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Silence and Ageing. A Correlation Between Pauses and Dementia[1]

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A large body of research highlights both an increased frequency of and a consistent trend for longer silent pauses in Alzheimer's Disease (AD). It has been shown that such phenomena mostly contribute to lexical retrieval within that condition. In the present paper, we analyze disfluencies in the spoken production of elderly Italian patients with and without AD with the aim of illustrating the correlation between Alzheimer's Disease, Mild Cognitive Impairment (MCI) and both the duration and collocation of Silent Pauses (SP). We hold the view that identifying a detectable parameter of AD would help diagnosis by making it noninvasive, inexpensive and easier. This research's main finding is that the observation of acoustic parameters' such as SP duration and Speech Rate could effectively help mild AD diagnosis. In conclusion, it became clear that SP longer than 1 second should be particularly addressed.

Keywords: Pathological Speech, Alzheimer's Disease, Silent Pauses, Mild Cognitive Impairment, Clinical Linguistics

1. *Introduction*

Dementia is a broad term for memory loss which applies to a range of conditions, such as cerebrovascular dementia, Fronto-Temporal Degeneration, Hippocampal Sclerosis, and so on. However, Alzheimer's Disease (AD) represents the leading cause of dementia worldwide (Brookmeyer et al. 2007; Govindaraju 2022), by accounting for 60–80% of dementia cases (https://www.alz.org/alzheimers-dementia/what-is-alzheimers, last accessed May 29, 2026). It is a multifactorial progressive neurological disorder with a growing impact on public health in terms of incidence, prevalence, mortality rates and costs of care (Alzheimer's Association 2024). Its exact pathogenesis is not yet fully understood. However, several hallmarks have been identified including loss of brain tissue, death of neurons, ac-

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cumulation of protein beta amyloid outside neurons. One of the first reliable signs of AD is a decline in discourse abilities (Mueller et al. 2018; Yuan et al. 2021). Taking into account language, AD is associated with conditions such as aphasia and dysarthria (Ferris, Farlow 2013), lexical retrieval difficulties, reduction of lexical richness and subsequent loss of fluency (Visch-Brink et al. 2009; Banovic et al. 2018), both complex syntactic structure comprehension difficulties and a decrease in their production (Kempler et al. 1998; Chapin et al. 2022) and variation in acoustic parameters, such as F0, speech rate and disfluencies (Meilán et al. 2014; Campbell et al. 2021; Mahajan et al. 2021; Dovetto et al. 2024, Dovetto et al. 2025). Mild Cognitive Impairment (MCI), on the other hand, is a clinical condition, considered to be AD's prodromal stage (Galvin, Sadowsky 2012). It affects cognitive domains such as memory, attention or language, but not to the extent that it interferes with a person's ability to carry out daily activities. The main impairments concern discourse and pragmatics: compared to healthy controls, individuals with MCI produce less coherent and less informative discourse, with more irrelevant details and incomplete content, although their overall discourse remains more efficient than that of AD patients. Despite these difficulties, they can still produce an adequate number of information units (Drummond et al. 2015, 9). People with MCI due to the onset of AD have biomarker evidence of Alzheimer's brain changes (Alzheimer's Association 2024). Among those diagnosed with MCI due to AD, nearly half develop dementia within three to five years (Glynn et al. 2021; Ward et al. 2013).

Delaying the onset of dementia by diagnosing it in its prodromal stage would be highly desirable (Pastoriza-Dominguéz et al. 2022; Livingston et al. 2017). Likewise, identifying parameters that enable early noninvasive and stress-free diagnosis is crucial. Language may offer a valuable source for such indicators (Zhang et al. 2025; Gagliardi, Tamburini 2025). Moreover, identifying an acoustic parameter, such as silent pause duration, may have useful practical implications: the automatic recognition of linguistic pathological markers would encourage noninvasive and inexpensive procedures.

The main aim of the present study is to contribute to the advancement of research in this direction by providing new Italian data on AD, which remain relatively sparse; indeed, there is a lack of Italian AD accessible corpora, with the exception of that of Beltrami and colleagues (2016), Martinelli and Gagliardi (2023) and Sigona and colleagues (2025). In particular, we will examine whether pauses, both in terms of duration and distribution, may be a valid AD linguistic marker. The present paper will be organized as follows: after an introduction on the role of pauses in both typical and atypical speech, materials and methods of the current research will be presented. Then, the data collected will be discussed. Data so far appear to support the hypothesis that pause-related parameters may also serve as valid diagnostic indicators in an Italian sample.

2. *Typical speech*

When we speak, the message we intend to convey does not rely solely on our words: proxemics, prosody, even hesitation phenomena are crucial (Corley, Stewart 2008, 589; Lickley

2015). However, as they make speech discontinuous, disfluencies have long been thought of as mere errors; relegated to the performance level, "false starts, deviations from rule, changes of plan in mid-course" have long been overlooked (Chomsky 1965, 4). Nonetheless, besides being due to replanning or physiological necessities, phenomena such as silent and filled pauses, repetitions and prolongations constitute a mean to build efficient communication (Dovetto 2010, 64; Bartolomeo et al. 2013, 228; Allwood 2017, 3).

It is necessary to interpret self-monitoring as an integral part of language production (Crocco, Savy 2003, 2) that presents its own constraints (Levelt 1983). Silent pauses often recur at the major syntactic boundaries of the utterance: as a result, the collocation of hesitation phenomena seems to hold its own grammaticality (Goldman-Eisler 1968; Duez 1982).

Gallo and Schettino (2025) argue that prolongations – i.e., the lengthening of sounds beyond their canonical duration, typically characterised by reduced intensity and a more stable, periodic phonation – also serve specific communicative functions. They classify these phenomena into four functional categories: hesitation (a general planning function), structuring (the organisation of information), word-finding (difficulty in lexical retrieval), and focalisation (the highlighting of semantically relevant elements). Their findings show that prolongations associated with lexical search tend to be longer and display lower intensity and fundamental frequency (F0), whereas those related to structuring are characterised by higher F0 and greater intensity (Gallo, Schettino 2025, 165 ff).

Schettino and colleagues (2022, 183) show that, despite some individual variability, Italian and Spanish speakers systematically employ disfluency phenomena, with both shared patterns and language-specific dynamics. In both languages, segmental prolongations are more frequent than filled pauses and are mainly used in word-final position to gain time for general planning and lexical retrieval. Filled pauses, by contrast, tend to occur when speakers need additional time to plan and introduce a new proposition. Moreover, filled pauses are on average longer in duration than prolongations, confirming their more salient role, whereas prolongations function as a more subtle and economical strategy for managing speech.

Obviously, some disfluencies are randomly distributed throughout the text, an ambiguity that can be easily explained when considering their high degree of multifunctionality. Indeed, hesitation phenomena, particularly pauses, may be employed as strategies to avoid error (Hieke 1981). They may have a cooperative function into the management of dialogic exchange (Clark 1994), or reflect underlying processes of planning and lexical retrieval needs (Maclay, Osgood 1959).

3. *Atypical speech*

Atypical pausing arises in many pathologies (Ramig et al. 1995; Shea, Leonard 2019; Yuan et al. 2021). Indeed, both neurodevelopmental and neurodegenerative disorders have been found to be linked with disfluency parameters' modifications. In particular, a correlation between silent pause duration and collocation and language pathologies has been highlighted (Gayraud et al. 2011, 13; Schettino et al. 2023).

In the context of developmental disorders, a link has been observed between such conditions and a variation in hesitation-related parameters (Guo et al. 2008; Finneran et al. 2009; Marra 2021). For instance, in their study of hesitation phenomena and bilingualism, Fichman and Altman (2024) show that a higher ratio of long pauses and repetition of content words in bilingual children with Developmental Language Disorder is due to their difficulties in dealing with the planning necessities of storytelling and reflects lower proficiency in the second language.

Considering neurodegenerative disorders, disfluencies' frequency in Parkinson's Disease (PD) has been shown to be linked with poorer motor function (Gooch et al. 2023), while it seems to be due to lexical retrieval difficulties in Alzheimer's Disease (Gayraud et al. 2011). In particular, silent pause duration varies between AD or PD individuals and healthy controls, whilst its incidence appears to vary only in AD (Gayraud et al. 2011; Schettino et al. 2023; Maffia et al. 2023; Dovetto et al. 2024). According to Maffia and colleagues (2023, 126), disfluency in early-stage Parkinson's Disease (PD) can be described by distinguishing between Forward-Looking (planning-related) and Backward-Looking (repair-related) phenomena. While PD patients and healthy controls show similar overall frequencies of disfluency, PD speakers exhibit a greater need for repair, producing more substitutions and bridging repetitions. They also more frequently interrupt words internally, whereas healthy speakers place disfluencies between larger syntactic units. Additionally, PD patients produce longer pauses. These patterns are influenced by cognitive and depression scores, suggesting that disfluency reflects a progressive deterioration of physiological conditions and adaptive speech management strategies.

Now shifting to AD, patients tend to produce more between-utterances pauses than controls, thus showing a greater need for speech planning and memory recall; moreover, pauses in early AD seem to reflect a compensatory strategy for strengthening memory retrieval (Pistono et al. 2017; Pistono et al. 2019). When considering AD pauses in relation to MCI, it seems that there is a gradation in pause duration that is group-dependent: Pastoriza-Domínguez and colleagues (2022) have shown that HC pauses are shorter than MCI's and that MCI's are shorter than AD's. Moreover, the MCI group is itself heterogeneous: pause duration of MCI individuals with encoding memory deficit is longer than that of MCI individuals with only retrieval impairment.

Löfgren and Hinzen (2022) aimed to characterize the pausing profile of individuals with AD by examining the syntactic distribution of pauses. They showed that silent pauses increase in AD and are not restricted to within-clause positions, which are most directly associated with lexical retrieval difficulties. Instead, they seem to be confined to nouns, thus revealing a grammatically specific difficulty related to the referencing of objects.

As a result, several scholars agree on the usefulness of considering silent pauses in AD diagnosis (Khatri et al. 2024; Braun et al. 2024). Khatri and colleagues (2024) proposed that considering both silent pause duration and collocation may help in detecting early AD. Indeed, they have found that incorporating the context in which silent pauses have been produced significantly improves the accuracy of AD classification.

4. *Materials and Methods*

Data discussed below is a sample of the FRA corpus, that is a corpus of semi-spontaneous speech of elderly individuals with and without neurodegenerative disorders developed within the framework of the DISAGE project (*DISease and AGEing – Language Corpora for the Assessment of Spontaneous Speech in Alzheimer's Disease and Mild Cognitive Impairment*)[2].

FRA includes a total of 60 interviews (20 AD, 20 MCI, 20 HC), conducted with native Italian speakers aged between 60 to 85 years, all right-handed and with a minimum of five years of education. The corpus comprises audio recordings collected through structured interviews consisting of three distinct tasks, each designed to elicit different types of spontaneous speech. All participants underwent neuropsychological screening, including the Mini-Mental State Examination (MMSE; Folstein, Folstein, and McHugh 1975) and Raven's Coloured Progressive Matrices (Raven 1941). Only individuals with mild AD (MMSE ≥ 19/30) and amnestic MCI were recruited (Dovetto, Marra 2024).

4.1 Participants

For the purposes of this research, a subset of the FRA corpus was carefully selected so that the participants were matched for sex, age and education level (≥ 5 years of schooling)[3]. In all, 12 participants were examined, 4 per each group (4 AD, 4 MCI, 4 HC), whose sociolinguistic data are summarised in the table below (Tab. 1). Participants were recruited at the University Hospital "Federico II" in Naples, in collaboration with the Center for Dementia and Cognitive Disorders and the Hematology Unit. Exclusion criteria for the control group (HC) included the presence of psychiatric or neurological disorders, sensory impairments, and scores below the cut-off on the MMSE (23.8, according to Folia et al. 2022) or on the Raven Matrices.

[2] DISAGE is a project co-funded by the University of Naples Federico II and Banca Intesa Sanpaolo. The FRA corpus is the project's main output, developed within the framework of the 'Finanziamento della Ricerca di Ateneo' (FRA, 'University Research Funding') programme.

[3] The wide range of educational backgrounds is attributable to the recruitment setting, namely a hospital environment. Some of the participants were patients undergoing treatment in the ward, while others had been recently admitted for diagnostic assessment, whilst the control subjects were often relatives or caregivers of the patients who were accompanying them to the hospital for a follow-up appointment or their initial consultation. Therefore, as many subjects as possible were recruited to fit the research criteria: we enrolled patients diagnosed with AD or amnestic MCI who did not present other pathological conditions, whose MMSE score exceeded the minimum threshold of 19 points and that were matched for age, sex, background and years of education. This resulted in a heterogenous, yet one-to-one matched, sample. In addition, the subsample presented here represents a small part of the entire FRA corpus, which comprises a total of sixty subjects divided into three groups (AD, MCI and HC) and one-to-one matched across groups.

Table 1 - *Sociolinguistic Data of Participants*

	age	*sex*	*origin*	*MMSE*	*YoE*
AD	70–78 MA 74	2 M 2 F	Campania, Italy	23–26/30 M 24.25	5–13 M 11
MCI	68–78 MA 73.5	2 M 2 F	Campania, Italy	23–30/30 M 26.25	5–13 M 9.75
HC	65–78 MA 72.75	2 M 2 F	Campania, Italy	28–29/30 M 28.5	5–13 M 11

4.2 Materials

Interviews were carried out on the basis of a three-step procedure, which consisted of three language tasks designed to elicit different types of oral production. First, a picture description task was conducted, in which participants described a complex image from ENPA (Capasso, Miceli 2001); follow-up questions were intended to elicit semi-spontaneous speech. Second, a guided conversation was conducted, structured into three sections to elicit discursive speech on familiar topics. Lastly, participants performed a free recall and narration of the fairy tale "Little Red Riding Hood," to stimulate spontaneous narrative production[4].

4.3 Methodology

Audio recordings (44 kHz, 16-bit) were collected using Zoom H4nPro recorders in clinical environments that, while not soundproofed, were adequate for verbal communication. Orthographic transcriptions were manually produced by a trained transcriber following the guidelines of the CLIPS corpus (Savy 2006), and subsequently reviewed by a second annotator. All files were pseudonymized using data masking techniques and accompanied by metadata sheets including demographic and clinical information. Annotations were performed in PRAAT (Boersma, Weenink 2024) across three distinct tiers:

1. G/F tier: interviewer (Giver) and interviewee (Follower) turns.
2. G/F pauses tier: within-turn silent pauses.
3. Inter-turn tier: between-turn silent pauses.

The transcription system faithfully reflects the speakers' linguistic production, including semi-lexical phenomena (e.g., hesitations, repetitions, self-corrections), non-lexical phenomena (e.g., paralinguistic vocalizations), dialectal markers, and pauses.

To test the hypothesis of a correlation between hesitation phenomena and AD, a detailed analysis of disfluencies was conducted. Manual annotation of silent pauses was carried out in PRAAT on a dedicated tier (i.e., Pause Tier). Several threshold values have been proposed in order to distinguish between long and short silent pauses: Hird and Kirsner (2010) set this barrier at 268 ms, Rosen and colleagues (2010) at 323 ms, Angelopoulou

[4] Informants are asked to briefly recall, if they can, the story of Little Red Riding Hood. For a more extensive introduction to the FRA corpus and its methodology, see Dovetto and Marra (2024).

and colleagues (2018) at 338 ms. As a general rule, silent pauses fall into three main groups: short (<200 ms), intermediate (200–1000 ms) and long pauses (>1000 ms) (Campione, Véronis 2002)[5]. For our purposes, all pauses longer than 150 ms were selected via Duration Logger Script (DiCanio 2011).

5. *Analysis*

For the purposes of the present survey, selected disfluencies have been extracted; in particular, all SPs have been drawn by running a duration logger Script (Di Canio 2011) in PRAAT, while other typologies by means of a Colab script designed *ad hoc*. Only four types of hesitation phenomena have been taken into account, the ones upon which scholars seems to agree (Guo et al. 2008): Silent Pauses (SPs), that is the absence of phonation during spoken discourse; Filled Pauses (FPs), that is non-lexical one-syllable fillers; Prolongations (P)[6], that is the hold of vowels or consonants during spoken discourse; Repetitions (R), that is the reiteration of sounds, syllables, or words.

After having labelled our disfluencies according to their typology, we observed how often they occurred in the course of the narrative task under consideration. Then, we looked at different parameters, such as the duration of SPs, location and function of each pause. As SPs were the most frequent type (49%), followed by prolongations (27%), FPs (17%), and repetitions (7%), our quantitative analysis has focused exclusively on SPs, to which the next paragraph will be devoted. In addition, other hesitations will be discussed from a qualitative perspective in the last paragraph of the current section.

5.1 SPs, Speech to Silence Ratio, Speech and Articulation Rate: a quantitative analysis

SPs were selected as the starting point of the analysis, given that they account for 49% of all detected hesitation phenomena. In order to assess the potential of SPs as markers for AD, all SPs produced by the interviewee exceeding 150 milliseconds were investigated. The investigation focused on the average duration of SPs, their frequency and task-specific duration across the three groups (AD, MCI, HC), and the overall speech-to-silence ratio observed in each group. All analyses were carried out using R (R Core Team 2024) via RStudio (RStudio Team 2024).

Preliminary observations indicated that participants with cognitive impairment tend to produce SPs that are both more frequent and of longer duration compared to healthy controls (see Table 2). These findings motivated a more detailed exploration of SPs duration and its variability across tasks.

[5] For a more in-depth discussion of the issue see Pastoriza-Dominguez and colleagues (2022, 113–114).

[6] The prolongations were detected on a perceptual basis.

Table 2 - *Preliminary Observations on SPs*

Group	*SPs occurences*	*SPs mean duration*
AD	417	0.954 s
MCI	575	0.811 s
HC	202	0.659 s

Linear mixed-effects models were used to analyze the data, as the observations were clustered and exhibited variability across units, with unequal numbers of observations per group due to the nature of interview-based, semi-spontaneous speech data; thereby we avoided artificial sample balancing procedures. This approach accounts for the hierarchical structure of the data and the resulting unbalanced design, allowing for appropriate modeling of variability both within and between groups.

We first checked whether speech turns were longer in the healthy group (HC). Pairwise comparisons were conducted on the estimated marginal means (EMMs) to assess differences between groups. No statistically significant differences in turn duration were found among the AD, MCI, and HC groups (all $p > 0.05$; AD vs. HC: $p = 0.2316$; AD vs. MCI: $p = 0.5169$; HC vs. MCI: $p = 0.8237$). However, a descriptive trend toward longer turn durations was observed in the HC group compared with the MCI and AD groups.

Then, we estimated the average duration of all silent pauses produced by each group. The mixed-effects linear model did not reveal any significant differences in the duration of pauses between the groups (all $p > 0.05$; in particular, AD vs. HC $p = 0.3156$; AD vs. MCI $p = 0.7500$; HC vs. MCI $p = 0.7333$), although the estimated mean values suggest longer pauses in the AD group compared with the MCI and HC. Although the mean pause duration showed a tendency to increase from the HC to the AD group, this variation did not reach statistical significance. Nevertheless, it is important to note that the sample size was relatively small, which may have limited the ability to detect subtle effects.

A linear mixed-effects model revealed a significant main effect of task on pause duration ($F(2, 1165.77) = 37.85$, $p < 0.001$), indicating that pause duration varied across tasks. However, no significant main effect of group was observed ($F(2, 11.12) = 2.69$, $p = 0.112$), nor was the group × task interaction significant ($F(4, 1166.34) = 1.59$, $p = 0.175$). Overall, these results suggest that while pause duration is modulated by task type, it does not differ significantly across diagnostic groups, nor does the effect of task vary by group.

The analysis of pause frequency revealed significant group differences based on pairwise comparisons of estimated marginal means (EMMs). Specifically, the HC group produced significantly fewer pauses than both the AD ($p = 0.0395$) and MCI ($p = 0.0048$) groups, whereas no significant difference was observed between the AD and MCI groups.

After dealing with SPs' duration and frequency, we investigated the ratio between silence and speech in discourse (See Table 3). Total Pausing Time (TPT), that is total duration of all pauses per sample in second, and Total Locution Time (TLT), that is the amount of time in the sample that contains both speech and pauses, were extracted following Roark and colleagues (2011).

Table 3 - *TPT vs. TLT*

Group	*TPT*	*TLT*
AD	400.737 s	1620.231 s
MCI	475.058 s	3483.225 s
HC	146.015 s	1743.802 s

Then, the ratio between TPT and TLT per group was calculated. The results revealed that SPs accounted about 8% of the total locution time (TLT) in the HC group, 14% in MCI, and 25% in AD.

We then assessed the pause ratio using the Kruskal-Wallis rank sum test; this revealed that the groups do not differ significantly in terms of the pause ratio, but there is a consistent pattern of variation (p-value = 0.063). The result is not statistically significant at the 0.05 level, but very close to the threshold (a strong trend is evident). A direct comparison between the AD and HC groups revealed a trend towards a difference in the ratio of pause time to speech time (Wilcoxon rank-sum test: W = 15, p = 0.057), suggesting a possible greater fragmentation of speech in the AD group compared with the controls, although this was not statistically significant.

Lastly, Speech Rate (SR) and Articulation Rate (AR) were measured. Speech Rate indicates the ratio between the number of syllables actually uttered, including disfluencies in the total duration of the utterance. The total duration of the utterance refers to the overall length of the participant's verbal production, including both speech sequences and silent pauses. It therefore corresponds to the sum of the participant's speaking turns within the analyzed time span (Pettorino, Giannini 2005, 91). AR indicates the ratio of the number of syllables uttered to the time taken to produce them (syll/s) (Pettorino, Giannini 2005; Roark et al. 2011). SR, that is all syllable produced including dysfluencies in the TLT, varies in a significant way between the 3 groups (one-way ANOVA F = 7.163; p = 0.003; F crit = 3.354): it is interesting to note the discrepancy between SR and AR in the AD group, as this highlights how dementigenic patients tend to produce more disfluencies than controls over the total amount of speech produced (see Tab. 4).

Table 4 - *Speech Rate and Articulation Rate*

Group	*SR*	*AR*
AD	3.212 syllables/s	4.942 syllables/s
MCI	4.207 syllables/s	4.810 syllables/s
HC	4.219 syllables/s	4.441 syllables/s

5.2 SPs, FPs, Prolongations and Repetitions: a qualitative analysis

Subsequently, the analysis was extended to the position and function of hesitation phenomena, with the aim of determining whether these features might assist in differentiating dementia-related pathologies from typical aging. To this end, a subset of disfluencies was

extracted from the storytelling task involving the narrative of Little Red Riding Hood. These instances were then categorized based on typology, position, and communicative function, in order to identify potential distributional patterns.

As mentioned before, our classification included four disfluency types: Silent Pauses (SPs), Filled Pauses (FPs), Repetitions (R), and Prolongations (P) (See Tab. 5).

Table 5 - *Disfluency's Tags*

Type	*Tag*	*Example*
SP	<pause dur="0.412s"/>	è andata col paniere nel bosco <pause dur="0.412s"/> e nel bosco ha trovato il lupo
FP	<eeh>	non doveva <eeh> <pause dur="0.734s"/> perdere tempo
R	{<repetition> ... </repetition>}	'{<repetition> *mia*<aa> <pause dur="0.597s"/> *mia* </repetition>}' zia
P	<VV> , <CC>	mi<ii> impegno

Regarding positional criteria, each phenomenon was categorized as either external if grammatical (i.e., occurring at syntactic boundaries) or internal if not (i.e., embedded within syntactic constituents).

Disfluencies were labelled as external when they marked major syntactic boundaries, as in (1):

(1) DGmaB01N, F#98[7]: È amp+ / andata col<ll> paniere nel bosco <pause dur="0.412s"/> e<ee> nel bosco ha trovato<oo> <inspiration> Cappuccett+ <eeh> / <ll>le+ / {<dialect> comm' s' chiamm' </dialect>} / il lupo <pause dur="0.514s"/>

è	and-at-a	co-l	paniere	ne-l	bosco	SP
AUX	go-PTCP.F	INS-DET	basket	LOC-DET	woods	SP

she went with the basket into the woods

e	ne-l	bosco	ha	trov-at-o	il	lupo
and	LOC-DET	woods	AUX	find-PTCP.F	DET	wolf

and into the woods she found the wolf

Here the hesitation phenomenon, a silent pause (SP), marks the boundary between the first clause, [$_{s1}$ è andata col paniere nel bosco], and the second, [$_{s2}$ e nel bosco ha trovato il lupo], in a complex sentence, which clearly states its syntactical nature.

[7] For each example, we have reported its source file (i.e., DGmaB01N) and the conversational turn in which it occurs (i.e., F#98). The file name indicates the type of speech (i.e., DG: dialogic), the group to which it belongs (i.e., ma, mci or ad), the speaker's identifier (i.e., capital letter), the recording number (i.e., 01, 02) and the speaker's origin (i.e., N: Naples). In addition, we first reported the complete utterance as it was transcribed in the corpus; then, the example has been tagged according to the Leipzig Glossing Rules and translated. In the tagged version, the disfluency produced has been indicated by its type, as shown in Table 5.

External disfluencies may separate both independent clauses (2) or main and dependent clause (3):

(2) DGmaL01N, F#50: <mh> <pause dur="4.567s"/> Cappuccetto Rosso era una bambina <pause dur="0.705s"/> <inspiration> andava a scuola

Cappuccetto Rosso	era		una	bambina	SP
Red Riding Hood	be-3SG.COP.IPFV		DET	child	SP
Red Riding Hood was a child					
andava	a	scuola			
go-3SG.IPFV	ALL	school			
she attended school					

(3) DGmciF01N, F#163: nel bosco non ti fermare <inspiration> <eeh> <pause dur="0.240s"/> {<dialect> 'nsomm' a <pp>parlà cu <nn>nisciun' </dialect>}

nel	bosco	non	ti	fermare	FP SP
LOC-DET	wood	NEG	2SG	stop-INF	FP SP
into the woods don't stop					
a	parlare	con	nessuno		
to	talk-INF	COM	anyone		
in order to talk to anybody					

However, not all hesitation phenomena are external. Conversely, many of them fall into a phrase, as the silent pause main $[_{NP}[_{Det}$ mia SP mia] $[_{N}$ zia]] (4):

(4) DGmaL01N, F#48: {<repetition> mia<aa> <pause dur="0.597s"/> mia </repetition>} zia

mia	SP	mia	zia
POSS	SP	POSS	aunt
my aunt			

It seems that some phenomena help lexical retrieval. That is the case of the prolongations accompanied by the filled pause in (5), which both precede the retrieval of a content word:

(5) DGmciQ01N, F#40: e poi alla fine il lupo mangiò<oo> <eh> anche<ee> Cappuccetto

e	poi	il	lupo	mangiò	P FP	anche	P	Cappuccetto
and	ADV	DET	wolf	eat-3SG.PST	P FP	ADV	P	Little Hood
then the wolf also ate Little Red Riding Hood								

Other phenomena seem to cooperate into discourse planning, as that in (6):

(6) DGmciF01N, F#165: corre a casa della nonna <eeh> e<ee> <pause dur="0.143s"/> {<dialect> s' mang' 'a nonn' </dialect>}

corre	a	casa	della	nonna	FP	e	P	SP
run-3SG.PRS	ALL	home	of-DET	grandmother	FP	and	P	SP
si	mangia	la	nonna					
ANTIP	eat-3SG.PRS	DET	grandmother					

he rushes to the grandmother's house and he eats her

In the above example the accumulation of disfluencies can be observed to precede the formulation of the new sentence. Unlike the previous instances, where disfluencies marked the boundaries between utterances, here the speaker uses filled pauses and prolongations to allow for additional processing time during speech. However, in this case too, the hesitation phenomenon marks the utterance boundary and therefore has a syntactic function.

At last, disfluencies may help the speaker in repairing errors, as in (7):

(7) DGmaB01N, F#92: E *<cc>contro il le+ / <eeh> {<repetition> il lupo <pause dur="0.254s"/> il lupo </repetition>}

e	incontra	il	le	FP	il	lupo
and	meet-3SG.PRS	DET	lio	FP	DET	wolf

and she meets the wolf

Here, the interviewee retrieved the wrong lemma, that is lion instead of wolf. That is why the speaker interrupts the flow of speech, gains time by producing a filled pause, and subsequently retrieves the target word.

To conclude, when examining function, between group differences do emerge: indeed, 50% of the phenomena detected in the AD group fulfil the function of lexical retrieval and are therefore non-grammatical (i.e., embedded within syntactic constituents), while in the remaining groups the planning function, signalled by disfluency phenomena of a grammatical nature (i.e., occurring at syntactic boundaries), is of greater importance.

6. *Discussion*

Our results, while not showing statistically significant differences across group (SPs), reveal at least two notable trends. First, the duration of conversational turns appears to vary in a group dependent way, by being longer in HC speakers compared to AD patients. The finding that the conversational turns of HC speakers are longer than those of AD speakers indicates a tendency for the former to have greater confidence in their verbal output; this would appear to confirm their stronger conversational pragmatic skills.

Second, silent pause duration seems to increase in individuals with AD, which implies that it might actually be a valid marker of AD, thus confirming what has been claimed in the literature (Pistono et al. 2016). Clearly, our observations suggest the need for further

analyses, particularly in light of the limited sample size of the subsample of the FRA corpus analysed here. In particular, we believe that it would be useful to more closely examine longer than one second pauses. Given that, for the purposes of this paper, we have examined a subsample of the FRA corpus, we hold the view that the analyses should be repeated on the entire sample within the FRA cohort and supplemented by further analyses of data collected in more controlled settings. Furthermore, our preliminary observations imply that it would be appropriate to particularly address P, that is longer than 1 second SPs, which revealed to be more frequent in patients than controls. Therefore, the option of splitting SPs into three groups according to their length could be fruitful.

Turning now to the relationship between speech and silence, our analyses revealed that Total Silence Time decreases from AD to HC group: indeed, the percentage of silence is greater in AD and decreases progressively from MCI to HC. In addition, SR suggests that AD patients tend to produce more hesitation phenomena than MCI and HC, as well as the frequency of silent pauses increases in the AD group. These findings suggest that silence may represent a compensatory strategy in AD, since Total Pausing Time increases notably in that group.

The collocation of hesitation phenomena further reveals that, since prolongations and repetitions are always internal, they are non-grammatical, whereas SPs and FPs tend to be grammatical. In terms of function, the qualitative analysis of the four types of disfluencies extracted (i.e., SP, FP, R, P) shows that disfluencies in AD support lexical retrieval more than that of MCI and HC groups.

Moreover, disfluencies often correlate to planning necessities and it seems that HC better control their speech, since they do not produce incomplete sentences.

Overall, the narrative task yields informative evidence regarding differences among the three groups, and could represent a valuable tool in supporting the early diagnosis of mild AD, as also demonstrated by Guida et al. (2023) in relation to spontaneous speech in AD. Notably, the descriptive task, which primarily involves naming abilities – despite its widespread use in cognitive assessment batteries – proves least effective in discriminating between the three groups, and in particular in distinguishing pathological from healthy participants.

7. *Conclusion*

The main aim of our research was to make available new Italian data on AD, also in light of the scarcity of accessible Italian AD corpora, with a few exceptions (see Section 1). We maintain that only a large and representative corpus of pathological speech produced by native Italian speakers can lead to reliable interpretations and generalizations of the linguistic data. Accordingly, the relatively limited size of our corpus, together with the wide range of years of schooling considered, should be regarded as a constraint affecting the generalizability of the present findings. The need of new Italian accessible data on AD is particularly pressing, given that the majority of studies – and the corresponding theoretical models – are based on analyses of speech produced by English speakers (a Germanic language), rather than by native speakers of Romance languages such as Italian. Indeed,

we argue that both the type and the occurrence of disfluencies are related to the speakers' geographical background – for instance, a greater tendency towards repetitions rather than vocalizations or prolongations, as demonstrated for regional varieties of Italian by Pettorino and Giannini (2003). At the same time, we consider it essential that the expansion of pathological speech corpora should be pursued in accordance with open-access principles and through transcription and annotation systems that are as comparable as possible, or at least mutually interoperable.

In the present study, in particular, we wondered whether dysfluency phenomena, and their acoustic correlates such as SPs duration, would allow us to discriminate between AD, MCI and HC in order to identify an easy to detect parameter that would help diagnosis by making it effortless, noninvasive, inexpensive and easier. In addition, we explored hesitation phenomena collocation and function too, in order to build up a broader picture on dysfluencies in AD.

It came out that some parameters, such as SPs frequency and SR, could actually help discriminate between AD/MCI patients and control. Furthermore, although our analysis did not yield statistically significant results, it does reveal, at least at a descriptive level, a clear trend: AD tendency to produce longer pauses compared to HC. Bearing in mind the above-mentioned limitations of this study, and in particular the small sample size here taken into account, we believe it is essential to continue working in this direction. Indeed, our preliminary observations also indicate that longer than 1 second pauses should be particularly taken into account, in accordance with previous literature (Dovetto et al. 2024). Clearly, this value (1 sec.) cannot be treated as independent of the specific language under analysis, nor of the broader reflection on the temporal organization of silence, which varies across languages, dialects and also speech styles.

To conclude, silence came out representing a compensatory strategy in AD, since silence ratio decreases from AD to HC. Last, our results also confirm that hesitation phenomena in AD mostly cooperate to lexical retrieval.

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