Age affects the processing of subject-verb agreement (in Italian)

Francesco Vespignani, Luca Artesini and Francesco Pavani (Università di Trento)
francesco.vespignani@unintn.it

Tanner and Van Hell (2014) studied the individual variability in the processing of syntactic violations on English verbs and claimed that the biphasic responses that are typically seen on grandaverages are likely to arise from a superimposition of different individual-level effects (see also McKnight et al., 2018). Differently, Caffarra, Mendoza & Davidson (2017) showed that in relation to determiner-noun violations in Spanish a clear biphasic LAN+P600 can be reliably seen at both individual and item levels.

Individual variability of ERP responses to syntactic violations may thus have a different impact across languages and/or dependency. In this study we collect ERP responses to subject-verb violations in Italian, a dependency for which across-studies variability is documented in the literature (see Kasparian et al. 2017 and therein references). In order to order to improve signal to noise ratio with respect to the standard in the literature we decided to present 160 items (half correct 1.a, half violated 1.b) together with 160 fillers, half of which contained semantic violations. All sentences had a transitive verb, an animated subject and an inanimate DO, correct and violated, singular and plural versions of the were counterbalanced across subjects with a latin square design. A further aim of this study is to collect normative data on the ERPs correlates of subject-verb agreement in Italian as a reference benchmark to study specific populations such as bilinguals, subjects with atypical language development and patients with language disorders in different ages. Despite the widespread assumption that grammatical competence and performances in processing morphosyntactic aspects of language are rather stable from puberty to early elderly, a recent corpus study suggests that grammatical diversity can show non-linear changes in the adulthood (Moscoso del Prado Martin, 2016). We thus decided to sample different age ranges to collect a relatively ample set of possible age-matched controls. We collected so far 12 subject for each group in the following age-ranges: 12-17, 18-29, 30-44, 45-70.

Sentences were visually presented word by word (SOA 600ms) and the EEG, referenced to the left mastoid, was continuously recorded at 1000Hz from 64 sites uniformly distributed on the scalp. Subjects were instructed to read carefully the sentences, not to blink during sentence presentation and to judge for acceptability of each sentence after its presentation.

Results (figure 1) show that the posterior and late stage of the P600 is rather similar across the age groups after 18 years of age while different topographic distribution of the preceding negativities are present across the four age groups. On top of this, a large difference in the topography of the early stage of the P600 is present in the interval 550-650ms after word onset in that younger subject do show a posterior focus of the component while older groups also show the presence of a large positive deflection for the violation at more frontal sites. The plot in figure 2 further suggests that the relation of the amplitude of this frontal effect with age may not be strictly linear. With respect to the nature of this effect it must be noted that the age-difference mainly emerges in term of a larger frontal negativity for older subjects in the correct condition rather than as a augmented positivity for the violation.

These age-related variations of the ERP response to a well controlled syntactic violation in native speakers are interpreted by assuming that a same linguistic computation may be performed in different ways by individuals with different cognitive resources, depending on age. Moreover, we think that the interpretation of ERP responses to syntactic violation is fare more complex than a specific pattern (LAN+600) or than an unidimensional continuum between negative responders (N400) and positive responders (P600) and that this interpretation should not only consider variability of effects (subtracted waveforms) but also the variability in the ERP responses to correct conditions only.

1.a Il falegname <u>leviga</u> il mobile

The$_{+S}$ joiner <u>smooths</u> the$_{+S}$ wardrobe

1.b * Il falegname <u>levigano</u> il mobile

The$_{+S}$ joiner <u>smooth</u> the$_{+S}$ wardrobe

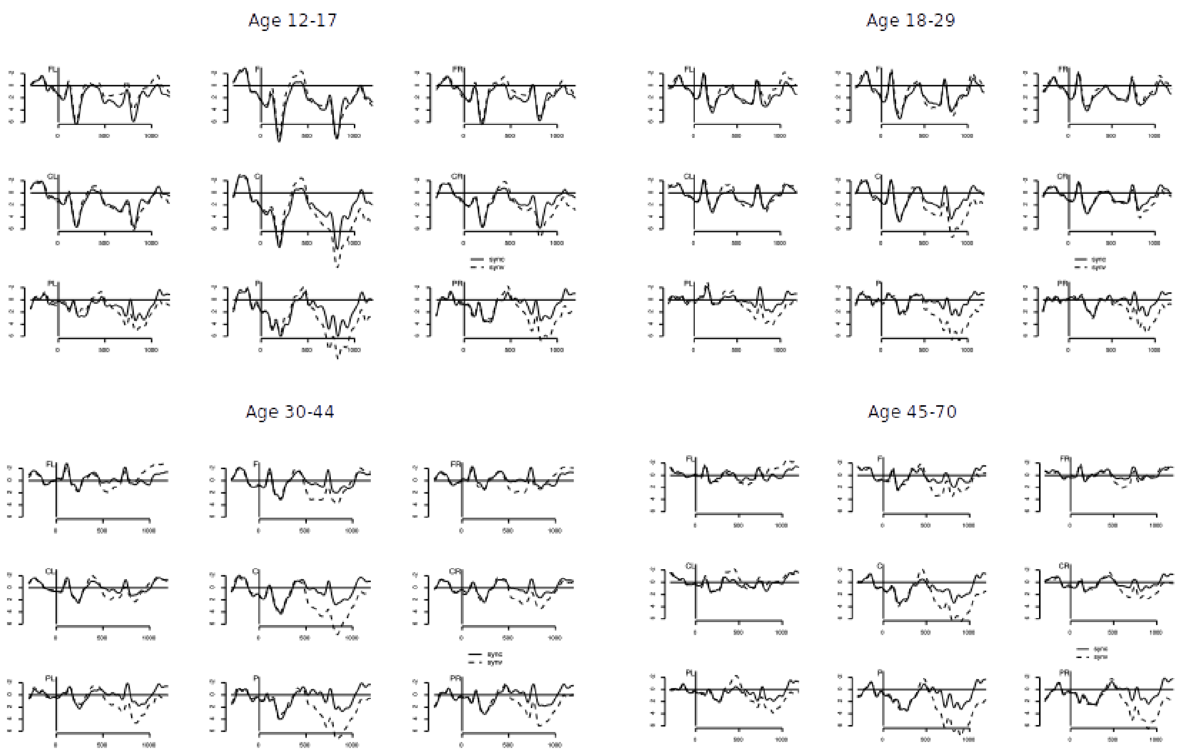

Figure 1: plots of grandaverage across the four age groups on nine 6-channel clusters (FL frontal left, F frontal midline, FR frontal right,CL central left, C central midline, CR central right, PL posterior left, P posterior midline, PR posterior right).

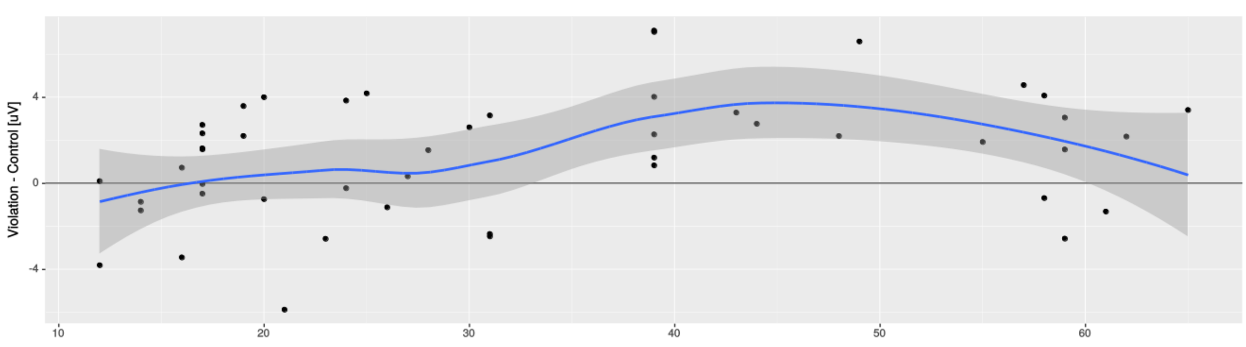

Figure 2: Scatterplot of single subject effects measured on the frontal midline cluster in the 550-650ms interval as a function of age; a local polynomial regression fit is drawn for illustrative purposes only.

Caffarra, Mendoza & Davidson (2017), bioRxiv, doi:10.1101/218594; Moscoso del Prado Martin (2016), Cogintive Science, 41(4), 950-975; McKnight et al. (2018) CUNY conference, 305 & 307; Tanner and Van Hell (2014) Neuropsychologia, 56, 289–301; Kasparian et al. (2017) Cogintive Science, 41(7), 1760-1803.