Measuring phonemic fluency ability by means of functional connectivity in resting state

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Background: Recently, it has been demonstrated that spontaneously activity in the brain “at rest” are not by chance. This “resting state” (RS) activity is well structured and has similar amplitude to those that appear during task performance. The use of functional connectivity (FC) measures in RS may serve to predict individual differences in performance of cognitive tasks. Using a phonemic fluency task, this work will investigate this possibility by studying FC in phonemic fluency brain areas at rest.

Methods: Resting state fMRI (rs-fMRI) data from ninety-three right-handed participants (mean age = 20.65±2.697; 37 male) and their performance in the Spanish version of F-A-S test were used. A total of nine seed-regions, which were extracted from Wagner et al (2014) meta-analysis of neuroimaging studies using the phonemic fluency task, were defined as 6-mm radius spheres and used in the FC analyses. Rs-fMRI datasets were processed by means of DPARSF Advanced. Then, FC ROI-wise analyses (pair correlations between ROIs) were conducted. SPSS was used for Pearson correlation analyses between the F-A-S phonemic scores and seed-regions FC z-values. Significant correlations were used to define a multiple regression analysis (stepwise method), whose aim was to identify the seed-regions that would influence in phonemic fluency ability.

Results: Pearson correlation analyses yielded significant negative correlations between phonemic fluency scores and brain connectivity of pairs Left Inferior Frontal Gyrus-Right Insula, Left Insula-Right Caudate Head and Left Anterior Cingulate Gyrus-Right Insula. On the hand, significant positive correlations were found with pair Thalamus-Cerebellum The regression model (corrected $R^2= .144; F_{2,9} = 8.75, p < 0.001$) was reached in two steps, contained two of the five predictors pair Left Thalamus-Right Cerebellum and Left Inferior Frontal Gyrus-Right Insula.

Conclusions: In the present study we used FC measures on rs-fMRI data to predict phonemic fluency performance. The results indicate that FC between relevant brain areas during the phonemic task could be a good predictor of phonemic fluency abilities. In fact, FC between areas in the left hemisphere was positively correlated with performance, whereas FC between target areas located in different hemispheres correlated negatively with performance. These results may contribute to measure phonemic fluency in clinical populations and can avoid the problems that involve working with patients.