Time reference in Greek, Italian and German agrammatic aphasia: A test of the PAst DIscourse LInking Hypothesis.

Agrammatic aphasia is primarily characterized by (morpho)syntactic impairment in production. It has been suggested that some aspects of the deficit may be observed not only across but also within (morpho)syntactic/functional categories. A number of studies, for example, have consistently found time reference, a semantic category closely related to (grammatical) tense, to be selectively impaired, with past reference more impaired than present or future reference. To account for this pattern, the PAst DIscourse LInking Hypothesis (PADILIH) (Bastiaanse et al., 2011) has been formulated. According to the PADILIH, past reference is more demanding in terms of processing resources than present/future reference, because, unlike the latter, it involves discourse linking. Most of the evidence for the PADILIH has been produced by using the *Test for Assessing Reference of Time* (TART) (Bastiaanse et al., 2008) in different languages. The TART, however, tests participants' ability to "copy and paste" the tense/time reference feature from a source sentence to the target sentence and to retrieve the corresponding verb form/inflection. This test, therefore, only taps into retrieval of verb forms/inflections, leaving unexplored the underlying ability to encode tense/time reference related abstract, prephonological features. Since both encoding and retrieval abilities are involved in time reference (see Faroqi-Shah & Thompson, 2007, and references therein), and given the PADILIH has been formulated based on evidence about retrieval abilities only, one could argue that this hypothesis makes strong claims.

The objective of the present study is to test the validity of the PADILIH taking a cross-linguistic approach. Eleven Greek-, 10 Italian-, and 10 German-speaking

individuals with agrammatic aphasia participated in the study. For each language, 10-14 age- and education-matched control individuals were also tested. Participants were administered a transformational sentence completion task testing past reference and future reference, and tapping both encoding and retrieval abilities.

In all three languages, aphasic participants fared significantly worse than healthy volunteers (in all comparisons, by Fisher's exact test, $p<.05$). At the group level, the performance of German- and Italian-speaking aphasic participants was equally impaired in past and future reference (in both comparisons, $p>.05$) (Figure 1). The Greek-speaking aphasic participants performed significantly better on future reference than on past reference ($p=.024$). In all three languages, however, double dissociations emerged, meaning that some participants performed significantly better on past reference than on future reference, and others exhibited the opposite pattern.

The PADILIH did not gain cross-linguistic support, as only the Greek results were consistent with it. Similar levels of performance on past and future reference in the Italian and German aphasic groups raise the possibility that discourse linking is involved not only in past reference (as the PADILIH assumes) but also in future reference. Alternatively, past and future reference may be impaired for different reasons. Past reference may be impaired because it is discourse-linked, and future reference may be impaired because it refers to possible worlds, which involves more abstract representations compared to past reference. Assuming that past and future reference are associated with different sources of difficulty provides a better account for the double dissociations observed.

References

Bastiaanse, R., Bamyaci, E., Hsu, C., Lee, J., Yarbay Duman, T., & Thompson, C. K.

(2011). Time reference in agrammatic aphasia: A cross-linguistic study. *Journal of Neurolinguistics*, *24*, 652-673.

Bastiaanse, R., Jonkers, R., & Thompson, C. K. (2008). *Test for Assessing Reference of Time (TART)*. Groningen: University of Groningen.

Faroqi-Shah, Y., & Thompson, C. K. (2007). Verb inflections in agrammatic aphasia: Encoding of tense features. *Journal of Memory and Language*, *56*, 129-151.

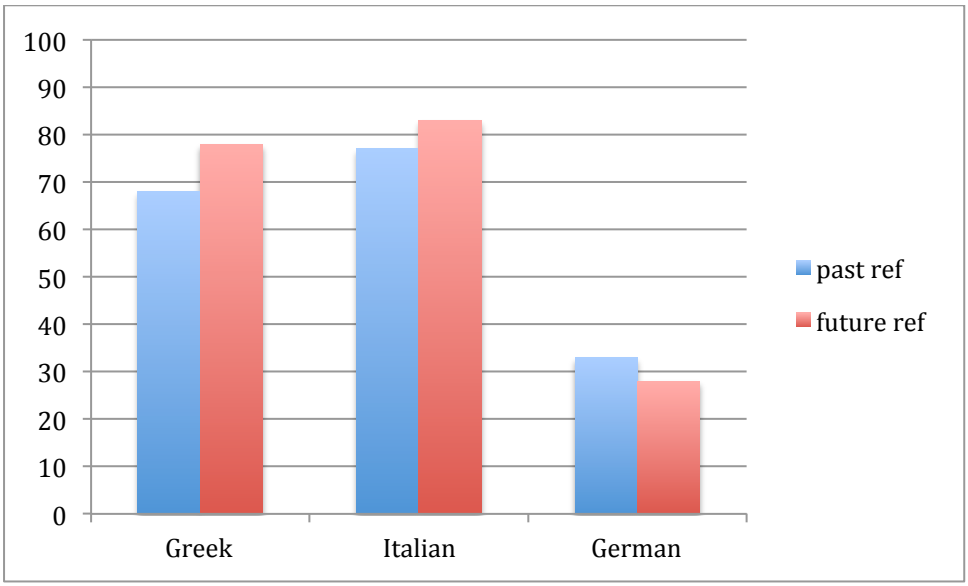

Figure 1. Correct % performance of Greek-, Italian-, and German-speaking aphasic participants.