SPONTANEOUS SPEECH IN PATIENTS WITH ALZHEIMER'S DISEASE: THE ROLE OF AGE OF ACQUISITION

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1. SUMMARY

Among the heterogeneity of symptoms related to Alzheimer's disease (AD), language impairments are already present at the very early stage of cognitive decline (Taler & Phillips, 2008). Because of their involvement in the preclinical phase of the disease, they can be used as clues for early diagnosis and dementia large-scale screenings.

The word retrieval impairment is one of the deficits affecting the language abilities in patients with Alzheimer's disease and it seems to follow the rule of “last-in, first-out” (i.e. the words acquired later are more vulnerable to cognitive decline) (Hodgson & Ellis, 1995). For this reason many studies have tried to use the age of acquisition (AoA) of word as a feature to assess the severity of cognitive decline (Silveri *et al.*, 2002; Forbes-McKay *et al.*, 2005; Rodríguez-Ferreiro *et al.* 2009; Cuetos *et al.*, 2010). Such experiments relied on verbal fluency or picture naming tasks and used two different values of AoA: (i) objective (directly from the children); (ii) subjective (by adult ratings).

In the present study we evaluate the role of AoA in the spontaneous speech of three different populations (early AD, Mild Cognitive Impairment – MCI, healthy controls) by matching the subjects production with two corpora available online containing the two different kinds of AoA: objective (Lotto *et al.*, 2010)[1] and subjective (Barca *et al.*, 2002)[2]. The spontaneous production of subject (n = 96) were collected during the execution of three tasks, elicited by these input sentences: (i) “Describe this picture” (Ciurli *et al.*, 1996); (ii) “Describe your tipical working day”; (iii) “Describe the last dream you had or remember”. This data was collected, transcribed and POS-tagged under the OPLON project (“OPportunities for active and healty LONgevity”, Smart Cities and Community – DD 391/RIC, co-funded by Ministry of Education as part of the Contract “Smart Cities and Communities and Social Innovation”) (Beltrami *et al.*, 2016).

To this end, we automatically match the words (noun) contained in the corpora with the lemmas extracted from each subject production by using a script made in Python. A value of AoA was given to the nouns thus obtained and for each subject and task we calculated the mean of the AoA value of matched nouns. We grouped the data by task, then we used the Kolmogorov-Smirnov nonparametric test to assess the statistical significance (p-value < 0.05) of the AoA feature.

We expected that the subjects affected by cognitive decline would produced a higher number of nouns with a

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1 http://www.dpss.unipd.it/materiali-e-strumenti-di-ricerca
2 http://www.istc.cnr.it/grouppage/lexvar

lower value of AoA and that the more severe is the impairment the more evident is the trend (Forbes-McKay *et al.*, 2005). Further analyses were made to determine the effect of word frequency on age of acquisition and to evaluate the hypothesis according to which the AoA has an independent effect on word retrieval (Morrison & Ellis, 1995).

The results presented here are from a subset of 48 subjects (Control = 21; MCI = 19; AD = 8). As for the corpus based on a subjective values of AoA, we found that it can significantly differentiate control group from the AD group and MCI from AD in two different tasks and in all tasks taken together. The other corpus, the one with objective values of AoA, was able to differentiate only the control group from the AD group in just one task. As expected, the AoA value in the subjects production is inversely proportional to the cognitive decline. Finally, no significance was found with respect to word frequency.

In trying to interpret these results, we have to take into account some limitations of the experimental design. First, this kind of experiments generally relied on verbal fluency task because the spontaneous speech has more intra-personal variability. Moreover, the corpora matched with subjects speech production were too small (626 and 223 tokens respectively), indeed the rate of the recognized nouns was around 40%. Because of the small size of the sample and the corpora, this study must be considered as a pilot study aimed to assess the feasibility of utilizing available corpora to analyzing spontaneous speech. Nevertheless these preliminary results seems to confirm for Italian the tendencies found in previous studies for English: the word acquired later are more vulnerable to cognitive decline. Finally, we validated the reliability of the adult rating as value of age of acquisition (Morrison *et al.*, 1997; Ellis & Morrison, 1998) and that the age of acquisition has an independent effect with regard to word frequency (Morrison & Ellis, 1995).

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