

## Awards in Focus

### Investigating cognitive abilities in SLI children

As founder and director of the UCL Centre for developmental language disorders and cognitive neuroscience (DLDCN), my research is at the intersection of trying to understand the cause(s) and nature at the behavioural and brain-systems level of language impairment in children and furthering our understanding of how the brain works. In particular, I am interested in how uniquely human and specialised brain systems – such as language. Young children show a remarkable ability to learn language: 4 year-olds know that “*Joe pushed Bill*” and “*Who did Joe push?*” are correct sentences, but “*Who did Joe push Bill?*” is not. However, some children produce such sentences, consider them grammatical, and show different brain responses when listening to such sentences. Approximately 2 children in every classroom, 7 per cent, have this developmental language problem, termed “Specific Language Impairment” (SLI). SLI has a large genetic component causing the impairment and often persists into adulthood. In other respects, children with SLI appear to be developing normally. SLI may not seem very important but it has significant implications. It affects understanding, talking, reading and writing and is a major cause of many children not reaching their educational potential.

Language is not one system or ability, but many: SLI primarily affects the grammar system and for many children, phonology too. Because of the dissociation between grammatical abilities and other language and cognitive abilities, investigations of SLI afford a unique window onto how human-specific brain systems develop and work. Recently, brain-imaging systems that are non-invasive and quiet have become available for using with children. One of these systems is Electroencephalography (EEG), shown in the picture. Here we measure the electrical responses of groups of neurones in the brain firing with a millisecond, by millisecond precision. Using EEGs, recently my colleagues and I at UCL have discovered that a system in the brain for processing grammar is impaired in some children with SLI, but that they compensate using a different



Electro-Encephalography (EEG) brain recordings measured groups of neurones firing on a millisecond by millisecond basis.

brain area. Our findings offer new hope to sufferers of SLI. Until now it has not been clear whether these children generally struggle to process language, or whether they have specific problems with grammar. Our findings reveal the latter for some of these children.

The developmental and cognitive brain sciences group at Harvard University is one of the strongest developmental groups world wide and their research interests complement mine very closely. My visit was hosted by Professor Steven Pinker-- whose work on language and cognitive science is well known. In addition, I worked with Professors Marc Hauser, Susan Carey, Elisabeth Spelke and Jesse Snedaker among others. Apart from general interactions and discussions, informally and in internal lab meetings and seminars on a daily basis, I developed new collaborative projects with these colleagues. My work with Steve focussed on developing an on-line 15-minute adult grammar and phonology language test that can be used in a large collaborative genetic study at Harvard and MIT. Marc Hauser works on what it is to be human, studying primates. Marc and colleagues and I engaged in a series of regular brain-storming sessions to discuss grammatical rules that are problematic for SLI children and aimed to devise non-linguistic versions

of such rules that could be administered to both monkeys and children. We are currently conducting this investigation into rule learning back in the UK and are recording EEG (Event-Related Potential) brain responses to violations of simple abstract rules. With Susan and Liz, we explored the impact of language on cognitive abilities-- in particular number and moral-social cognitive development. Studies of SLI children allow us to tease apart the impact of language on these other cognitive abilities. Our initial results from number, suggest that there is more independence between developing brain systems than previously thought.

My sabbatical culminated with a Workshop discussing issues surrounding “Specific language impairment and the language faculty debate”

Apart from these new collaborative projects, my time at Harvard has made me think in some new directions with respect to attention, memory, perception and abstract knowledge underpinning developing cognitive abilities. For sure, my Harvard sabbatical has given me enough “food for thought” for many years of research to come!

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