	11
Denominal Verbs	F17, G4, G5, G8	4
50-50	SD20, G3, R10, R2	4

4.2.4 Errors

As for this second research question, errors are productions that we could not classify as either deverbal or denominal. AD patients in eighteen cases produced primitive nouns, primitive verbs or neologism whose base we could not identify, or we did not since the lexical base was corrupted for different reasons.

Table 4.2.4 – Denominal/Deverbal Errors, Q2

Item Type	*X*	*Error*
Denominal	10	/
MMSE: 0	1	
pianificare	amare	Verbal P
MMSE: 1	1	
scandalizzare	balandizzare	Neologism
MMSE: 2,7	1	
concimare	cimentizzare	Neologism
MMSE: 4,2	1	
regalato	comprato	Sem P
MMSE: 5,2	1	
ramificato	mericato	Neologism
MMSE: 10,2	2	
faticato	fraticato	Phon P
telefonato	telenato	Phon P
MMSE: 11,4	1	
sorseggiare	sortificare	Phon P
MMSE: 15,8	1	
prolificato	profileggiato	Phon P
MMSE: 19,4	1	

demonizzando	demoficando	Phon P
Deverbal	8	/
MMSE: 0	2	
stampante	talmante	Neologism
stretta	trettata	Neologism
MMSE: 1	1	
comando	condeggiato	Neologism
MMSE: 4,2	1	
ambulatorio	ufficio	Sem P
MMSE: 11	1	

condizionatore	condiscione	Neologism
MMSE: 11,4	1	
battente	bassante	Neologism
MMSE: 13	2	
cinta	cimitero	Verbal P
condizionatore	condoniatura	Neologism
Total	18	/

Legend. Verbal P = verbal paraphasia; Sem P = semantic paraphasia; Phon P = phonemic paraphasia.

Globally speaking, our investigated group performed better when it had to produce a complex noun formed from a verbal base.

4.3 Research Question 3

The third research question merges together the first two interrogatives.

Q3 - How do the two considered variables, namely the diverse lexical bases and the morphological mechanisms applying on them, interact with each other?

Interestingly, also in this case we found that findings are coherent all over the patterns investigated.

4.3.1 Group Global Production

AD patients derived more nominals from verbal bases and applied more consistently conversion to form verbs from nominal bases. The same applies also for §4.3.2 and §4.3.3.

Table 4.3.1 – Group Global Production, Q3

	Conversion	*%*	*Suffixation*	*%*	*X*	*%*	*NR*
Denominals	146	21,3%	105	15,3%			
Deverbals	105	15,3%	163	23,8%			147 (21,5%)
X	6	0,9%	7	1%	5	0,7%	

4.3.2 Group Correct Production

What we found computing only correct answers is comparable to the previous section. To notice that the only production resulting under the chance level concerns verbs derived from a nominal base (40,3%). So, AD patients showed more difficulties when it was required to attach a suffix to a nominal base in order to create a complex verb.

Table 4.3.2 – Group Correct Production, Q3

	Conversion	*%*	*Suffixation*	*%*
Denominals	102	59,6%	69	*40,3%*
Deverbals	92	53,8%	100	58,4%

4.3.3 Individual Level Production

Investigating individual performances, what emerges is much the same as results in §4.3.1 and §4.3.2.

Table 4.3.3 – Individual Level Production, Q3

Item Type	*Word-Formation Process*	*Patients*	*Total*
Deverbals	Conversion	T1, F18, SD20, M16	4
Deverbals	Suffixation	F11, R2, G8, M15, M14, R10, G3, G6, SD19	9
Deverbals	50-50	M12, M13, M9, G5, G4	5
Deverbals	None	F17	1
Denominals	Conversion	F17, G4, G5, SD19, T1, G6, F18, SD20, G3, M16, M14, M9, M15, M13, M12	15
Denominals	Suffixation	R10	1
Denominals	50-50	G8, R2	2
Denominals	None	F11	1

The majority of AD patients formed complex nouns applying a suffix to a verbal base (9/19) and complex verbs converting a nominal base (15/19). AD patients' preference for the transcategorial mechanism of conversion, to create complex verbs, is sharper than suffixation. On the contrary, the pattern appears less clean when looking at deverbals.

Nonetheless, the major part of AD individuals applied suffixation on verbal bases more consistently. Patients F17 and F11 stand outside this picture since their production is totally different. Indeed, they produced exclusively 1 item: one denominal through conversion and one deverbal through suffixation respectively.

4.3.4 Errors' Pattern

Again, in producing ill-formed outcomes, we noticed that AD patients employed conversion to form complex verbs more consistently, regardless of the correct mechanism of word-formation normally required. On the contrary, they preferred to apply suffixation when they had to form a noun from a verbal base. In this case, a marked preference emerges only when the input mechanism of word-formation is conversion, suggesting that they experienced fewer difficulties in forming complex nouns adding a suffix to a verbal base, instead of applying conversion.

Table 4.3.4 – Denominal/Deverbal, Conversion/Suffixation Errors' Pattern, Q3

Input	*Output*	*Denominals*	*Deverbals*
Conversion	*Conversion*	**12**	7
Conversion	*Suffixation*	17	**40**
Suffixation	*Conversion*	**35**	9
Suffixation	*Suffixation*	24	24

Overall, we found two different patterns, cursorily respected also when creating ill-formed words. Concerning the first one, AD patients produced more DVNs applying suffixation. As for the second one, they formed a greater number of DNVs through conversion.

4.4 Research Question 4

The fourth research question aimed to investigate conversion more in depth.

Q4 - Looking at conversion, how do AD patients deal with the different morphological bases that are taken as the starting point of the morphological operation?

4.4.1 Group Global Production

AD subjects showed no particular preference for one of the verbal stems proposed. Nonetheless, they produced more complex nouns from the participle stem.

Table 4.4.1 – Group Global Production, Q4

Conversion			*Suffixation*			*NR*
Athematic	*Participle Stem*	*Present Stem*	*Action*	*State*	*Instrument*	*/*
30	36	33	34	2	4	31

4.4.2 Group Correct Production

We noticed even less difference between stems when computing only correct answers.

Table 4.4.2 – Group Correct Production, Q4

Conversion		
Athematic	*Participle Stem*	*Present Stem*
30	31	31

We claim that AD patients did not encounter a specific difficulty with one of the proposed verbal stems.

4.4.3 Individual Level Production

When we checked the individual productions, we noticed an extremely heterogenous picture, reported in Table 4.4.3. The reason behind this may be found in the experimental design. Indeed, every patient had to produce just 3 items per type of stem (in total nine items). Consequently, we could not identify distinct patterns since the difference in production, in terms of numbers, is too small to be considered a real "scheme".

Table 4.4.3 – Individual Level Production, Q4

Athematic	*Participle Stem*	*Present Stem*	*Total*	*Patient*
0	0	0	0	F11, F17
0	1	0	1	G4, G5, G3
2	0	0	2	T1
2	1	0	3	SD19

0	2	1	3	G6
2	2	1	5	R10
3	1	2	6	F18
2	2	3	7	SD20, M14, R2
2	3	3	8	M16, M13, M12
3	2	3	8	M15, G8
3	3	3	9	M9

4.4.4 Errors

Focusing on wrong verbal stem selection, patients produced just a couple of errors (7/48). Some ill-formations present a regularization (i.e. *dorm**ata***), some others were produced picking up a competing verbal stem (i.e. *pulso*), as reported in Table 4.4.4.

Table 4.4.4 – Stem Errors, Q4

Athematic	*Participle Stem*	*Present Stem*	*Output Stem*	*Output*
Stretta			**Participle Stem**	Trettata
	Battente		Participle Stem	Bass**ante**
	Dormita		Participle Stem	Dorm**ata**
	Stampante		Participle Stem	Talmante
	Pulsante		**Present Stem**	Pulso (x 2)
		Comando	**Participle Stem**	Comandato

Overall, patients did not perform a wide range of errors when selecting the wrong verbal stem to form a complex noun. This is probably due to the fact that, as previously said, they preferred to apply the competing mechanism of word-formation. So, their outcomes are ill-formed but more transparent and iconic novel words. Moreover, we found some regularizations of the verbal base concerning three items formed through suffixation, instead of producing the correct word from the athematic stem. Indeed, *stretta*, *spinta* and *rottura* were formed, at least in one occasion, selecting the regular base of the verb and attaching to it the suffix "-tura". Thus, some patients produced *spingi + tura, stringi + tura* and *rompi + tura.*

4.5 Research Question 5

Our last research question concerns derivation and relative suffixes.

Q5 - Looking at the derivational morphological process, how do AD patients employ the suffixes selected to compose complex word forms, concerning their inherent semantic content and their morphological restrictions?

The findings will be divided in two subgroups. The first one will focus on deverbals (a). The second one will concentrate on denominals (b).

4.5.1a Group Global Production – Deverbals

AD patients produced all target suffixes. In addition, they also selected additional suffixes introduced through the distractor 1 and 2.

Table 4.5.1a – Deverbal Suffixes, Group Global Production

Deverbal Suffixes													
-aggio	*-aio*	*-ario*	*-ino*	*-mento*	*-ore*	*-tore*	*-torio*	*-tura*	*-ture*	*-zione*	*NR*	*X*	*0*
1	7	1	16	21	1	19	18	22	1	18	35	3	9
0,6%	4,1%	0,6%	9,3%	12,3%	0,6%	11,1%	10,5%	12,9%	0,6%	10,5%	20,5%	1,7%	5,2%

Legend. 0 = Conversion.

Overall, the most employed suffix was "-tura", belonging to the action semantic class and used to form complex action names.

4.5.2a Group Correct Production – Deverbals

As for correct productions, AD patients applied all the proposed suffixes consistently. There is no extreme difference between their employment. Anyway, overall, action suffixes, i.e. "-mento", "-tura" and "-zione", resulted the most used. In general, our patients did not show any difficulty in forming complex nouns through derivation, as it is showed in Table 4.5.2a.

Table 4.5.2a – Deverbal Suffixes, Group Correct Production

Deverbal Suffixes					
-mento	*-tura*	*-zione*	*-ino*	*-tore*	*-torio*
18	17	17	16	15	17
62%	60,7%	58,6%	55,2%	53,6%	60,7%

4.5.3a Individual Level Production – Deverbal

What previously said for conversion in §4.4.3 applies also here. Since the picture was too heterogeneous, we could not identify one or more patterns. In addition, it would have been useless since the test items were not perfectly balanced between Sessions and Times.

4.5.4a Errors, Deverbals

Table 4.5.4a – Suffix Errors, Deverbals - Q5

OUTPUT	*Agent*	*Action*						*Beneficiary*	*Place*	*Instr.*	*X*	*Tot.*
INPUT	*-aio*	*-aggio*	*-mento*	*-ore**	*-tura*	*-ture*	*-zione*	*-ario*	*-torio*	*-tore*	*X*	
Action		1	3		4	1	1					10
-mento		1										1
-tura					1	1	1					3
-zione			3		3							6
Place	1							1	1		1	4
-torio	1							1	1		1	4
Instr.	6			1	1					4	1	13
-ino	4									4		8
-tore	2			1	1						1	5
Total	7	1	3	1	5	1	1	1	1	4	2	27

Note. The suffix "-ore" is restricted to a small number of common action names, normally denoting physical or psychological experiences: *amore*, *bollore*, *bruciore*, etc.

Looking at the errors produced in forming suffixed complex nouns, we noticed that, overall, AD patients created novel word-forms from legal combinations of meaningful parts of real words. Nonetheless, there are some exceptions, involving "aio" and "ario" suffixes, which normally attach to a nominal base.

4.5.1b Group Global Production – Denominals

As for DNVs, the overall picture appeared as presented in Table 4.5.1b.

Table 4.5.1b – Denominal Suffixes, Group Global Production

Denominal Suffixes						
-eggi-	*-ific-*	*-izz-*	*-iggi-*	*NR*	*X*	*0*
35	31	26	1	42	3	33
20,4%	18,1%	15,2%	0,6%	24,5%	1,7%	19,2%

AD patients employed all denominal suffixes almost in a consistent way. The suffix most produced was "-eggi-". Most surprisingly, the most productive suffix according to Grossmann (2004)[79], namely "-izz-", was the one they applied the less.

4.5.2b Group Correct Production – Denominals

Also computing correct answer only, "-eggi-" was the suffix applied to compose the major part of complex verbs. As for the remaining two suffixes, both performances were fairly under the chance level.

Table 4.5.2b – Denominal Suffixes, Group Correct Production

Denominal Suffixes		
-eggi-	-ific-	-izz-
31	19	19
54,5%	33,3%	33,3%

4.5.3b Individual Level Production – Denominals

Look at §4.5.3a.

[79] According to Grossmann (2004) the suffix "-izz-" is productively used, both in learned (also in technical/scientific) and non-learnt registers, to form transitive, intransitive as well as both transitive/intransitive, pronominal and non-pronominal verbs from all types of nominal bases. Verbs derived from the suffix "-izz-" accounts for the 40% of all denominals. Since, after the 50's, new-formations in "-izz-" corresponds to 73% of denominal verbs, the productivity of this suffix is considered the highest.

4.5.4b Errors, Denominals

Finally, focusing on errors, AD patients seemed to prefer the suffix "-ific-" to compose ill-formed words. We believe this is an unusual choice since this is a learned suffix normally used to form complex words belonging to the technical scientific domain.

Table 4.5.4b – Suffix Errors, Denominals - Q5

SUFFIXES	*-eggi-*	*-ific-*	*-iggi-*	*-izz-*	*X*	*Total*
-eggi		5	1	2		8
-ific	3	2		2	3	10
-izz	1	5		3		9
Total	4	12	1	7	3	27

Nonetheless, AD patients always formed novel word-forms resulting from legal combinations of meaningful parts of attested words. In a minority of cases, they also created neologisms. Moreover, the erroneous selection of a verb-forming suffix resulted to be the second choice, since ill-formed complex verbs were preferably produced applying conversion.

To conclude, the global picture resulting from our investigation is presented below:

Q1 – AD patients experienced fewer difficulties in producing correct complex words applying the transcategorial mechanism of conversion. On the contrary, the competing operation of derivation was widely applied to create ill-formed and semantically more transparent novel words.

Q2 – AD patients showed a more consistent pattern when forming a correct complex word from a verbal base.

Q3 – Findings disclosed the following patterns:

a. AD patients formed DNVs through conversion more consistently:

NOUN ⟶ conversion ⟶ COMPLEX VERB;

b. AD patients experienced fewer difficulties in deriving complex DVNs:

VERB ⟶ suffixation ⟶ COMPLEX NOUN.

Q4 – AD patients, in producing complex nouns from verbs, sporadically adopted a regularization strategy. This pattern was found also when deriving complex nouns through suffixation, again unsteadily.

Q5 – AD patients produced 105/537 ill-formed complex words through suffixation. Nonetheless, we considered both denominals and deverbals as novel word-forms resulting from legal combinations of meaningful (sometimes meaningless, i.e. neologisms) parts of (non)attested words. We can conclude that WFRs employed to perform the task are well preserved. Overall, the MMSE score seems to be not useful in predict the linguistic pattern adopted by AD patients since neither for the morphological mechanisms of word-formation or the lexical base on which they apply the transcategorial operation, it shed light on the adopted patterns.

4.6 Our Predictions

4.6.1 Question 1, Prediction

As for the first research question on transcategorial morphological processes of word-formation, we claimed that the adoption either of conversion or suffixation could depend on the inner principle guiding AD patients' production (§3.4.2). Following Dressler's Natural Morphology principles of transparency and iconicity, we hypothesized that, if AD patients rely more on these natural parameters, they should produce more complex words applying the transcategorial mechanism of suffixation, thus respecting the naturalness scale introduced by the author. On the contrary, if AD patients rely more on Clark's acquisitional principles of simplicity and economy, we claimed that they should prefer the morphological mechanism of conversion. The results of the analysis revealed that, overall, in producing correct outcomes, they applied more consistently the transcategorial mechanism of conversion, supporting Clark's perspective. On the other hand, looking at errors, we noticed that in creating ill-formed novel words they preferred the competing mechanism of derivation, relying on the principles of naturalness supported by Dressler. Overall, the victory of conversion over derivation can be justified from different points of view. First of all, AD patients adopted conversion because of its

"simplicity". This property applies at the formal level, since it implies no addition of supplementary morphological material, but it is also directly connected to the cognitive load. Indeed, one of the key assumptions of Natural Morphology (Dressler, 2005; Gaeta 2002) is that formal complexity of word forms has consequences on the cognitive level of linguistic processing. Moreover, conversion is a process morphotactically more transparent than derivation, since normally the lexical base does not undergo relevant modifications. On the other hand, ill-formed outcomes are mostly created through suffixation. We claim that the reason behind the adoption of this morphological process instead of conversion can be ascribed to the other competing processes. In composing online complex words, AD patients are guided by the principles of transparency and iconicity. Indeed, the result of the process applied by AD patients is a more transparent outcome presenting a compositional meaning (i.e. meaning of the base + meaning of the suffix). Remarkable is the fact that some ill-formed productions were formed also through conversion, even though a minority. We take as premise the assumption that a novel word cannot be retrieved from the lexical storage, since it is not present. As a consequence, it can only be formed through an online process. All the resulting ill-formed outcomes produced by AD patients respect all requirements to be fully considered correct from a formal point of view, but also the semantic play a key role. To justify these converted outcomes, we propose two possible explanations, which might be equipollents. From the one hand, also conversion might rely on WFRs, similar to the ones postulated for derivation. From the other hand, analogy might be the effective process underlying these productions, which in any case does not necessarily exclude that conversion could rely on WFRs. If the novel words are really formed relying on the process of analogy, these new items should present a morpho-phonological form similar to already existing words. This is exactly the case. Since the semantics of the name-deriving affixes is not identical to that of conversion, we expect that some processes are not eligible (or penalized) if a certain meaning is to be conveyed by the name. Data is reported in Table 4.6.1.

Table 4.6.1 – Converted Ill-formed outcomes

INPUT	Semantic Value	Sentence Context	Output Conversion
Cambiamento	Eventive/Result	I miei nonni hanno subito un gran ____ negli anni	Cambia/Cambio
Nutrimento	Eventive/Result	Ho visto la mamma che da al bimbo il ___ per crescere	Nutrito
Spostamento	Eventive/Result	Ho saputo che c'è stato uno ___ dei turni di lavoro	Sposto
Rottura	Eventive/Result	Giocando due bambini causano la ___ della fune	/
Bruciatura	Eventive/Result	Mi sono preso una bella ___ toccando il fornello caldo	/
Scrittura	Eventive/Result	La mia nuova vicina di banco usa una gran bella ____	Scriva
Lavorazione	Eventive/Result	Il papà mi ha mostrato le fasi di ___ di un vaso	/
Adorazione	Eventive	Ho scoperto che le suore stanno in ___ per molte ore	/
Costruzione	Eventive/result	Ho visto i miei cugini giocare con una nuova ___	Costruita
Laboratorio	Place	Mi hanno detto che lo zio ha aperto un nuovo ___	/
Ambulatorio	Place	Il dottor Rossi ha aperto un nuovo ___ in città	/
Conservatorio	Place	Da bambino ho studiato musica classica al ___	/
Temperino	Instrument	Per fare la punta alla matita uso il ___ nuovo.	Temperante
Misurino	Instrument	Ho visto che il cuoco usa un ___ per preparare i dolci	/
Colino	Instrument	Mia mamma per passare il minestrone usa sempre il ___	/
Bollitore	Instrument	Mia mamma in cucina per scaldare l'acqua usa il ___	/
Distributore	Instrument	Ho sentito dire che all'entrata c'è un nuovo grande ___	/
Condizionatore	Instrument	Per la calda estate che ci attende ho comprato un ___	/

As the table clearly shows, the erroneous items produced applying conversion are the ones which meaning can be directly conveyed through conversion. On the contrary, the other complex nouns were derived since a dedicated suffix was available to create a more transparent form. To conclude, we can state that conversion is the overall winning process. The other option is restored in case the resulting outcomes presents a semantic

congruence in association with a more morphosemantic transparency, given by the suffix. It is true that among the range of suffixes there is an oscillation, but it is always semantically driven. So, in AD patients, semantics is (almost) completely intact and is one of the "inner motors" guiding word-formation, alongside with the other principles previously discussed. We report again that the only exception, discussed in §3.4.3.6, 3 – PLACE, is the suffix "-aio". It was combined with a verbal base in a sentence context requiring the formation of a *nomina instrumenti*, not a *nomina agentis* as expected by the core semantics of the suffix in question. Ill-formed outcomes prove that (i) WFRs are intact, respected and also productive; (ii) there is a correct mapping between morphology and semantics; (iii) since these words cannot be stored in the mental lexicon, AD patients produced them online. We could even go as far as to say that, since the correct interpretation of the complex word in given by the sentence context, they are not only semantically but also pragmatically felicitous.

4.6.2 Question 2, Prediction

We widely discussed about the well-known V-N dichotomy in chapter three, concluding that, even though many studies have investigated the matter, no satisfactory explanation has been provided yet. Different theories have been proposed, focusing on either the semantic or syntactic differences between these categories: none of them however fully captures the empirical realm. So, the origin of these disturbs is still not completely clear. In other words, what has not been understood so far is whether they originate from the way in which the grammatical classes are organized (according to semantics, syntactic, or grammatical principles) in the brain or they derive from the selective damage of the neural representation of actions vs. objects. So, we predicted that patients should show a more severe impairment in forming complex nouns or complex verbs according to the nature of the underlying trouble. This should be linked to the cerebral region more affected by the neuron degeneration, as found in aphasia. Globally, we found that AD patients produced more deverbal nominals in all patterns investigated (Global All, Global C and Individual Patterns). Complex words formed from a verbal base are considered

"hybrids", since they are non-prototypical nouns presenting verbal features, among them the argument structure. We could claim that, in forming complex items, AD patients experienced fewer difficulties in converting or deriving complex nouns since the argument structure and all verbal properties showed by these items are directly inherited from the verbal base. On the contrary, in forming complex verbs from nouns, the argument structure needs to be created *ex novo*, a process requiring a major cognitive work. Basically, the problem cannot concern the morpho-syntax interface, but it involves the processing system, otherwise AD patient would have not produced any deverbal noun. Nonetheless, some AD patients among the group showed less difficulties in forming complex verbs or showed no difference at all. Since also the MMSE score could not shed light on this tripartite pattern: the type of deficit could be patient specific. Moreover, the data we gathered are not sufficient to take a clear position on this burning issue.

4.6.3 Question 3, Prediction

Concerning our third research question on the interaction between different grammatical classes (i.e. Ns vs Vs) and distinct transcategorial morphological operations of complex word-formation (i.e. Conversion vs Derivation), we could not make a real prediction. Indeed, in the current literature there are no studies investigating this issue. What emerged from our investigation is that AD patients generated the two following patterns:
a. NOUN ⟶ conversion ⟶ COMPLEX VERB;

b. VERB ⟶ suffixation ⟶ COMPLEX NOUN.

Most surprisingly, a. and b. were followed not only in producing correct answers, but also in creating ill-formed words. So, regardless of the outcome, AD patients performed exactly the same two patterns, converting complex verbs and deriving complex nouns. Starting from the first one, complex verbs were formed for the majority through conversion since, from a morphotactic point of view, the outcome is extremely transparent. The only suffix added to the nominal base is indeed inflectional, in order to make the new verb enter one of the conjugations of the Italian verbal system. Moreover, the inflectional suffix attaches directly to the nominal base (i.e. *puzza* > *puzzare*) or the

base undergo a slight modification (i.e. deletion: *regal(o)* > *regalare*). The competing mechanism of word-formation might not have been applied for two reasons: (i) a problem in morpheme stacking, since in deriving a verb two different affixes need to be added to a nominal base (i.e. the derivational infix and the flexional suffix); (ii) verb-deriving affixes are more opaque than nominal ones, since the same verbal suffix convey a multiplicity of possible meanings[80]. So, not only does it seem that converted verbs are morphotactically more transparent, but also morphosemantically. As for the second pattern, in deriving a complex noun from a verbal stem there might be some more difficulties. From the morphotactic point of view, the selection of the verbal stem is sometime controversial, as seen in chapter 2. Nonetheless, also in applying conversion the selection of the verbal base is complex, since many different stems are eligible for being converted in nouns (i.e. present stem, participle stem, athematic stem). On the contrary, we believe that selecting a certain suffix, conveying a specific meaning, results in a compositionally more transparent procedure and, consequently, it is easier to process. It is true that the range of noun-deriving suffixes is wider than the verb-deriving suffixes, but their core semantics is definitely more transparent and, in some cases, rather circumscribed (i.e. "ino" suffix). So, the problem is not with conversion per se, since it is employed to form complex verbs from nominal bases (and sporadically complex nouns). Again, the process selected depends on the competition between the "inner forces" already mentioned. In this case, the winners are the principle of morphosemantic transparency and of iconicity.

4.6.4 Question 4, Prediction

Our fourth research questions aimed to deeply investigate the conversion mechanism of word-formation, more precisely the stems used as base of the process of transcategorization. We based our prediction on psycholinguistics storage and processing models of complex word-forms. A dual-route mechanism model implies that words are

[80] The application of semantically less transparent WFRs is more severely disturbed in aphasia (Dressler, 1987).

accessed either from the mental lexicon, as whole-units, or as decomposed smaller units, that is in terms of their component morphemes. More specifically, Ullman et al. (1997) proposed dual-route model for past tense processing, in which the lexicon is used to access irregular forms and the other way, the rule system, produce regular inflected forms. In their study investigating AD patients, they reported a case of better performance in inflecting English regular verbs than irregular forms. According to the authors, this result was viewed as a proof that rule-based lexical knowledge was intact, while rote-learned morphological knowledge was impaired. On the basis of these findings, we supposed that AD patients, if presenting difficulties in accessing the lexicon to retrieve whole forms, including the irregular ones, should privileged the other way and so assemble the complex word online, picking up regular forms. Our findings have shown that patients produced just a couple of errors as regards the verbal stem. Some of them present a regularization (i.e. *battante* < *battente*), some others were produced picking up a competing verbal stem (i.e. *pulso* < *pulsante*). The major parts of ill-formed productions were indeed composed through suffixation. When the correct item corresponded to the athematic stem, AD patients in many cases produced an ill-formed word picking up the regular base and adding a suffix to it (i.e. *spingi* + *tura, stringi + tura*). Our results seem thus to support a dual-route processing of word-formation. As previously said, a model of this type assumes two different ways of word processing and retrieval. The first one is the retrieval of a stored word in its whole form from the mental lexicon. On the contrary, adopting the second route, complex words are built up online merging together their components morphemes, namely lexical bases and transpositional suffixes. Since irregular forms are believed to be only listed as whole units in the lexicon, the selection of the regular form of the verbal base to create the complex item is an indicator that the DVN has been composed online, opting for the "combinatory" way. So, our findings are consistent with Ullman et al.'s proposal.

4.6.5 Question 5, Prediction

As far as the last research question is concerned, our foci were the derivational affixes used to create complex nouns and verbs. We predict that if AD people experienced difficulties in accessing the lexicon to retrieve whole forms, and WFRs are really stored together with their component elements (i.e. N/V bases; affixes), in choosing the "compositional" way they should have created only complex words respecting the form and semantics expressed by the WFRs. So, AD patients should have produced unattested but possible Italian-like words. This is exactly what we found. AD patients produced 63,1% of ill-formed outcomes applying the transcategorial process of suffixation and respecting WFRs. We can argue then that knowledge of lexical rules (WFRs) is represented in a separate lexicon from knowledge of vocabulary (whole units). To conclude, AD patients have an intact procedure for composing polymorphemic words online. Possibly, this procedure is employed only when retrieving a whole word fails.

4.7 Comparison with literature and previous studies

4.7.1 Mechanisms of Word-formation: Suffixation vs Conversion

Word-formation is a linguistic domain which has been densely investigated. Many different frameworks have tried and are still trying to explain the mechanisms underlying the different processes involved in the growth of the lexicon. Studies are numerous and embrace different fields of research, from typological and theoretical linguistics to language acquisition and language pathologies. We have already discussed word-formation in language acquisition (§3.4.2), introducing Clark's study (1993, 1995, 1998) on novel forms derived by children (with or without suffix) and the guiding principles (i.e. simplicity, transparency, frequency, productivity, etc.) she postulated for the acquisition of morphology. We also presented Dressler's Natural Morphology theory (§3.4.2). The competition between the word-formation processes is an issue still debated. Indeed, languages differently privileged conversion over suffixation and *vice versa*. As claimed by Dressler (1987, p. 105) *"[…] a first prediction concerns the cross-linguistic distribution of WF techniques. WFRs of the type I. 1) (affixation) should be more frequent than I. 2)*

(conversion) in the languages of the world […]". We have already said in chapter two (§ 2.3.2), that conversion concerns the emergence of a grammatical form, with no suffixes expressed. Following Dressler's naturalness scale, which allow some predictions both on language use and acquisition, conversion should be considered a totally uniconic process. Indeed, the operation of converting a noun into a verb, or *vice versa*, is not reflected by any formal modification. As a consequence, conversion should not be favored among word-formation rules (Giacalone Ramat, 1995). This situation seems to be the case for many languages all over the world. Nonetheless, we know that languages behave differently, such as English where conversion is a rather wide-spread process (Plag, 2003). Nonetheless, competition in morphology is a relatively rare topic. Two of the major works on this issue are Kjellmer (1984) and (2001), which investigated constraints on adverb and verb formation respectively. Plag (1999) conducted a similar study on verb formation. Kaunisto (2007) investigated the competition between "-ic" and "-ical" suffixes in adjective formation. Finally, Bauer, Valera and Díaz-Negrillo (2010) focused on the competition between conversion and "-en" affixation for the formation of verbs. The overmentioned studies came all to the same conclusion that *competition is a highly complex issue where an interplay of factors, phonological, structural, semantic and etymological, provide an obscure factors where it cannot always be said which of such factors prevails and decides whether derivation by a given process is possible or not, and even less on which grounds is one or the other specific affix is selected*[81]. Quoting Bauer (2009, p. 177). *"[…] we can see two types of change: individual words which instance various word-formation patterns come and go, and various processes (specific patterns of affixation, compounding or conversion) come and go"*. As far as we know, there are no several studies precisely investigating this competition between word-formation mechanisms in pathological populations. Indeed, the majority of studies focused on inflectional morphology, also in AD population (Ullman, 1997). Other researchers investigated compounding and derivation in Wernicke's and Broca's aphasics (Dressler

[81] Dadgostar, S. 2015. *Competition in derivational morphology: suffixal verbs*. MA Thesis, Universidad de Granada, p. 12.

and Denes, 1988). Overall, studies on aphasic patients provided clear evidences on how the language system represent and process polymorphemic complex words. Their error patterns were considered the final evidence supporting Halle's claim that the knowledge of the component parts of words and WFRs used to combine them are stored in the brain separately from knowledge of words themselves. Interestingly, the error patterns we found investigating our AD patients perfectly match the ones found in aphasic populations by Dressler, Denes et al., supporting once more Halle's theory. Furthermore, evidence for online decomposition of complex words has been provided, alongside with the fact that stem and affixes may be affected independently. All these findings support dual route hypotheses of complex words processing (Semenza and Mondini, 2015). In our work we have used the same principles found in language acquisition to explain a pathological language, namely production patterns adopted by AD patients, the focus of our research. We are far from explaining why conversion should be preferred with respect to suffixation or the opposite patterns. However, our findings are comparable to results of Semenza (1989), which will be presented in §4.7.5.

4.7.2 Lexical Bases and the Mental Lexicon

The organization of lexical knowledge within our mind is still a debated problem. Within our study we could not shed light on this topic since our data did not provided us with any clue to untangle this complex knot. Indeed, many studies are still investigating whether or not the grammatical properties/nature of distinct word classes play a role in lexical organization. The major part of these studies has primarily focused on the dissociation between nouns (Ns) and verbs (Vs). In studying this dichotomy some issues were taken into account. (I) Almost all languages include, among their words types, a category corresponding to the overmentioned syntactic items, at least roughly (Laudanna and Voghera, 2002). Nonetheless, inquiries on non-Indo-European languages disclosed that nouns and verbs are not always separate objects (Sasse, 2001). (II) If we assume Ns and Vs as theoretical categories, their distinction needs to be further specified. *According to different theoretical positions (Bybee 2000), lexical, semantic, syntactic, morphological*

and pragmatic factors may act differently in shaping the noun/verb distinction[82]*.* (III) Looking at available evidence from different linguistics domains this N-V distinction emerges as a multi-factorial issue. Consequently, it cannot be reduced to a single dimension of language processing or language description. Moreover, researchers have demonstrated that this (double)dissociation can show up in different modalities (oral/written), tasks (oral production, reading, writing, picture naming, and so on), in production and/or comprehension. Furthermore, *it is likely to be modulated according to the specific intersection of modalities, tasks and behaviors we consider*[83]. The resulting dissociation hypothesis, enhanced by empirical evidences (i.e. pathological populations), claims that Ns and Vs are different grammatical classes, autonomously represented in the lexicon. In cognitive linguistics, several experiments have focused on this distinction, inspecting how these two classes are processed and represented. Many studies provided consistent support for the noun/verb dissociation (Burani and Colombo, 2002). A recent study (Traficante et al. 2014) investigated whether noun and verb bases affect children's reading of complex words in a different way. They tested Italian children of 4th and 5th grades, both good and poor readers. Their task was to read aloud nouns derived from either a noun base or a verb base. They found that *(i) word and base frequency affected latencies only for deverbal nouns. (ii) An effect of word length emerged for denominal nouns. Moreover (iii) an inhibitory effect of suffix length was found for both types of stimuli. (iv) Verb bases led to higher error rates than noun bases*[84]*.* Poor readers showed a pattern similar to the one of normal readers, even though they were slower and less accurate in completing the task. Data confirmed that in young readers morphological decomposition might affect reading aloud of complex words. The most interesting part of the results was the finding that, according to the researchers, the grammatical class of the base can modulate this effect. As for neuropsychology, other research has focused

[82] Laudanna, A. and Voghera, M. 2002. *Nouns and verbs as grammatical classes in the lexicon*. Italian Journal of Linguistics, 141: p. 10

[83] Ibidem.

[84] Traficante et al. 2014. *Influence of verb and noun bases on reading aloud derived nouns: evidence from children with good and poor reading skills.* Reading and Writing, Springer, 27: pp. 1303-1326.

mainly on production (Rapp and Caramazza, 1997). First of all, evident dissociations have been shown in the retrieval process of nouns and verbs in agrammatic patients, with an impairment in verb retrieval as compared to noun retrieval (McCarthy and Warrington 1985; Miceli et al. 1988, *inter alia*). In this pathological population, *deficits on verbs have been connected to a damage to the syntactic processing device*[85]. Indeed, Vs are more closely related to sentence processing in speech production, since their argument structure plays a key role in the composition of sentences, helping to position lexical items into their slots within the syntactic frame (Laudana and Voghera, 2002). As a consequence, a dysfunction/disconnection between syntactic processing and the lexicon would affect verbs, sparing nouns. Nevertheless, clinical and experimental observations also shown the opposite pattern, in both comprehension and production, namely a selective deficit in noun processing (Daniele et al., 1994; Zingeser and Berndt, 1990). The nature of this distinction, however, is not well understood yet. Some studies have suggested that this dissociation might reflect differences in the neural representation of objects and actions (Damasio and Tranel, 1993; McCarthy and Warrington, 1985; Pulvermuller, 1999). Their proposal claims that the brain distinguishes between nouns and verbs on the basis of semantics (i.e. meaning), not according to the grammatical category. Another position holds that the brain also represents information about a word's syntactic function, and that this is the information that might undergo a selective impairment (Caramazza and Hillis, 1991; Miceli et al., 1984; Shapiro et al., 2000). This controversy on meaning impairment VS grammatical function impairment (or both) remains unclear. As far as neural localization of the lesions concerns, scholars found evidence for relevant dissociations. Recently, on the basis of neuroimaging studies, two specific hypotheses have been advanced, as reported by Laudana and Voghera (2002): a) two distinct neural circuits subserve nominal and verbal morphosyntax: (I) the first left fronto-temporal circuit would be associated with the processing of nouns; (II) the second left fronto-parietal circuit would be associated with the processing of verbs; b) the left prefrontal area is involved in processing words as grammatical objects (for instance, in

[85] Ibidem

carrying out morphological manipulations on verbs), independent of their semantic content (Caramazza and Shapiro, 2001). Evidence in favor of the functional distinction between nouns and verbs comes also from experimental studies on normal adults. One example comes from investigation in the English language domain. Researchers found that nouns are processed better and faster than verbs in comprehension tasks (Spenney and Haynes 1989). Thus, the processing disadvantage of Vs, with respect to Ns, has to be attributed to different semantic and syntactic properties: (a) looking at acquisition domain, verbs are generally acquired later (Guasti, 2002; Garaffa, Guasti et al., 2018), (b) are less imageable (Chiarello, Shears and Lund, 1999) and (c) have a more complex syntactic structure than nouns (Kim and Thompson, 2000). Moreover, *also the inflectional characteristics of verbs may contribute to their processing peculiarities*[86]. Despite the rich investigation on this topic, the interpretation of this dissociation is far from being completely understood, since several sources of information, processing components and distributional/formal factors (i.e. AoA, familiarity, etc.) could be responsible for the differences found. Considering our results, if correct complex words were retrieved directly form the mental lexicon as whole units, we could claim that our patients experienced less difficulties in retrieving complex nouns, since as reported also in §4.4.2 of this chapter, they showed a greater production of DVNs. This is true only if we take as base assumption a theory where items are stored in the mental lexicon according to their grammatical (or syntactic) category. On the contrary, if we consider a theory were items are stored as underspecified categories (such as in DM), our investigation cannot give any clue on how the mental lexicon is organized. Moreover, both DVNs and DNVs show similar properties, such as lexical aspect, argument structure, etc. and are considered as hybrid categories. As a consequence, neither from a formal and semantic point of view our experiment can help in understanding how complex words are organized within our mind.

[86] Ivi, p. 1307.

4.7.3 Word-formation operation and verbal/nominal bases in interaction

On the basis of Dressler's *Leitmotifs in Natural Morphology* (1987), in which he presents his theory of morphological naturalness, and the consequent predictions of his principles on different languages, we can drown only one conclusion. Languages are extremely heterogeneous. They behave in different ways, they change over time, they apply different mechanisms to enrich their lexicon and they respect different rules. It is thus far from our knowledge to explain why nouns/verbs should be more frequently converted or derived (we did not consider all other mechanism of word-formation) in complex verbs/nouns respectively in AD populations. Nevertheless, we report an interesting study. Pavesi's investigation (1994) on the acquisition of conversion by Italian learners of English revealed the existence of selective patterns, presenting the preference of conversions with respect to more transparent derivations. She pointed out that *nouns are more likely than verbs to be formed by means of conversion and among verbs de-adjectival verbs are preferred to denominal ones*[87]. Pavesi accounted for these data on the basis of a semantic parameter she called "semantic proximity": *the less the semantic modification between the base and the derivative is, the more likely the conversion is*[88]. To justify her claim, she proposed the case of *nomina actionis*. These complex words are very close to their base verb from a semantic point of view but, at the same time, are clearly distinct in relation to their syntactic position and other dependency relations. According to Pavesi *it can be maintained that an iconic relation holds between the minimal semantic differentiation and the lack of morphological cues*[89]. This was also confirmed by her data on conversion for locative and agentive nouns, which was completely avoided by second language learners. Indeed, she asserted that in overmentioned cases the semantic modification of the derived form is more relevant than for action nouns. Pavesi proposed also another parameter, connected to the notion of prototypicality of nouns and verbs (Hopper and Thompson, 1985). The transcategorial mechanism of conversion is preferred when the

[87] Giacalone Ramat, A. 1995. *Iconicity in Grammaticalization Processes*. Iconicity in Language. John Benjamins Publishing Company, p. 125
[88] Ibidem.
[89] Ibidem.

lexical bases and the forms derived from them are not prototypical members of their categories. As a consequence, verbs should not be derived from nouns of concrete objects by means of conversion. We point out that in Italian we found several cases of verbs directly converted from nouns of concrete objects, i.e. *pettinare* < *pettine*, *pugnalare* < *pugnale*, *remo* < *remare*. Furthermore, our AD patients produced many novel verbs converting a nominal base, such as *vaporare* < *vapore*, *ramare* < *ramo*, *nidare* < *nido*. So, the parameter proposed by Pavesi could better work for a language such as English, the one she investigated. As for Italian, the pattern might be different. Indeed, also Rainer (2016) pointed out that more than a half of all derived verbs in Italian are produced through conversion, mostly of nominal bases. The pattern showed by our AD patients results thus to be not surprising at all, since they showed fewer difficulties in forming DNVs applying the transcategorial mechanism of conversion. So, the selection of the word-formation process adopted by our AD patients might have been guided not only by the simplicity of form principle, but also by the principle of frequency (in this case we refer to tokens, since the number of complex verbs created through the conversion of a nominal base seems rather high in Italian).

4.7.4 Conversion and Stems

To the best of our knowledge there are no specific studies investigating conversion and, more precisely, the competition between Italian verbal stems in pathological populations. This is probably due to the fact that, overall, there are no many studies concerning Italian derivational morphology. Nonetheless, it is worth reporting some findings from language acquisition domain. In both first and second language acquisition, many researchers have pointed out that speakers use regularization strategies during the acquisition of morphology. Concerning SLA (Bernini and Giacalone Ramat, 1990), the adoption of a regularizing strategy was found when investigating learners of Italian. As reported by the authors, they found that second language learners of Italian tended to avoid variation in verb stem. Indeed, they regularized past participles producing more transparent forms like *chiedata* < *chiedere* instead of *chiesta* (Giacalone Ramat, 1995). While the adoption of a regularization strategy in SLA is probably due to lack of knowledge, in our AD

population it might be due to lexical retrieving difficulties. As previously said, adopting a dual-route model of complex word processing and retrieval, irregular forms are believed to be listed as a whole in the mental lexicon. As a consequence, they are retrieved as whole units and never composed online. If the retrieval of a stored word fails, due to difficulties in processing, in accessing the mental lexicon or to the absence of the item itself, AD patients should most probably produce the required complex item selecting the other available way. When composing an online form, this follow a "regular" pattern, predisposed by a WFR. So, the regularization pattern observed in our experiment can be considered as evidence that complex words are formed online and not retrieved as whole units, since the novel form cannot be stored in the mental lexicon. The regularized item is an evidence of the strategy adopted by our AD patients and, at the same time, it can also be considered as way to reduce the cognitive load.

4.7.5 Derivation and Suffixes

Nowadays there are not many studies investigating derivational morphology in AD or other pathological populations. Indeed, in the last years, neuroscientific research has mainly focused on inflectional morphology (Ullman et al., 1997; Ullman, 2001) as well as language acquisition and psycholinguistics. So, data on word-formation are limited. Nonetheless, Semenza et al. (1989) described three aphasic patients whose speech contained novel word-forms (i.e. unattested). These were the result of legal combinations of meaningful parts of real words, for example *fratell*+*ismo* (*brother* + *ness*) produced instead of *fratell*+*anza* (*brother* + *hood*). Patients also produced combinations of meaningless and meaningful parts, like *terness*+*ice*, where "ice" is a real Italian suffix (unproductive, i.e. *forbice*, adapted from Latin) and *terness* is a neologism. Before the study, these phenomena were unreported. To justify their findings, they claimed that the novel outcomes produced by aphasic speakers could have been formed only if a procedure for composing polymorphemic words online was available. Moreover, this procedure had been applied only in case of failure in finding a whole word. So, these individuals retained control of word-forming derivational rules, despite the fact that they

experienced a severe difficulty in word retrieving. Another group of studies (Marangolo et al., 2003, Marangolo and Piras 2008, 2010) presented two cases of right hemisphere damage, presenting no aphasia syndrome. Patients showed a selective problem with derivation (corroborating the validity of the independence of inflection and derivation). These patients had difficulties in producing a derived noun but not a derived verb in the infinitive form in a picture naming task involving actions. Furthermore, they presented *difficulties in producing noun derived from verbs, but not the infinitive form of verbs from nouns*[90]. Interesting data also comes from SLA. Berretta (1995) investigated the form of morphemes preferred by second language learners of Italian. She looked at the choice that they made among various allomorphs and how they used different morphs. First of all, she analyzed novel words produced by non-beginner speakers. In these productions, irregular Italian forms were regularized in the stem as well as in the inflectional or derivational morpheme, substituted through the basic allomorph. As for verbal morphology, she presented some past participles constructed picking up the regular stem of the present but with an evident preference for the allomorph "-ato" (i.e. *distrugge-re* > *distruggi-ato)*. She highlighted that in the novel forms created by learners the regularity of the stem and of the suffix selected makes clearer the borders between the two elements. Morphotactic and semantic transparency was found also in derivate forms (Dressier 1981, 1987). Studies (Bozzone Costa 1986, 1988; Berretta 1986, 1987, 1988), on the development of Italian word-formation rules in second language learning provided some interesting examples: (i) *riciclare* > *riciclamenti* (*riciclaggi*); (ii) *incrinare* > *incrinazioni* (*incrinature*); (iii) *testardo* > *testardezza* (*testardaggine*); (iv) *guarire* > *guaritamento* (*guarigione*); (v) *incastrare* > *incastramento* (incastro), etc. Thanks to this spontaneous or elicited production, the abovementioned studies have drown the following conclusions. Generally, the most frequent morphemes are overused, limiting

[90] Semenza, C. and Mondini, S. 2015. *Word-formation in aphasia*. Word-Formation. An international Handbook of the Languages of Europe. Volume 3, p. 2165.

the adoption of less frequent ones (i.e. (i) suffixes -mento and -zione). Productions are guided by formal and semantic transparency, obtained with additive morphemes (i.e. (iv) *guarita-mento 'guarigione'*). Finally, conversion is often avoided, despite its greater formal simplicity[91] (i.e. (v) *incastra-mento* for *incastro*). Nonetheless, Berretta (1995) highlighted the fact that the adoption of conversion differed according to the derivative categories. Indeed, she pointed out that it is pretty high for deadjectival and denominal abstract nouns (i.e. *acido* > *acidare* for *inacidire*), lower in deverbal abstract nouns (i.e. *chiudere* > *chiuso* for *chiusura*) and even lower for nomina agentis (i.e. *ambulare* > *ambula* for *ambulante*). The different distributions observed, not only by Berretta but also in other studies, are probably due to *the transparency that the derivate verb possesses from its own morphology, from its own infinitive morpheme (compare acido with acidare)*[92] and even more to the major need for semantic transparency in nominalization. To conclude, our findings are consistent with Semenza et al. (1989), since also our AD patients produced legal combination of meaningful (sometimes also meaningless) parts of real words, such as *brucia+zione* (meaningful base + meaningful nominal suffix) or *baland+izz+are* (meaningless base + meaningful verbal suffix). Nonetheless, while according to Semenza et al., their aphasic subjects retained control of word-forming derivational rules, we cannot claim the same. Indeed, even though almost every novel complex form was composed respecting Italian WFRs some exceptions were present. Some AD patients produced also agrammatical forms, selecting as transcategorial suffix a morpheme generally used to create agent nouns from nominal bases. Indeed, they produced novel words such as *condizion+aio* or *col+aio*. On the other hand, in line with data from SLA, our AD patients also avoided the conversion mechanism of word formation in producing DVNs, forming novel items such as *ricerca+tura* for *ricercare* or

[91] This is a case of conflict between formal simplicity and semantic simplicity, exactly like the ones found in our study.

[92] Berretta, M. 1995. *Morphological Markedness in L2 Acquisition*. Iconicity in Language, John Benjamins Publishing Company, p. 220

sosta+tura for *sosta*. Finally, they also preferred conversion when forming DNVs, producing novel words such as *vaporare* for *vaporizzare* or *nidare* for *nidificare*.

CONCLUSION

The purpose of our experimental study was to investigate a pathological population, presenting as diagnosis (probable) Alzheimer's Disease[93]. Previous studied with a linguistic import have demonstrated that this population shows difficulties in naming (lexical retrieval), as well as semantic difficulties (meaning of words/encyclopedic knowledge). Indeed, AD patients are generally described as presenting anomias, paraphasias, etc. Only in the last decades also other linguistic domains have been investigated in this population, to wholly understand the language regression detectable in this neurodegenerative pathology. This study perfectly enters this line of research. Indeed, our primary aim was to determine whether other linguistic functions (i.e. the morphosyntax and semantics interface) were also impaired at some point of the AD cognitive deterioration. More precisely, our investigation aimed to better understand how AD patients deal with morphologically complex words and, consequently, on the basis of the gathered data, try to understand how these complex items are represented and processed in the mind. We tested the competence on complex words processing of 20 AD patients. They have been administrated with a multiple-choice filling-the-gap task, which was picture-supported. In brief, they were presented with a sentence including a missing word and were required to choose an item to fill the gap among three different possible candidates: the target item and two distractors. All of the three candidates were complex words, real or artificially built up merging together meaningful bound and free morphemes. We only focused on two of the major word-formation processes available in languages, namely conversion and suffixation. Moreover, complex items were formed from both nominal and verbal bases, giving rise to deverbal nominals, i.e. DVNs, and denominal verbs, i.e. DNVs. As previously discussed, in psycholinguistic literature two different models of morphological complex words storage and processing have been

[93] We also accepted other single cases of Mixed degenerative/vascular Dementia (MDVD), Senile Dementia (SD) and Degenerative Dementia (DD).

proposed (i.e. the full listing hypothesis VS the fully decompositional account). An attempt to conciliate these two contrasting approaches was advanced by Ullman et al. (1997). They developed a dual-route model for past tense processing in which the components employed to produce inflected verbs are two. The first one is the lexicon, used for access irregular inflected forms. The second one is the rule system, used for computing regular inflected verbs. As for derivational morphology, many scholars also support a dual-route model of lexical access and process of complex words. According to this model, suffixed items are accessed either as whole units or in terms of their component elements (base + bound morpheme) and so, they are formed on-line. In normal neurological conditions to claim whether a complex word is retrieved from the mental lexicon or it is formed through an online process, respecting and following some WFRs, is not possible because the correct functioning of the system generally does not reveal any clear clue about its organization and its working. On the contrary, pathological populations offer the perfect scenario to test this possible distinction. Indeed, language pathologies such as aphasia and in our case, AD give the opportunity to study the organization of language system in the brain and its functioning, since they generally present different patterns of language impairment and errors. Finally, we also checked whether the cognitive impairment, measured through the Mini Mental State Examination (MMSE), was somehow mirrored by the language deficit. On the basis of the semantic (i.e. the core semantics of the suffixes employed in the derivational process), syntactic (i.e. the syntactic category of the lexical base) and morphological (i.e. the type of morphological processes involved in the complex word-formation) variables we considered in assembling the experimental study, we formulated the following research questions:

Q1. Considering the transcategorial morphological operations involved in the experimental study, namely conversion and derivation, how do AD patients deal with these mechanisms?

Analyzing our data, we found out that AD patients experienced few difficulties in producing correct complex words applying the transcategorial mechanism of conversion. On the contrary, the competing operation of derivation was more limitedly employed to

produce correct outcomes. Nonetheless, suffixation was widely applied to create ill-formed but semantically more transparent and iconic novel words.

Q2. Does the lexical base, nominal or verbal, on which morphological operations (i.e. derivation and conversion) apply, have an impact on AD patients' performance?

Our findings revealed that AD patients were more accurate when selecting a correct complex word from a verbal base than selecting a complex word from a nominal base. So, they overall produced more correct DVNs than DNVs.

Q3. How do the two considered variables, namely the diverse lexical bases and the morphological mechanisms applying on them, interact with each other?

Interestingly, our results disclosed the two following patterns:

a. AD patients formed DNVs through conversion more consistently;

b. AD patients experienced fewer difficulties in deriving complex DVNs than in deriving complex DNVs.

Q4. Looking at conversion, how do AD patients deal with the different morphological bases that are taken as the starting point of the morphological operation?

Our investigated group sporadically adopted a regularization strategy when producing complex nouns from verbal bases. Indeed, they selected the regular form of the feminine allomorph of "-ato" and the regular form of the present participle inflectional suffix "-ante", both belonging to the first conjugation (i.e. *dorm**ata** < dormita, batt**ante** < battente*). Moreover, the same pattern was also found when deriving some complex nouns through suffixation (i.e. *spingi+tura < spinta*, *stringi+tura < stretta*), again unsteadily.

Q5. Looking at the derivational morphological process, how do AD patients employ the suffixes selected to compose complex word forms, concerning their inherent semantic content and their morphological restrictions?

On a total of 537 complex items, our AD patients produced 105 ill-formed complex words applying the transcategorial mechanism of suffixation[94]. Both denominal and deverbal items incorrectly derived were considered novel word-forms, resulting from legal combinations of meaningful (sometimes meaningless, i.e. neologisms) parts of (non)attested words. Just a small portion of these novel complex items did not comply with the WFR, namely derived items which selected the suffix "-aio". Nonetheless, we concluded that, globally speaking, knowledge of WFRs is well preserved and separately stored from whole units. Moreover, they were employed mostly in a correct way.

Finally, for every research question we also checked patients' MMSE score. Unfortunately, the patterns exhibited by the AD patients did not correlate with their MMSE score. In fact, patients with different MMSE scores showed the same response pattern, for both the morphological mechanisms of word-formation and the lexical base on which the transcategorial operation was applied. In other words, MMSE score of AD patients did not match with their linguistic performance. We may conclude that at least for our case study, the morphological operations of word-formation seem to be preserved or impaired in a very individual-specific way. Therefore, testing suffixation and conversion is not a powerful linguistic domain in the diagnosis of Alzheimer's Disease.

We are aware that our results can be read in many different ways, according to the theoretical background taken as starting point of the analysis (lexicalist approach, DM model, etc.). Moreover, our investigation did not take a stand on and did not clarify whether word-formation processes apply at the morphological or at the syntactic level. Nonetheless, we also believe that our study can be taken as evidence that mechanisms working, using Kastovsky's words, at the crossroad of morphology, syntax and semantics are preserved in AD. Indeed, almost every novel complex word elicited by our AD patients can be considered grammatical, since they respect Italian WFRs. Evidence from aphasic population concerning the distinction between knowledge of derivational complex words and knowledge of the rule applied for composing them is already present in the literature

[94] To notice that for 57/105 items the correct mechanism of word formation to be applied was conversion, whereas the remaining 48 outcomes were formed employing the correct operation but selecting the wrong suffix among the competing ones.

(Semenza et al., 2012 *inter alia*). To the best of our knowledge, this distinction has not been tested on AD yet. So, our experimental study showed that, even though AD people are believed to be impaired in naming tasks (verb/name retrieval), the knowledge of rules used to form complex words is retained, supporting the claim of a separate storage of these two kinds of representations in the brain. Moreover, the selection of whether to apply one or the other mechanism of word formation in creating an online form could be based on the same principles claimed to guide language acquisition of word-formation, namely formal simplicity, semantic simplicity, economy, etc. As a matter of fact, if we consider that in AD patients' lexical entries are somehow corrupted and that the only available way to form complex items is processing them online, their behavior may somehow be compared to strategies adopted by children when they start to form complex items.

So, our study goes together with others in claiming a separate representation of whole units and component elements of complex items. Nonetheless, some other aspects of complex word-formation are still open for possible discussions. Future studies may consider the different readings of nominalizations more in depth, to check whether their different behavior is also differently impaired in AD or not. Indeed, as pointed out by Melloni (2011), E nominals are closer to verbs since they preserve the thematic grid and they inherit the verbal actionality. On the contrary, R nominals behave like absolute nouns. Another fascinating topic concerns the actionality showed by DVNs. It might be engaging to check how these complex elements are interpreted in a sentence comprehension task to verify whether they show a modified (Gaeta) or the exact same (Melloni) Aktionsart, with respect to the verbal base from which they are generated. Another interesting issue to investigate is the well-known competition between event-denoting deverbal nouns and nominal infinitives, since also these different nominalizations present a different syntactic behavior. Indeed, both type of nominalizations seems to denote an event. So, it might be interesting to check whether their use is differently impaired in AD population, how their meanings differ or whether they can be considered semantic competitors. Moreover, to administrate a similar task to different neurodegenerative populations and compare their productions could shed

some light on their specific language impairment and may help the early differential diagnosis. To conclude, since we have previously pointed out the existence of similar production patterns in SLA (these are also present in first language acquisition), testing children presenting both typical and atypical language development and second language learners of Italian could be extremely interesting. In these cases, a guided and spontaneous elicitation test might be more informative[95]. Finally, comparing their productions with AD novel words may shed some more light on the inner functioning of word-formation, on the organization of the mental lexicon, and on the principles guiding their formation.

[95] Obviously, the linguistic task needs to be shaped according to the age of the children one wants to investigate.

APPENDIX

- Chapter 1 -

Table 1 - Differential diagnosis of the dementia syndrome

DISEASE CATEGORY	*IMPORTANT EXAMPLES*
Infections	Prion diseases, syphilis, Lyme disease, chronic meningidites, PML, HIV, Whipple's disease, hydrocephalus.
Neoplasms	Primary or metastatic tumors, (particularly of the frontal lobe), paraneoplastic encephalitis, disseminated intravascular lymphoma, hydrocephalus.
Traumatic Brain Disease	Chronic subdural hematoma, contusions, diffuse axonal injury, hydrocephalus, dementia pugilistica.
Autoimmune Disease	Multiple sclerosis, primary CNS angiitis, lupus and other vasculidites, sarcoid.
Metabolic Disorders	Renal and hepatic failure, hyper/hypo-thyroidism/calcemia/natremia, Wilson's disease, metachromatic/adrenoleukodystrophy, GM2 and other gangliosidoses, Pantothenate kinase deficiency.
Toxic Disorders	POLYPHARMACY Drugs: antidepressants, anxiolytics, sedatives, hypnotics, anticholingergics, neuroleptics, multiple cardiac and antihypertensive drugs, narcotics, lithium, antineoplastics, antiepileptics Metals (arsenic, thallium, lead, manganese) Industrial agents (CCl4, CS2, TCE, organophosphides)

	Radiation encephalopathy Alcohol and other drugs of abuse.
Nutritional/Deprivation	B12/Folate and others vitamin deficiencies Wernicke-Korsakoff syndrome.
"Degeneraive" Dementias	Alzheimer's disease Frontotemporal and Parkinsonian dementias Huntington's disease Neuronal ceroid lipofuscinosis
Vascular Dementias	Multiple infarct dementia "Binswanger's disease" "Small vessel ischemic disease" CADASIL
Psychiatric Disorders	Schizophrenia Dementia syndrome of depression Bipolar disorder Malingering Obsessive compulsive disorder

Legend. CCl4 = carbon tetrachloride; CS2 = carbon disulfide; CADASIL = cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy; CNS = central nervous system; HIV = human immunodeficiency virus; PML = progressive multi-focal leukoencephalopathy; TCE = trichlorethylene; pantothenate kinase deficiency = Hallervorden-Spatz disease. The present table was taken from Kowall and Budson, (2011). "The Handbook of Alzheimer's Disease and Other Dementias". Wiley - Blackwell Handbooks of Behavioral Neuroscience.

Table 2 - Dementing Disorders

DISEASE	PRIMARY SITE OF DEGENERATION/ DYSFUNCTION	PROFILE	DIAGNOSIS	COMMUNICATION	BEHAVIOR
Alzheimer's (AD)	Cortical	- Insidious onset; - more likely after age 65; - progressive course; - slow course with plateaus not unusual; - can be familial or non-familial; - can coexists with other conditions such as Parkinson's disease.	- Proliferation of neural plaques and neurofibrillary tangles at autopsy.	**- Aphasia is common, starting as either fluent on nonfluent;** **- semantic system is most affected;** **- syntax and phonology are affected later;** **- language comprehension deficits, difficulty with topic maintenance, echolalia, lack of meaningful speech, gradual progression to mutism.**	- Depression; - insomnia; - incontinence; - delusions; - agitation; - restlessness; - hyperactivity; - disorientation; - delusions of persecution; - loss of initiative.
Vascular Dementia	Cortical, called multi-infarct dementia (MID) when multiple lesions/infarcts are present in both gray and white matter.	- Caused by multiple strokes, some without noticeable clinical signs; - symptoms may begin suddenly, often progressing in stepwise fashion after each small stroke; - sometimes co-occurs with Alzheimer's disease.	- Vascular disease resulting in damage to cortical areas of the brain due to diminished blood flow; - symptoms similar to Alzheimer's disease makes it difficult to make a firm diagnosis.	**- Motor speech disorders are prominent;** **- slurred speech** **- word retrieval difficulties;** **- difficulty following instructions.**	- Depression and mood changes; - confusion; - problems with short-term memory; - wandering or getting lost in familiar places; - impaired coordination or balance.
	Subcortical, also called Binswanger's Disease	-Usually due to chronic, untreated hypertension	- Disease results in thickening and narrowing of arteries that feed	**- Difficulty with speech (dysarthria);**	- Progressive loss of memory and other cognitive functions including

		can co-occur with cortical vascular dementia.	subcortical areas of the brain; - pattern of damage can be seen on brain imaging (CT or MRI).	**- less spontaneous communication;** **- difficulty with swallowing (dysphagia).**	organization, attention, and decision making, apathy, irritability, and depression slowness, poor balance, unsteady gait, urinary incontinence not caused by urological disease.
Lewy Body (LBD)	Cortical	- Periods of normal cognition alternate with abnormal cognition progressive course, often rapid.	- Presence of Lewy bodies (intraneuronal cytoplasmic inclusions) typically found in the substantia nigra at autopsy.	**- Motor speech disorder with hypophonia;** **- disorganized speech.**	- Visual and auditory hallucinations; - pronounced fluctuations in alertness and attention; - periods of delirium (confusion) and daytime drowsiness; - Parkinsonian motor symptoms (e.g., rigidity and loss of spontaneous movement.
Frontotemporal Lobar (FTD) **Pick's Disease**	Cortical	- Insidious onset, more likely before age 65; - progressive course, often slow.	- Focal cortical atrophy; - degeneration in frontal and temporal lobes two kinds of neuronal abnormalities: Pick bodies (dense intracellular formation in cytoplasm) and Pick cells (inflated neurons).	**- Reduced speech output;** **- speech is nonfluent progressive decrease in expressive vocabulary;** **- word-finding problems;** **- reduced spontaneous conversation;** **- echolalia and meaningless repetition of phrases.**	- Wide range of behavioral changes, especially frontal lobe variant executive dysfunction (in frontal variant) behavioral (personality) changes and disregard for social conventions

					uninhibited behavior, including inappropriate social behavior, depression, irritability, mood fluctuations.
Frontotemporal Lobar (FTD) Primary Progressive Aphasia (PPA)	Cortical	- May be caused by a wide variety of underlying diseases, possibly inherent genetic preprogramming; - gradual loss of language function in the context of relatively well-preserved memory, visual processing, and personality until the advanced stages.	- A focal dementia (or focal cortical atrophy syndrome) structural and physiological abnormalities typically noted only in the left hemisphere language-related cortices (i.e., frontal, parietal and temporal regions).	**- Symptoms usually begin with word-finding problems and progress to impaired grammar (syntax) and comprehension (sentence processing and semantics);** **- symptoms associated with impaired speech production can also be present (e.g., dysarthria and apraxia).**	- Activities of daily living, judgment, insight, and behavior are relatively, if not totally spared.

Note. Table revised from Hegde, 2006; Hickey and Bourgeois, 2018; Johnson and Jacobson, 2007; National Institute of Neurological Disorders and Strokes (NINDS), 2013; 2015; National Organization for Rare Disorders (NORD), 2015 - (https://www.asha.org/Practice-Portal/Clinical-Topics/Dementia/Common-Dementias/).

APPENDIX

- Chapter 3 -

Table 1 - Demographical data of Control Group

Subject	*Gender*	*Age*	*Education level*	*Session*
CG1	M	20	Bachelor's Degree (ongoing)	1
CG2	F	25	PhD (ongoing)	1
CG3	F	26	Master's Degree (ongoing)	1
CG4	M	53	Middle School	1
CG5	M	56	High School	1
CG6	F	78	Elementary School	1
CG7	F	80	Elementary School	1
CG8	F	89	Elementary School	1
CG9	M	24	Master's Degree (ongoing)	1
CG10	M	26	Master's Degree	1
CG11	M	24	Master's Degree (ongoing)	2
CG12	M	25	Master's Degree (ongoing)	2
CG13	M	25	PhD (ongoing)	2
CG14	F	26	Elementary School (3 years)	2
CG15	M	27	High School	2

CG16	F	58	High School	2
CG17	F	75	Elementary School	2
CG18	M	77	Middle School	2
CG19	F	85	Elementary School	2
CG20	F	28	Master's Degree (ongoing)	2

Table 2 - List of items included in S1T1[96]

TYPE	TEST ITEM	Distractor 1	Distractor 2
1. Warm Up	Mondo	Tondo	Rombo
2. Warm Up	Bevuto	Bevato	Potuto
3. Test Item	Adorazione	Adoramento	Adoratura
4. Filler	Costruendo	Costruando	Costruito
5. Test Item	Vaporizzata	Vaporata	Vaporificata
6. Test Item	Rottura	Rompitura	Rompizione
7. Filler	Panico	Panicamento	Panicatura
8. Test Item	Scritta	Scrittura	Scrivata
9. Test Item	Battente	Battuto	Battante
10. Test Item	Stretta	Stringitura	Stringata

[96]In the experiment each item is randomized in every Session and Time, excluded the two Warm Up.

11. Test Item	Temperino	Temperante	Temperaio
12. Test Item	Stampante	Stampatrice	Stampificatrice
13. Test Item	Baciata	Baceggiata	Bacizzata
14. Filler	Venduto	Vendato	Vendificato
15. Filler	Domenica	Domanica	Domani
16. Filler	Gelato	Gelo	Gelito
17. Test Item	Regalato	Regaleggiato	Regaluto
18. Filler	Mangiare	Mangiere	Mangificare
19. Test Item	Nidificando	Nidificato	Nidificizzando
20. Test Item	Ricerca	Ricercatura	Ricercazione
21. Test Item	Sciando	Sciandeggiando	Sciato
22. Test Item	Ambulatorio	Ambulaio	Ambulificio
23. Test Item	Scandalizzare	Scandalare	Scandizzare
24. Test Item	Fioccando	Fioccheggiando	Fiocchificando
25. Test Item	Pianificare	Pianeggiare	Pianare
26. Test Item	Sorseggiare	Sorsare	Sorsificare

Table 3 - List of items included in S1T2

TYPE	TEST ITEM	Distractor 1	Distractor 2
1. Warm Up	Mondo	Tondo	Rombo

2. Warm Up	Bevuto	Bevato	Potuto
3. Filler	Dormendo	Dormando	Dormito
4. Test Item	Bollitore	Bollore	Bollificio
5. Test Item	Scrittura	Scrizione	Scriva
6. Filler	Rotto	Romputo	Rompato
7. Filler	Volare	Volato	Voleggiare
8. Filler	Libro	Libruto	Timbro
9. Test Item	Parcheggiando	Parcando	Parchizzando
10. Test Item	Ramificato	Ramato	Rameggiato
11. Test Item	Fotografare	Fotare	Fotograficare
12. Test Item	Spinta	Spingitura	Spinzione
13. Test Item	Cambiamento	Cambiaggio	Cambio
14. Filler	Estate	Inverno	Estatura
15. Test Item	Pulsante	Pulsore	Pulso
16. Test Item	Polemizzare	Polemicare	Polemificare
17. Test Item	Sospirato	Sospificato	Sospireggiato
18. Test Item	Comando	Comandato	Comandaggio
19. Test Item	Arrivo	Arrivatura	Arrivaggio
20. Test Item	Fiammeggiando	Fiammando	Fiammificando

21. Filler	Treno	Trenante	Freno
22. Test Item	Laboratorio	Laboraio	Laboramento
23. Test Item	Viaggiando	Viaggendo	Viaggificando
24. Test Item	Incontrato	Incontreggiato	Incontreto
25. Test Item	Distributore	Distributaio	Distribuimento
26. Test Item	Ondeggiare	Ondare	Ondificare

Table 4 - List of items included in S2T1

TYPE	TEST ITEM	Distractor 1	Distractor 2
1. **Warm Up**	Mondo	Tondo	Rombo
2. **Warm Up**	Bevuto	Bevato	Potuto
3. **Test Item**	Colino	Colaio	Colitore
4. **Test Item**	Lavorazione	Lavoratura	Lavoramento
5. **Test Item**	Pugnalato	Pugnalizzato	Pugnaleto
6. **Test Item**	Mangiata	Mangiatura	Mangiazione
7. **Test Item**	Domanda	Domandatura	Domandazione
8. **Test Item**	Chiusa	Chiuditura	Chiudizione
9. **Filler**	Costruendo	Costruando	Costruito
10. **Test Item**	Dormita	Dormata	Dormizione
11. **Test Item**	Pietrificare	Pietrare	Pietrizzare

12. Test Item	Demonizzando	Demonificando	Demoniando
13. Filler	Venduto	Vendato	Vendificato
14. Test Item	Cinta	Cinzione	Cintura
15. Test Item	Concimare	Concimizzare	Concimere
16. Test Item	Misurino	Misuraio	Misuratore
17. Test Item	Costruzione	Costrutta	Costruita
18. Filler	Mangiare	Mangiere	Mangificare
19. Test Item	Grandinando	Grandizzando	Grandando
20. Test Item	Faticato	Fatificato	Faticizzato
21. Test Item	Fraternizzare	Fratellare	Fraternare
22. Filler	Gelato	Gelo	Gelito
23. Filler	Panico	Panicamento	Panicatura
24. Test Item	Corteggiare	Cortare	Cortificare
25. Filler	Domenica	Domanica	Domani
26. Test Item	Lampeggiando	Lampando	Lampizzando

Table 5 - List of items included in S2T2

TYPE	TEST ITEM	Distractor 1	Distractor 2
1. **Warm Up**	Mondo	Tondo	Rombo
2. **Warm Up**	Bevuto	Bevato	Potuto

3. Test Item	Cornificare	Cornare	Cornizzare
4. Test Item	Crescita	Crescizione	Crescitura
5. Test Item	Spostamento	Sposto	Spostaggio
6. Filler	Estate	Inverno	Estatura
7. Filler	Treno	Trenante	Freno
8. Test Item	Remando	Remeggiando	Remolando
9. Test Item	Danneggiato	Dannato	Dannificato
10. Test Item	Puzzare	Puzzire	Puzzolare
11. Filler	Dormendo	Dormando	Dormito
12. Filler	Libro	Libruto	Trimbo
13. Test Item	Telefonato	Telefonicato	Telefato
14. Test Item	Ricovero	Ricoveratorio	Ricoveranza
15. Test Item	Mossa	Muovitura	Mossatura
16. Test Item	Conservatorio	Conservario	Conservatario
17. Test Item	Bruciatura	Bruciura	Bruciazione
18. Filler	Volare	Volato	Voleggiare
19. Test Item	Agonizzare	Agonare	Agoneggiare
20. Test Item	Immaginando	Immaginificando	Immagizzando
21. Test Item	Condizionatore	Condizionatorio	Condizionaio

22. Test Item	Prolificato	Prolifato	Prolifeggiato
23. Test Item	Pettinando	Pettineggiando	Pettinolando
24. Filler	Rotto	Romputo	Rompato
25. Test Item	Nutrimento	Nutrito	Nutritaggio
26. Test Item	Sosta	Sostatura	Sostata

Table 6 - Frequencies[97] of words included in S1T1

TYPE	*WORD*	*FREQUENCY*
1. Warm Up	Mondo	2193
2. Warm Up	Bere	243
3. Test Item	Adorazione	11
4. Filler	Costruire	605
5. Test Item	Vaporizzare	3
6. Test Item	Rottura	110
7. Filler	Panico	76
8. Test Item	Scritta	64

[97] We checked the frequency on the "Corpus e Lessico di Frequenza dell'Italiano Scritto" - (CoLFIS): Bambini, Valentina and Marco Trevisan. 2012. EsploraCoLFIS: Un'interfaccia Web per ricerche sul Corpus e Lessico di Frequenza dell'Italiano Scritto, Quaderni del Laboratorio di Linguistica della Scuola Normale Superiore,Vol. 11, 1-16. http://linguistica.sns.it/esploracolfis/home.htm

9. Test Item	Battente	19
10. Test Item	Stretta	37
11. Test Item	Temperino	5
12. Test Item	Stampante	6
13. Test Item	Baciare	119
14. Filler	Vendere	482
15. Filler	Domenica	511
16. Filler	Gelato	51
17. Test Item	Regalare	195
18. Filler	Mangiare	502
19. Test Item	Nidificare	12
20. Test Item	Ricerca	652
21. Test Item	Sciare	17
22. Test Item	Ambulatorio	17
23. Test Item	Scandalizzare	30
24. Test Item	Fioccare	11
25. Test Item	Pianificare	20
26. Test Item	Sorseggiare	13

Table 7 - Frequencies of words included in S1T2

TYPE	*WORD*	*FREQUENCY*
1. Warm Up	Mondo	2193
2. Warm Up	Bere	243
3. Filler	Dormire	368
4. Test Item	Bollitore	4
5. Test Item	Scrittura	90
6. Filler	Rompere	245
7. Filler	Volare	250
8. Filler	Libro	1004
9. Test Item	Parcheggiare	69
10. Test Item	Ramificare	3
11. Test Item	Fotografare	86
12. Test Item	Spinta	85
13. Test Item	Cambiamento	228
14. Filler	Estate	533
15. Test Item	Pulsante	28
16. Test Item	Polemizzare	28

17. Test Item	Sospirare	65
18. Test Item	Comando	166
19. Test Item	Arrivo	286
20. Test Item	Fiammeggiare	3
21. Filler	Treno	230
22. Test Item	Laboratorio	195
23. Test Item	Viaggiare	215
24. Test Item	Incontrare	654
25. Test Item	Distributore	37
26. Test Item	Ondeggiare	15

Table 8 - Frequencies of words included in S2T1

TYPE	*WORD*	*FREQUENCY*
1. Warm Up	Mondo	2193
2. Warm Up	Bere	243
3. Test Item	Colino	1
4. Test Item	Lavorazione	54
5. Test Item	Pugnalare	6
6. Test Item	Mangiata	4
7. Test Item	Domanda	680

8. Test Item	Chiusa	1
9. Filler	Costruire	605
10. Test Item	Dormita	4
11. Test Item	Pietrificare	2
12. Test Item	Demonizzare	6
13. Filler	Vendere	482
14. Test Item	Cinta	18
15. Test Item	Concimare	7
16. Test Item	Misurino	2
17. Test Item	Costruzione	238
18. Filler	Mangiare	502
19. Test Item	Grandinare	1
20. Test Item	Faticare	72
21. Test Item	Fraternizzare	1
22. Filler	Gelato	51
23. Filler	Panico	76
24. Test Item	Corteggiare	26
25. Filler	Domenica	511
26. Test Item	Lampeggiare	5

Table 9 - Frequencies of words included in S2T2

TYPE	*WORD*	*FREQUENCY*
1. Warm Up	Mondo	2193
2. Warm Up	Bere	243
3. Test Item	Cornificare	0
4. Test Item	Crescita	203
5. Test Item	Spostamento	73
6. Filler	Estate	533
7. Filler	Treno	230
8. Test Item	Remare	8
9. Test Item	Danneggiare	68
10. Test Item	Puzzare	11
11. Filler	Dormire	368
12. Filler	Libro	1004
13. Test Item	Telefonare	235
14. Test Item	Ricovero	64
15. Test Item	Mossa	108
16. Test Item	Conservatorio	14
17. Test Item	Bruciatura	8

18. Filler	Volare	250
19. Test Item	Agonizzare	6
20. Test Item	Immaginare	353
21. Test Item	Condizionatore	15
22. Test Item	Prolificare	0
23. Test Item	Pettinare	11
24. Filler	Rompere	245
25. Test Item	Nutrimento	10
26. Test Item	Sosta	115

Table 10 - Summary of Experimental Variables.

1. Morphological Variable	Deverbal Nouns / Denominal Verbs
2. Morphological Operation Variable	Conversion / Suffixation
3. Morpho-syntactic Base Variable	Different stems
4. Morphological Affixes Variable	Nouns and Verbs derived through Suffixation
5. Semantic Variable	Different Types of Suffixes

Table 11 - Sample of the Experimental Protocol

PROTOCOLLO "DE"

Data del test _____

Esaminatore _____

Dati del paziente:

Sesso ☐ Maschio ☐ Femmina

ID (Nome e Cognome) _____

Data di nascita _____
Età (Anni) _____

ISTRUZIONI

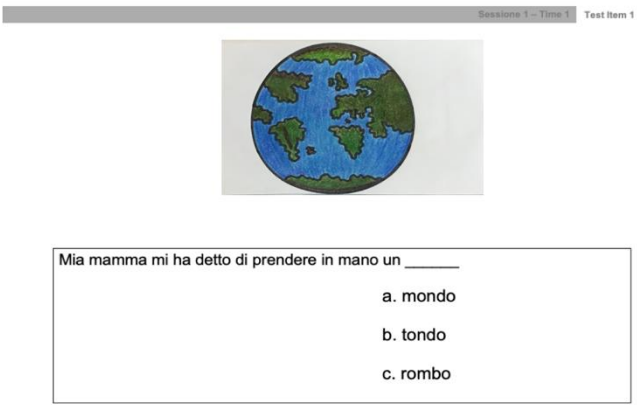
1) Da preparare prima del test:

1. protocollo esaminatore (foglio che sta leggendo);
2. protocollo paziente (booklet plastificato con immagini);
3. MMSE (Mini-Mental State Examination) handout;
4. penna che servirà per marcare l'opzione scelta dal paziente e scrivere eventuali note.

2) Indicazioni per lo esaminatore:

A livello di design l'esperimento è composto da 3 elementi:

1. immagine, che serve per orientare la scelta e dare un contesto non verbale;
2. frase con parola mancante;
3. tre opzioni per la parola mancante da individuare.



3) Tipologia di Test: gap filling exercise con multiple choice.

Il test è suddiviso in due sessioni, ciascuna suddivisa a sua volta in due parti: Time 1 e Time 2, indicazione presente a livello di intestazione. Il suo compito sarà quello di somministrare una sola sessione del test ad ogni partecipante, nello specifico dovrà somministrare entrambe le parti del test (ad esempio S1, Time 1 and 2) al medesimo paziente nel medesimo paziente nel medesimo giorno a distanza massima di 6 ore.

4) Procedura

L'esaminatore dovrà somministrare prima il MMSE e poi potrà procedere con la somministrazione dell'esperimento.

Ciò che le viene richiesto di fare è:

a. far vedere l'immagine al paziente;
b. leggere la frase in modo chiaro;
c. leggere le 3 opzioni proposte quando si giunge al "gap";
d. marcare con un cerchio l'opzione scelta dal paziente (cfr. tabella nelle pagine seguenti);
e. annotare nella sezione "Commenti" eventuali osservazioni o note che ritiene utili segnalare (il paziente oggi era particolarmente distratto, il paziente non era motivato, il paziente non ha capito l'immagine, ecc.)

I punti b. and c. possono essere ripetuti per un massimo di 3 volte, nel caso in cui si noti una certa difficoltà da parte del paziente. Se al terzo tentativo la risposta del soggetto testato dovesse essere ancora nulla, si passi alla frase successiva.

N.B. È consigliato visionare il test prima della somministrazione, in modo da non commettere errori durante la lettura delle nonparole.

Recap:

Step 1. MMSE

Step 2. Consegnare booklet al paziente

Step 3. Inizio del test

Inizio del test

- Esaminatore:

Buongiorno Sig./Sig.ra _____

Adesso le presenterò, una alla volta, una serie di immagini, ognuna delle quali è accompagnata da una frase. In ogni frase vi è una ***parola mancante****, che nel suo*

quadernetto lei vede segnalata graficamente con il tratteggiato. Io le leggerò la frase e le tre possibili parole che possono riempire il buco lasciato dalla parola mancante. Il suo compito sarà quello di ***ascoltare con attenzione*** *e scegliere una delle tre opzioni, tra quelle che le proporrò, per riempire il buco della frase. Le è tutto chiaro?*

(Se non dovesse essere chiaro ripetere, eventualmente semplificando la spiegazione del task)

Table 12 - Sentences included in S1T1

Number	Item Type	Target Item	Sentence	Syllables
1	Warmup	Mondo	Mia mamma mi ha detto di prendere in mano un ___	15
2	Warmup	Bevuto	Mia mamma mi racconta che da piccolo ho ___ tanto	15
3	Test Item	Adorazione	Ho scoperto che le suore stanno in ___ per molte ore	16
4	Filler	Costruendo	Ho letto sul giornale che l'azienda sta ___ un ponte	15
5	Test Item	Vaporizzata	Mi hanno detto che in sauna l'acqua viene sempre ___	15
6	Test Item	Rottura	Giocando due bambini causano la ___ della fune	15
7	Filler	Panico	L'arrivo dello squalo ha generato ___ in acqua	15
8	Test Item	Scritta	Ho visto che il comune ha appeso una ___ al muro	16
9	Test Item	Battente	Per bussare alla porta dei miei uso sempre il ___	16
10	Test Item	Stretta	Per presentarmi do ogni volta una ___ di mano	15

11	Test Item	Temperino	Per fare la punta alla matita uso il ___ nuovo.	15
12	Test Item	Stampante	La mamma mi ha detto che ha comprato una bella ___	16
13	Test Item	Baciata	Quando è arrivata la mamma la bambina l'ha ___	15
14	Filler	Venduto	Ho sentito che il carrozziere ha ____ la macchina	15
15	Filler	Domenica	Tutta la mia famiglia si riunisce a pranzare ogni ___	16
16	Filler	Gelato	Ho visto un bambino comprarsi un ___ davvero enorme	15
17	Test Item	Regalato	Il papà ha ____ qualcosa al piccolo Ferdinando	15
18	Filler	Mangiare	Ieri ho visto Matteo ____ di gran gusto la cena	15
19	Test Item	Nidificando	La mamma mi ha detto che un uccello sta ____ sul tetto.	15
20	Test Item	Ricerca	Il ragazzo seguendo le orme ha iniziato la ____ .	16
21	Test Item	Sciando	Nelle montagne del Bellunese la bambina sta ___ .	15
22	Test Item	Ambulatorio	Il dottor Rossi ha aperto un nuovo ___ in città.	15
23	Test Item	Scandalizzare	Ho sentito che la vicenda può ____ molte persone.	15
24	Test Item	Fioccando	Guardo dalla finestra la neve mentre sta ___ dal cielo.	16

25	Test Item	Pianificare	La mamma mi ha detto che le piace ___ le vacanze.	15
26	Test Item	Sorseggiare	La famiglia ha passato il pomeriggio a ___ il tè.	16

Table 13 - Sentences included in S1T2

Number	Item Type	Target Item	Sentence	Syllables
1	Warmup	Mondo	Mia mamma mi ha detto di prendere in mano un ___	15
2	Warmup	Bevuto	Mia mamma mi racconta che da piccolo ho ___ tanto	15
3	Filler	Dormendo	Nel suo letto mio cugino sta ___ profondamente	16
4	Test Item	Bollitore	Mia mamma in cucina per scaldare l'acqua usa il ___	16
5	Test Item	Scrittura	La mia nuova vicina di banco usa una gran bella ____	15
6	Filler	Rotto	Con il martello ho ___ il maialino dei risparmi	15
7	Filler	Volare	Ieri ho visto padre e figlia guardare un aquilone ___	16
8	Filler	Libro	La mamma mi ha detto che c'è un ___ sopra il tavolo	16
9	Test Item	Parcheggiando	Ho visto il papà mentre stava ____ la macchina nuova	16
10	Test Item	Ramificato	La mamma mi ha detto che il fagiolo nel vaso ha ___	15

11	Test Item	Fotografare	Una mia cara amica ama ___ i fiori del giardino	15
12	Test Item	Spinta	Ho visto un signore dare una ___ alla macchina ferma	16
13	Test Item	cambiamento	I miei nonni hanno subito un gran ____ negli anni	15
14	Filler	Estate	Mi piace molto andare al mare con la mamma in ____	15
15	Test Item	Pulsante	So che per salire di piano devo premere un ____	15
16	Test Item	Polemizzare	Ieri mi hanno detto che a Sara piace molto ____	15
17	Test Item	Sospirato	Oggi, per le troppe cose da fare, mia mamma ha ____	15
18	Test Item	Comando	Ho visto il tenente chiamare i soldati per dargli un ____	16
19	Test Item	Arrivo	Ieri ho visto le macchine da corsa giungere all'____	16
20	Test Item	Fiammeggiando	Ho appena visto che nella padella il fuoco sta ____	15
21	Filler	Treno	Arrivato in stazione ho preso il ___ delle due	15
22	Test Item	Laboratorio	Mi hanno detto che lo zio ha aperto un nuovo ___	16
23	Test Item	Viaggiando	La mamma ha detto che si scoprono molte cose ___	15
24	Test Item	Incontrato	La mamma mi ha detto che ha ____ una vecchia amica	15

25	Test Item	Distributore	Ho sentito dire che all'entrata c'è un nuovo grande ___	15
26	Test Item	Ondeggiare	Mi piace molto fermarmi a guardare il mare ___ di sera	16

Table 14 - Sentences included in S2T1

Number	Item Type	Target Item	Sentence	Syllables
1	Warmup	Mondo	Mia mamma mi ha detto di prendere in mano un ___	15
2	Warmup	Bevuto	Mia mamma mi racconta che da piccolo ho ___ tanto	15
3	Filler	Colino	Mia mamma per passare il minestrone usa sempre il ___	15
4	Test Item	Lavorazione	Il papà mi ha mostrato le fasi di ___ di un vaso	15
5	Test Item	Pugnalato	Ieri sera ho visto un film dove un uomo veniva ___	15
6	Filler	Mangiata	Nella sala da tè ci siamo fatti proprio una bella ___	16
7	Filler	Domanda	La mamma mi dice che a lezione faceva sempre una ___	16
8	Filler	Chiusa	Ho visto che è stata costruita una ___ sul fiume	15
9	Test Item	Costruendo	Ho letto sul giornale che l'azienda sta ___ un ponte	15
10	Test Item	Dormita	Il papà ha detto che si è fatto proprio una bella ___	16

11	Test Item	Pietrificare	Ho sentito che Medusa poteva ____ le persone	15
12	Test Item	Demonizzando	Ho visto alla tv che stanno ____ un personaggio pubblico	16
13	Test Item	Venduto	Ho sentito che il carrozziere ha ____ la macchina	15
14	Filler	Cinta	Ho visto una città circondata da una ___ muraria	15
15	Test Item	Concimare	La mamma ieri pomeriggio mi ha insegnato a ___ l'orto	15
16	Test Item	Misurino	Ho visto che il cuoco usa un ___ per preparare i dolci	15
17	Test Item	Costruzione	Ho visto i miei cugini giocare con una nuova ___	16
18	Test Item	Mangiare	Ieri ho visto Matteo ____ di gran gusto la cena	15
19	Test Item	Grandinando	Non posso ancora tornare a casa perché sta ___ troppo	15
20	Test Item	Faticato	Ho visto che per portare la cassa l'uomo ha ___ molto	16
21	Filler	Fraternizzare	Ho visto due bambini ___ dopo un brutto litigio	15
22	Test Item	Gelato	Ho visto un bambino comprare un ___ davvero enorme	15
23	Test Item	Panico	L'arrivo dello squalo ha generato ___ in acqua.	15
24	Test Item	Corteggiare	Il papà ha detto che bisogna sempre ___ le ragazze	16

25	Test Item	Domenica	Tutta la famiglia si riunisce a pranzare ogni ___	15
26	Test Item	Lampeggiando	La mamma mi ha detto che la sirena sta ___ da ore	15

Table 15 - Sentences included in S2T2

Number	Item Type	Target Item	Sentence	Syllables
1	Warmup	Mondo	Mia mamma mi ha detto di prendere in mano un ___	15
2	Warmup	Bevuto	Mia mamma mi racconta che da piccolo ho ___ tanto	15
3	Filler	Cornificare	Il papà mi dice che non bisogna ___ la compagna	15
4	Test Item	Crescita	La mamma mi dice che le piante subiscono una ___	15
5	Test Item	Spostamento	Ho saputo che c'è stato uno ___ dei turni di lavoro	16
6	Filler	Estate	Mi piace molto andare al mare con la mamma in ____	15
7	Filler	Treno	Arrivato in stazione ho preso il ___ delle due	15
8	Filler	Remando	Ho visto una mamma con il figlio attraversare il fiume ___	16
9	Test Item	Danneggiato	Ho sentito che il tornado ha ___ gravemente la città	16
10	Test Item	Puzzare	Passeggiando per strada ho sentito un signore ___ molto	16

11	Test Item	Dormendo	Nel suo letto mio cugino sta ___ profondamente	16
12	Test Item	Libro	La mamma mi ha detto che c'è un ___ sopra il tavolo	16
13	Test Item	Telefonato	Prima ho sentito che la mamma ha ___ alla nonna	15
14	Filler	Ricovero	Quando ero piccolo sono stato in ___ per tre giorni	16
15	Test Item	Mossa	Ho vinto la partita di scacchi grazie alla ___ giusta	15
16	Test Item	Conservatorio	Da bambino ho studiato musica classica al ___	15
17	Test Item	Bruciatura	Mi sono preso una bella ___ toccando il fornello caldo	16
18	Test Item	Volare	Ieri ho visto padre e figlia guardare un aquilone ___	16
19	Test Item	Agonizzare	Per il troppo dolore ho visto la mamma ___ ieri	15
20	Test Item	Immaginando	La mia compagna di banco sta ___ le vacanze estive	16
21	Filler	Condizionatore	Per la calda estate che ci attende ho comprato un ___	15
22	Test Item	Prolificato	Ho visto che i conigli che vivono in giardino hanno ___	16
23	Test Item	Pettinando	Guardo la mia sorellina mentre si sta ___ i capelli	16
24	Test Item	Rotto	Con il martello ho ___ il maialino dei risparmi	15

25	Test Item	Nutrimento	Ho visto la mamma che da al bimbo il ___ per crescere	15
26	Test Item	Sosta	Per fare la benzina ho dovuto fare una breve ___	16

Table 16 - Brief recap of global data - All Items

Table 16 a

Deverbal N					
342					
Conversion			Suffixation		
171			171		
Athematic	Present stem	Participle stem	Action	Instrument	Place
57	57	57	86	57	28
			-zione	-ino	-torio
			29	29	28
			-mento	-tore	
			29	28	
			-tura		
			28		

Table 16 b

Denominal V			
342			
Conversion		Suffixation	
171		171	
Transitive	Intransitive	Transitive	Intransitive
85	86	86	85
		-ific-	-ific-
		29	28
		-eggi-	-eggi-
		29	28
		-izz-	-izz-
		28	29

Table 17 - Data coding: Labels adopted and their Values

Label	*Value*
ID - patient's identity code	See Table 1
Diagnosis	See Table 1
*MMSE - Pc. when it was possible**	See Table 1
Session	1, 2
Time	1, 2
Item Type	Warm Up, Filler, Test Item
Test Item Type	0, Deverbal Noun, Denominal Verb
Morphological Process	0, Conversion, Suffixation
Property Item	0, Present stem, Participle stem, Athematic stem, Transitive, Intransitive, Action, Place, Instrument
Suffix	0, -mento, -tura, -zione, -ino, -tore, -torio, -eggi-, -izz-, -ific-
Verbal Answer	NR, V, Z
Manual Answer	NR, M, Z
Position of Correct Answer	a. – b. – c.
Verb Type	0, Gerund Form, Past Participle Form, Infinitive Form
Deverbal/Denominal Frequency	See Table 6,7,8,9
Deverbal/Denominal Base Frequency	See Table 6,7,8,9
Status	Concrete, Abstract
Correct Answer	See Table 2,3,4,5
D1	See Table 2,3,4,5
D2	See Table 2,3,4,5

Given Verbal Answer	NR, Given V Answer, Z
Given Manual Answer	NR, Given M Answer, Z
Correct/Wrong Verbal	NR, C, D1, D2, W, Z
Correct/Wrong Manual	NR, C, D1, D2, Z
Test Item Type Answer	NR, 0, Deverbal Noun, Denominal Verb, X
Morphological Process Answer	NR, 0, Conversion, Suffixation, X
Property Item Answer	NR, 0, Present stem, Participle stem, Athematic stem, Transitive, Intransitive, Action, Place, Instrument, X
Suffix Answer	NR, 0, -mento, -tura, -zione, -ino, -tore, -torio, -eggi-, -izz-, -ific-, X
Verb Type Answer	NR, 0, Gerund Form, Past Participle Form, Infinitive Form
Aktionsart	0, Activity, Accomplishment, Achievement, State

Note. *Pc. = short for "score corrected for educational attainment and age".
NR: no reply; 0: value not computable; V: verbal; M: manual; Z: not V but M and vice versa; C: correct answer, D1: distractor 1; D2: distractor 2; W: wrong answer – not present in the experimental design; X: different production

Table 18 - Patient's Deverbals and denominals Global Score

ID	*Denominals*	*Deverbals*	*NR*	*X*	*Total*
F17	2	0	30	4	36
G4	6	9	19	2	36
G5	10	11	15	0	36
SD19	13	16	6	1	36
T1	4	5	25	2	36
G6	17	18	0	1	36
F11	0	1	35	0	36

F18	14	18	2	2	36
SD20	17	17	1	1	36
G3	16	16	2	2	36
M16	16	17	3	0	36
R10	18	16	0	2	36
M14	15	16	4	1	36
M9	17	18	0	1	36
M15	17	18	1	0	36
M13	15	18	3	0	36
M12	18	18	0	0	36
G8	18	18	0	0	36
R2	18	18	0	0	36
Total	**251/342**	**268/342**	**146/684**	**19/684**	**684**
%	**73,3%**	**78,3%**	**21,3%**	**2,8%**	**100%**

Note. X: patients produced a word/non word which cannot be classified as deverbal or denominal.

Table 19 - Patient's Conversion and Suffixation Global Score

ID	*Conversion*	*Suffixation*	*NR*	*X*	*Total*
F17	4	0	30	2	36
G4	7	10	19	0	36
G5	10	11	15	0	36
SD19	12	18	6	0	36
T1	7	2	25	2	36
G6	12	24	0	0	36
F11	0	1	35	0	36

F18	16	18	2	0	36
SD20	20	14	1	1	36
G3	11	23	2	0	36
M16	15	18	3	0	36
R10	14	21	0	1	36
M14	16	16	4	0	36
M9	18	18	0	0	36
M15	21	14	1	0	36
M13	20	13	3	0	36
M12	20	16	0	0	36
G8	17	19	0	0	36
R2	17	19	0	0	36
Total	**257/684**	**275/684**	**146/684**	**6/684**	**684**
%	**37,5%**	**40,2%**	**21,3%**	**0,8%**	**100%**

Table 20 - Ill-formed Productions and Error Type - Input: Conversion VS Output: Conversion

	OUTPUT: CONVERSION				
	Target Item	Produced Item	C/W	Item Type	Error Type
	puzzare	tossire	W	Denominal	Verbal paraphasia
I	dormita	dormata	D1	Deverbal	Morphological substitution
N	remando	remolando	D2	Denominal	Morphological insertion
P	pugnalato	pugnaleto	D2	Denominal	Morphological substitution
U	telefonato	telenato	W	X	Phonemic deletion
T	faticato	fraticato	W	X	Phonemic insertion
:	grandinando	grandando	D1	Denominal	Phonemic deletion
C	pugnalato	pugnaleto	D2	Denominal	Morphological substitution
O	pugnalato	pugnaleto	D2	Denominal	Morphological substitution
N	stampante	talmante	W	X	neologism
V	stretta	trettata	W	X	neologism
E	incontrato	incontreto	D2	Denominal	Morphological substitution
R	pulsante	pulso	D2	Deverbal	Morphological substitution
S	pulsante	pulso	D2	Deverbal	Morphological substitution
I	sciando	sciato	D1	Denominal	Morphological substitution
O	comando	comandato	D1	Deverbal	Morphological substitution
N	fotografare	fotare	D1	Denominal	?
	battente	bassante	W	X	neologism
	sciando	sciato	D1	Denominal	Morphological substitution

Note. Morphological substitution, Morphological insertion, Morphological deletion = different phenomena of Morphological Paraphasias. Phonemic deletion and Phonemic insertion = different phenomena of Phonemic Paraphasias

Table 21 - Ill-formed Productions and Error Type - Input: Conversion VS Output: Suffixation

	OUTPUT: SUFFIXATION				
	Target Item	Produced Item	C/W	Item Type	Error Type
	cinta	cintura	D2	Deverbale	Morphological insertion
	sosta	sosta**tura**	D1	Deverbale	Morphological insertion
	crescita	cresci**zione**	D1	Deverbale	Morphological insertion
	faticato	faticizzato	D1	Denominale	Morphological insertion
	concimare	cimentizzare	W	X	Neologism
I	domanda	domanda**zione**	D2	Deverbale	Morphological insertion
N	mangiata	mangia**zione**	D2	Deverbale	Morphological insertion
P	ricovero	ricoveranza	D2	Deverbale	Morphological insertion
U	remando	remeggiando	D1	Denominale	Morphological insertion
T	concimare	concimizzare	D2	Denominale	Morphological insertion
:	dormita	dormi**zione**	D2	Deverbale	Morphological insertion
C	mangiata	mangia**tura**	D1	Deverbale	Morphological insertion
O	faticato	faticizzato	D1	Denominale	Morphological insertion
N	pugnalato	pugnalizzato	D1	Denominale	Morphological insertion
V	cinta	cin**tura**	D2	Deverbale	Morphological insertion
E	cinta	cin**tura**	D2	Deverbale	Morphological insertion
R	cinta	cin**tura**	D2	Deverbale	Morphological insertion
S	sosta	sosta**tura**	D1	Deverbale	Morphological insertion
I	pettinando	pettineggiando	D1	Denominale	Morphological insertion
O	ricerca	ricerca**tura**	D2	Deverbale	Morphological insertion
N	immaginando	immaginificando	D1	Denominale	Morphological insertion
	remando	remeggiando	D1	Denominale	Morphological insertion
	domanda	domanda**tura**	D1	Deverbale	Morphological insertion
	mangiata	mangia**tura**	D1	Deverbale	Morphological insertion
	stampante	stampa**trice**	D2	Deverbale	Morphological insertion
	stampante	stampa**trice**	D2	Deverbale	Morphological insertion

	arrivo	arriv**aggio**	D2	Deverbale	Morphological insertion
	sospirato	sospificato	D2	Denominale	Morphological insertion
	spinta	spingi**tura**	D2	Deverbale	Morphological substitution + insertion
	parcheggiando	parchizzando	D2	Denominale	Morphological insertion
	fioccando	fioccheggiando	D2	Denominale	Morphological insertion
I	ricerca	ricerca**tura**	D2	Deverbale	Morphological insertion
N	baciata	bacizzata	D2	Denominale	Morphological insertion
P					Morphological
U	stretta	stringi**tura**	D2	Deverbale	substitution + insertion
T	scritta	scrit**tura**	D2	Deverbale	Morphological insertion
:	arrivo	arriv**aggio**	D2	Deverbale	Morphological insertion
C	comando	comandaggio	D2	Deverbale	Morphological insertion
O	spinta	spin**zione**	D1	Deverbale	Morphological insertion
N	parcheggiando	parchizzando	D2	Denominale	Morphological insertion
V	ricerca	ricerca**tura**	D2	Deverbale	Morphological insertion
E					Morphological
R	stretta	stringi**tura**	D2	Deverbale	substitution + insertion
S	comando	condeggiato	W	X	Neologism
I	spinta	spin**zione**	D1	Deverbale	Morphological insertion
O	ricerca	ricerca**tura**	D2	Deverbale	Morphological insertion
N					Morphological
	stretta	stringi**tura**	D2	Deverbale	substitution + insertion
	scritta	scrit**tura**	D2	Deverbale	Morphological insertion
	arrivo	arrivaggio	D2	Deverbale	Morphological insertion
	spinta	spingi**tura**	D2	Deverbale	Morphological insertion
	fioccando	fioccheggiando	D2	Denominale	Morphological insertion
	ricerca	ricerca**tura**	D2	Deverbale	Morphological insertion
	regalato	regaleggiato	D1	Denominale	Morphological insertion
	baciata	bacizzata	D2	Denominale	Morphological insertion

	stampante	stampatrice	D2	Deverbale	Morphological insertion
	stretta	string**itura**	D2	Deverbale	Morphological substitution + insertion
	scritta	scrit**tura**	D2	Deverbale	Morphological insertion
	spinta	sping**itura**	D2	Deverbale	Morphological substitution + insertion
	stampante	stampatrice	D2	Deverbale	Morphological insertion

Table 22 - Ill-formed Productions and Error Type - Input: Suffixation VS Output: Conversion

	OUTPUT: CONVERSION				
	Target Item	Produced Item	C/W	Item Type	Error Type
	nutrimento	nutrito	D1	Deverbale	Morphological deletion
	fraternizzare	**fraternare**	D2	Denominale	Morphological deletion
	costruzione	costruita	D1	Deverbale	Morphological deletion
	pietrificare	petrare	W	Denominale	Morphological deletion
	vaporizzata	vaporata	D2	Denominale	Morphological deletion
	prolificato	prolifato	D1	Denominale	Morphological deletion
	fraternizzare	**fratellare**	D1	Denominale	Morphological substitution
	agonizzare	agonare	D1	Denominale	Morphological deletion
	lampeggiando	lampando	D2	Denominale	Morphological deletion
I	**fraternizzare**	fraternare	D2	Denominale	Morphological deletion
N	**demonizzando**	demoniando	D2	Denominale	Morphological deletion
P	**nutrimento**	nutrito	D1	Deverbale	Morphological deletion
U	**fraternizzare**	**fratellare**	D1	Denominale	Morphological substitution
T	**spostamento**	sposto	D1	Deverbale	Morphological deletion
:	**fraternizzare**	**fratellare**	D1	Denominale	Morphological substitution
	demonizzando	demoniando	D2	Denominale	Morphological deletion
S	**pietrificare**	pietrare	D2	Denominale	Morphological deletion
U	**cornificare**	cornare	D1	Denominale	Morphological deletion
F	**demonizzando**	demoniando	D2	Denominale	Morphological deletion

F	pietrificare	pietrare	D2	Denominale	Morphological deletion
I	prolificato	prolifato	D1	Denominale	Phonemic deletion
X	cornificare	cornare	D1	Denominale	Morphological deletion
A	demonizzando	demoniando	D2	Denominale	Morphological deletion
T	vaporizzata	vaporata	D2	Denominale	Morphological deletion
I	pianificare	pianare	D2	Denominale	Morphological deletion
O	ondeggiare	ondare	D2	Denominale	Morphological deletion
N	fiammeggiando	fiammando	D1	Denominale	Morphological deletion
	polemizzare	polemicare	D1	Denominale	Morphological deletion
	ramificato	ramato	D1	Denominale	Morphological deletion
	sorseggiare	sorsare	D1	Denominale	Morphological deletion
	cambiamento	cambio	D2	Deverbale	Morphological deletion
	ramificato	mericato	W	X	Neologism
	vaporizzata	vaporata	D2	Denominale	Morphological deletion
	cambiamento	cambio	D2	Deverbale	Morphological deletion
	scrittura	scriva	D2	Deverbale	Morphological substitution
	scandalizzare	scandalare	D1	Denominale	Morphological deletion
	ondeggiare	ondare	D2	Denominale	Morphological deletion
	temperino	temperante	D2	Deverbale	Morphological substitution
	cambiamento	cambia	W	Deverbale	Morphological deletion
	ondeggiare	ondare	D2	Denominale	Morphological deletion
	ramificato	ramato	D1	Denominale	Morphological deletion
	polemizzare	polemicare	D1	Denominale	Morphological deletion
	pianificare	pianare	D2	Denominale	Morphological deletion
	polemizzare	polemicare	D1	Denominale	Morphological deletion

Table 23 - Ill-formed Productions and Error Type - Input: Suffixation VS Output: Suffixation

	OUTPUT: SUFFIXATION				
	Target Item	Produced Item	C/W	Item Type	Error Type
	cornificare	cornizzare	D2	Denominale	Morphological substitution
	lampeggiando	lampiggiando	W	Denominale	Phonemic pharapashia
	misurino	misuraio	D1	Deverbale	Morphological substitution
	demonizzando	demonificando	D1	Denominale	Morphological substitution
	lavorazione	lavoratura	D2	Deverbale	Morphological substitution
I	conservatorio	conversatorio	W	Deverbale	Phonemic pharapashia
N	corteggiare	cortificare	D2	Denominale	Morphological substitution
P	misurino	misuratore	D2	Deverbale	Morphological substitution
U	lavorazione	lavoramento	D1	Deverbale	Morphological substitution
T	prolificato	prolifeggiato	D2	Denominale	Morphological substitution
:	condizionatore	condizionaio	D2	Deverbale	Morphological substitution
S	bruciatura	bruciazione	D2	Deverbale	Morphological substitution
U	conservatorio	conservario	D1	Deverbale	Morphological substitution
F	spostamento	spostaggio	D2	Deverbale	Morphological substitution
F	corteggiare	cortificare	D2	Denominale	Morphological substitution
I	misurino	misuratore	D2	Deverbale	Morphological substitution
X	pietrificare	pietrizzare	D1	Denominale	Morphological substitution
A	lavorazione	lavoratura	D2	Deverbale	Morphological substitution
T	colino	colaio	D2	Deverbale	Morphological substitution
I	lampeggiando	lampizzando	D1	Denominale	Morphological substitution
O	colino	colaio	D2	Deverbale	Morphological substitution
N					Phonemic pharapashia +
	prolificato	profileggiato	W	X	Morphological substitution
	agonizzare	agoneggiare	D2	Denominale	Morphological substitution
	lampeggiando	lampizzando	D1	Denominale	Morphological substitution
	colino	colitore	D1	Deverbale	Morphological substitution

	condizionatore	condoniatura	W	X	Neologism
	misurino	misuratore	D2	Deverbale	Morphological substitution
	lavorazione	lavoratura	D2	Deverbale	Morphological substitution
	demonizzando	demoficando	W	X	Phonemic pharapashia
	pianificare	pianeggiare	D1	Denominale	Morphological substitution
	scandalizzare	scandizzare	D2	Denominale	Morphological substitution
	nidificando	nidificato	D1	Denominale	Morphological substitution
I	vaporizzata	vaporificata	D1	Denominale	Morphological substitution
N	laboratorio	laboraio	D2	Deverbale	Morphological substitution
P	fiammeggiando	fiammificando	D2	Denominale	Morphological substitution
U	polemizzare	polemificare	D2	Denominale	Morphological substitution
T	sorseggiare	sorsificare	D2	Denominale	Morphological substitution
:	nidificando	nidificato	D1	Denominale	Morphological substitution
S	adorazione	adoramento	D1	Deverbale	Morphological substitution
U	bollitore	bollore	D1	Deverbale	Morphological substitution
F	scandalizzare	balandizzare	W	X	Neologism
F	rottura	rotture	W	Deverbale	Morphological substitution
I	adorazione	adoramento	D1	Deverbale	Morphological substitution
X	distributore	distributaio	D1	Deverbale	Morphological substitution
A	polemizzare	polezzare	W	Denominale	Morphological substitution
T					Phonemic pharapashia +
i	sorseggiare	sortificare	W	X	Morphological substitution
O	rottura	rompitura	D2	Deverbale	Morphological substitution
N	vaporizzata	vaporificata	D1	Denominale	Morphological substitution

Table 24 - Input VS Output Suffix Employment - Productions

INPUT SUFFIX	OUTPUT SUFFIX 1	OUTPUT SUFFIX 2	OUTPUT SUFFIX 3
Instrument			
-ino	-aio colaio misuraio	-tore colitore misuratore	
-tore	-aio condizionaio distributaio	-ore bollore	-tura condoniatura
Action			
-zione	-tura lavoratura	-mento lavoramento adoramento	
-mento	-aggio spostaggio		
-tura	-zione bruciazione	-ture rotture	
Place			
-torio	-ario conservario	-aio laboraio	

Table 25 - Property Item - Stems and Suffixes, Input VS Output

	OUTPUT													
INPUT	Property Item	Agent	Athematic Stem	Action	Intransitive	Place	NR	State	Instrument	Participle Stem	Present Stem	Transitive	X	Beneficiary	Total
	Action		1	62			16			3	4				86
	Suffixation		1	62			16			3	4				86
	-mento			19			4			2	4				29
	-tura		1	20			7								28
	-zione			23			5			1					29
	Place	1				18	7						1	1	28
	Suffixation	1				18	7						1	1	28
	-torio	1				18	7						1	1	28
	Intrument	6		2			12		35	1			1		57
	Suffixation	6		2			12		35	1			1		57
	-ino	4					4		20	1					29
	-tore	2		2			8		15				1		28
	Intransitive				131		39						1		171
	Conversion				68		17						1		86
	Suffixation				63		22								85
	-eggi-				22		6								28
	-ific-				18		10								28
	-izz-				23		6								29
	Transitive						41					130			171
	Conversion						21					64			85
	Suffixation						20					66			86

-eggi-						6						23			29
-ific-						8						21			29
-izz-						6						22			28
Athematic		30	16			9			1				1		57
Conversion		30	16			9			1				1		57
Participle Stem			5			12		4	34	2					57
Conversion			5			12		4	34	2					57
Present Stem			13			10	2		1	31					57
Conversion			13			10	2		1	31					57
Total	7	31	98	131	18	146	2	39	40	37	130	4	1		684

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