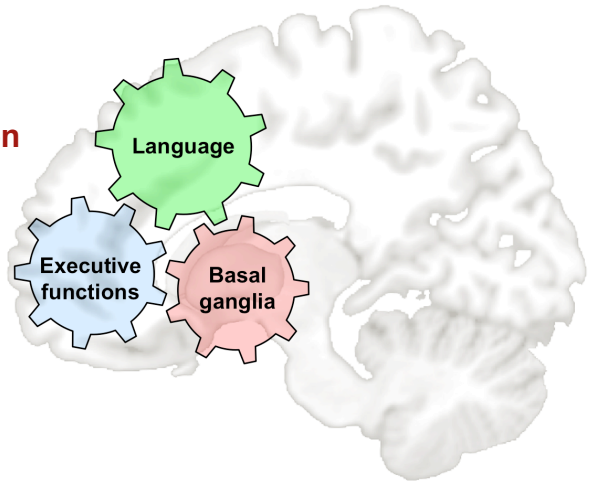
Workshop
New Ideas in Neuropsychology

The role of the basal ganglia in the interaction between language and other cognitive functions

Grad student presentations and discussion
October 12, 2017

Ecole normale supérieure
Salle séminaire du DEC, 29 rue d'Ulm

Paris (75005)



Program

16h00 - 16h30 Welcome coffee

16h30 - 18h30 Student presentations and discussion (20 min talk + 10 discussion)

- Lorna Le Stanc (NPI, DEC ENS/Inserm U955)
- Simone Roberts (Georgia State University)
- Joan Orpella (University of Barcelona)
- Michelle Toti (Università Vita-Salute San Raffaele)

18h30 – 19h00 General discussion

19h30 Social dinner

Abstracts (in alphabetical order)

Lorna Le Stanc
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Role of the striatum in linguistic processing: an evidence accumulation model analysis.

Huntington's Disease is an inherited autosomal dominant neurodegenerative disease characterized by progressive cognitive, psychiatric and motor impairments associated with a striatal atrophy. Among cognitive impairments, patients present linguistics deficits leading to question the role of the striatum in linguistics processes. Yet, the striatum is

also known to be involved in decision-making processes and almost all tasks used to assess language deficits involve a decision-making component. It remains unclear whether language deficits observed in Huntington patients are due to a core linguistic impairment, or whether it can be reduced to a decision-making impairment be it specific to language or domain general. We addressed this issue by testing early Huntington's Disease patients (N=27), pre-manifest Huntington's Disease participants (N=18) and their two matched control groups (respectively, N= 26 and N=19 participants) with two auditory contrasted discrimination tasks identical in design except that one involved linguistic processing while the other was restricted to pure auditory processing. The behavioral data show normal performance in pre-manifest HD participants but impaired performance in early HD patients compared to controls both in the linguistic and non-linguistic tasks (slower response, worse accuracy, lower sensitivity and biased response). Even if these results are not in favor of a deficit specific to linguistic processes in early Huntington's Disease patients, they do not allow to assess separately the impact of decision making deficit in their performances in both linguistic and non-linguistic tasks.
To tackle this issue, we took advantage of the recent development of drift diffusion models that decomposes responses and reactions times into parameters of the decision process: decision threshold, drift rate of accumulation, decision bias and non-decision time. This analysis revealed that early Huntington's Disease patients' decisional component is impaired in both linguistic and non-linguistic tasks. In addition and more importantly, we were able to identify an additional non-decisional deficit specific to linguistic processing. These results provide new insight on linguistic impairments and allow to disentangle the effect of decision making component from linguistic process in Huntington's Disease patients for the first time, highlighting the benefits of formal computational analysis for studying patients and the role of the striatum.

Joan Orpella
Department of Cognition, Development and Educational Psychology, Universitat de Barcelona Cognition and Brain Plasticity Unit, IDIBELL

Prediction and Attention in the extraction of language rules

Proper language use relies on knowledge of the rules that govern the combination of its basic units, i.e. morphosyntax. It is commonly agreed that the learning of such rules in one's native language proceeds -at least to a certain degree- without explicit instruction, and more consciously in later life. In this talk, I shall present evidence that the learning of simple rules from speech in adulthood is in fact a two-stage process involving early prediction-based learning and the progressive engagement of goal-oriented attention. The neural correlates of these processes in relation to language rule learning will be discussed based on our recent fMRI, rTMS and DTI studies.

Simone Renée Roberts
Student at Georgia State University, Atlanta, GA, USA; Affiliate of Emory University and the Center for Visual & Neurocognitive Rehabilitation at the US Department of Veterans Affairs, Atlanta, GA, USA

Subcortical Connectivity & Intra-thalamic Topography of the Inferior Frontal Gyrus

The inferior frontal gyrus (IFG) is widely accepted for its functional role in the language network. Communication between the IFG and subcortical brain structures has been theorized to support or mediate numerous language faculties, however the scope and detail of structural inquiry in humans is limited. Re-conceptualization of existing, deterministic network tractography methods enables in vivo exploration of the IFG's inter-structural (i.e. between region) and intra-structural (i.e. within region) white matter connectivity, and highly specific quantification of topographical relationships. Direct, intra-structural network tractography was used to examine the structural connectivity of each of the IFG's three gyral regions with the thalamus and the putamen, in a healthy, young adult sample. Additionally, topographical relationships between thalamic projections to or from different inferior frontal regions were quantified to describe intra-thalamic overlap and segregation between these pathways. An overview of relevant prior research and the results of this investigation will be discussed.

Michelle Toti
Centre for Neurolinguistics and Psycholinguistics, San Raffaele University, Milan

Does linguistic distance modulate left caudate activity in bilinguals?

Traditionally, subcortical structures (i.e., basal ganglia) have been associated with motor control, emotional control and cognitive control (Graybiel, 2000). In recent years, growing evidence has shown that the left caudate (LC) is involved also in controlling language production in speakers who speak more than one language. Indeed, many functional neuroimaging studies using paradigms investigating language control such as language translation (Price et al., 1999: Lehtonen et al., 2005), language selection (Crinion et al., 2006; Abutalebi et al., 2008; Branzi et al., 2015), and language switching (Zou et al., 2012; Abutalebi et al., 2013) have highlighted the specific engagement of LC activity. Abutalebi and colleagues (2013) also reported that this LC activity is specific to bi/multilinguals and not necessary for monolinguals. The authors compared a group a multilinguals to a group of monolinguals during a switching paradigm (switching between languages for multilinguals and switching between nouns and verbs of the single language for monolinguals). While both groups activated similarly the anterior cingulate cortex (ACC, a cortical region critically involved in monitoring potential conflicts) a different picture emerged for the LC: monolinguals deactivated the LC while multilinguals actively engaged the LC. Moreover, the lower the proficiency of their languages was, the more LC activity was necessary.
Our present purpose is to further characterize the role of the LC. Since Abutalebi et al. (2013) have shown that LC activity is 1) specific to bilingual language processing; and 2)

driven by language proficiency, our present research question was whether LC activity is influenced by linguistic distance. 58 very high proficient, balanced bilinguals with the same second language (L2; English) belonging to 3 distinct language groups (Cantonese-English, n=19; Hindi-English (n=19), and Dutch-English (n=20) were scanned during a word translation task with a 3T Philips Achieva scanner at the University of Hong Kong. All subjects were matched for age, education, socio-economics status and L2 proficiency. All subjects had comparable L1 and L2 proficiency in order to exclude that potential differences of the BOLD signal of the LC may be due to differences in language proficiency. As in Abutalebi et al. (2013), we extracted the BOLD signal from the LC and the ACC and performed group comparisons and correlations.

We report, interestingly, no significant differences in LC activity between the 3 groups. Likewise, no significant correlation was found between LC activity & and behavioral measures across the three groups. In other words, linguistic difference does not seem to modulate LC activity. The LC acts, hence, as a universal language control region independently of linguistic distance. Support for this notion (i.e., the LC as an universal language control region) comes also from a study reporting that the LC controls also language output in bimodal bilinguals (Zou et al., 2012).

However, ACC activity was significantly modulated by linguistic distance: controlling two linguistically close languages was associated to increased ACC activity as compared to two distant languages. These results will be discussed during the presentation.