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## AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2013

SECRETARÍA DE ESTADO  
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SUBDIRECCIÓN GENERAL  
DE RECURSOS HUMANOS  
PARA LA INVESTIGACIÓN

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**Área Científica:** Psicología

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### Título:

Using neuroimaging to unravel the structural and functional bases of disorders of consciousness

### Resumen de la Memoria:

Unlike other neurological syndromes, such as Alzheimer's or Parkinson's disease, where the underlying neuropathological mechanisms are at least partially understood, clear biomarkers have not yet been defined for the vegetative state and related disorders. My research aims to identify these biomarkers with the final goal of addressing three of the major clinical challenges posed by this group of patients: diagnosis, treatment, and prognosis.

Diagnostic accuracy has profound implications for medical/legal decision-making, because a diagnosis of vegetative state can lead to the cessation of life-sustaining therapies. However, because diagnosis remains entirely based on behavioural observations, an alarmingly high rate of error exists (43%). In a landmark study I was able to use state-of-the-art diffusion tensor imaging (DTI) to correctly and objectively diagnose patients as VS or minimally conscious with a high level of accuracy. Moreover, using state-of-the-art fMRI methods, I was recently able to demonstrate that a patient who had been repeatedly diagnosed as vegetative for 12 years was indeed aware. Remarkably, he was able to use my fMRI methods to communicate and convey answers to clinically relevant questions about his condition such as whether he was in any kind of physical pain.

Due to the currently poor understanding of the neuroanatomical basis of these conditions, there is a paucity of effective therapies. A second aim of my research programme makes use of state-of-the-art imaging techniques, e.g. tractography, to identify potential targets for therapeutic trials. By acquiring high field structural data, in concert with established fMRI paradigms, it is possible to explore how damage to specific regions of the brain can generate the particular patterns of impaired or preserved functional activity exhibited by these patients. Indeed, I have already provided the only evidence for in vivo structural impairments differentially related to these conditions. For example, I have recently identified a number of specific white matter pathways and thalamic nuclei that show subtle differences in the pattern of damage between vegetative and minimally conscious patients, which go above and beyond the global brain damage. Advancing the understanding of these function-structure relationships will pave the way for the identification of potential therapeutic targets.

Finally, a further major aim of my work is to improve prognostication in this group. There is some preliminary evidence that structural and functional MRI can provide useful information to this regard. Interestingly, I have recently provided some early evidence that combining information from both functional and structural techniques may be a more powerful way of improving prognostication

### Resumen del Currículum Vitae:

I have Bachelors' degrees in Speech and Language Pathology (2001) and Psychology (2006) from the University of Oviedo, Spain, where I obtained the Extraordinary Award for the best grades of the BSc programme for both degrees, and a Special Mention in the National Extraordinary Awards for my grades in Psychology. My research career has focused on the application of Magnetic Resonance Imaging (MRI) to the study of the Disorders of Consciousness (DOC), such as Vegetative State and Minimally Conscious State - conditions in which an individual appears to be awake but entirely unaware. I obtained an MSc in Neurosciences (2008) and a PhD in Biomedicine (2010), summa cum laude and European mention, from the University of Barcelona, Spain. During my doctorate, I established the only Spanish project on this topic (funding: AP2006-00862, SAF-2007-66077) and successfully published 8 articles, 4 as first author, in top-tier international journals (2 Neuroimage, 2 Journal of Neurotrauma, 1 Cortex, 1 Brain Injury, 1 BMC Neurology, 1 American Journal of Geriatric Psychiatry). I was also invited to complete two research stays at the University of Cambridge, where I formed long term collaborations with prestigious scientists such as Prof. John Pickard, Dr. Tristan Bekinschtein or Dr. Adrian Owen. My doctoral thesis, titled 'The Vegetative and the Minimally Conscious State: Brain Function, Connectivity and Structural Abnormalities', supervised by Dr. Carme Junqué (University of Barcelona) and Dr. Adrian Owen (MRC-CBU, Cambridge, UK) was awarded the Barraquer i Bordás prize from the Catalan Society for Neuropsychology. In 2011, upon completion of my PhD, I was invited to join Dr. Owen's lab as a post-doctoral fellow at their new home at the University of Western Ontario, Canada with the responsibility of establishing, coordinating, and supervising the MRI research project with DOC patients. The success of my work to establish a productively DOC research project in Canada is evident in our successful acquisition of a \$1M grant to equip our facilities and hire personnel, two \$250,000 grant to fund our research programme, and my 13 publications in top-tier international journals (1 Nature Reviews Neuroscience, 2 Lancet, 1 Annals of Neurology, 1 Neurology, 1 Cortex, 1 Neuroimage Clinical, 1 Plos One, 1 Progress in Brain Research, 1 BMC Neurology, 1 AJOB-Neuroscience, 1 Pediatric Research, 1 Brain Injury) that have been conducted in my relatively brief postdoctoral period there. My research has led to 40 contributions to international and national conferences, including 5 as an invited speaker. Due to the internationally high-profile nature of my research, I have formed close productive ties



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with scientists at the University of Cambridge (UK), the University of Barcelona (Spain), the University of Liege (Belgium), Cornell University (NY, USA), and the London Health Sciences Centre (Canada). These collaborations have so far resulted in a total of 491 citations from 26 publications in only 5-years, which have granted me an h-index of 12.



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### Título:

APRENDIZAJE ASOCIATIVO: DE LOS FACTORES ATENCIONALES AL RAZONAMIENTO CAUSAL

### Resumen de la Memoria:

Although my research has focused on different research topics, ranging from causal cognition to the contextual cueing of attention, a common feature of all of them is their relevance to the development of associative learning theories. Many of my studies have focused on using learning theories as an alternative framework to the more complex dual-process theories that pervade causal cognition studies. This includes an interesting series of papers on the development of causal illusions and illusions of control. I have also explored how conflicting memories are encoded, stored and recovered from memory, using experimental paradigms related to interference, retrieval-induced forgetting, and inhibition. This research shows that many of the concepts developed recently by memory researchers have important implications for associative learning theories as well. Much of this work was made possible by the development of an online laboratory, which required extended dedication during my PhD but has turned out to be very productive and has stimulated interesting research during the last years. Since I started working at UCL, most of my research is focused on studying how the deployment of attention changes as a result of learning. Part of this work is conducted with an adaptation of the dot-probe task that we have developed recently and another part is being conducted with the popular contextual-cueing task. This research about the attentional effects of learning is turning out to be particularly productive and well-received by the international community. During the last decade, I have also become involved in several activities related to the public engagement of science, with important contributions to several science blogs and one book on the psychology of the Internet. All this work has been carried out simultaneously with an important dedication to teaching and administrative duties.

### Resumen del Currículum Vitae:

Se adjunta un CV normalizado con los méritos investigadores y docentes del candidato. Como podrá comprobarse, se incluyen 49 publicaciones, de las cuales 36 corresponden a artículos de impacto indexados en el JCR, muchos de ellos en las revistas más importantes del área como Journal of Experimental Psychology: General; Journal of Experimental Psychology: Learning, Memory, and Cognition; Psychonomic Bulletin & Review; Quarterly Journal of Experimental Psychology; Memory & Cognition; o PLoS ONE. Así mismo se proporciona información sobre las diversas estancias y pre y postdoctorales en el extranjero (USA, UK, Bélgica y Australia) y los proyectos de investigación en los que he participado como colaborador o como IP. Finalmente, se presenta información adicional sobre la importante trayectoria docente recorrida y la dedicación a actividades de divulgación científica en diversos formatos.



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**Área Científica:** Psicología  
**Correo Electrónico:** calabria.marc@gmail.com

### Título:

NEUROPSYCHOLOGY OF LANGUAGE IN AGING AND DEMENTIA

### Resumen de la Memoria:

My research experience started in 2001 when I was an undergraduate student of Psychology at University of Padova (Italy). I was awarded with an Erasmus scholarship for a six-month period abroad and then I moved to Université Catholique de Louvain in Belgium where I investigated the neurophysiological components of visual face processing. In 2003 I spent six months at INSERM Unit U864 in Bron (France) with the supervision of Prof. Yves Rossetti. I was primarily involved in projects investigating the rehabilitation of spatial neglect and the mental representation of space and numbers. From September 2003 to March 2004 I did an Internship at the Cognitive Neuroscience Laboratory in Brescia (Italy) with Prof. Carlo Miniussi and Dr. Maria Cotelli. At that time I started to collaborate in projects investigating language deficits of patients with dementia. This collaboration was very fruitful in giving me a solid background in the field of neuropsychology. In 2006 I started my PhD in Psychobiology at University of Padua with the supervision of Prof. Patrizia Bisiacchi. The topic of my thesis was ♦Memory for faces and names: semantic and episodic aspects♦. I kept the collaboration with the Cognitive Neuroscience Lab with some projects on memory and language in dementia patients. This research experience was crucial to learn more about the application of EEG and TMS in the study of clinical populations. In 2009 I finished my PhD and then I moved to Barcelona for a post-doctoral experience. I joined the Speech Production and Bilingualism (SPB) (Prof. Albert Costa) at Universitat Pompeu Fabra. From 2009 on my research interests are focused on the study of language production and cognitive control mechanisms in healthy and brain-damaged bilinguals. In 2010 I was awarded with a Post-doctoral fellowship from the Spanish Government (Juan de la Cierva). Along my research experience, the skills of independent thinking as well as leadership are demonstrated by the wide variety of research topics I have been involved in and the number of peer-reviewed articles I have published as a first author and I co-authored. For instance, I started with face processing and event-related potentials (ERPs) during the first years and then I moved to neuropsychology by studying different topics, such as spatial attention in stroke patients, cognitive decline in aging and dementia, language processing in bilingual speakers with neurodegenerative diseases. Moreover, the fact that my career covers several topics within the field of psychology allowed me to have several collaborations across Europe (UCL in Belgium, INSERM in France, and Cognitive Neuroscience Laboratory in Italy). During my post-doc I was collaborating with Dr. Albert Costa at the University Pompeu Fabra in Barcelona (Centre for Brain and Cognition, CBC). During these years I was leading projects aimed at investigating language and executive control functions in bilingual speakers with neurodegenerative disease. Finally, I have demonstrated leadership qualities in tutoring students who were interested in conducting their dissertation and research assistants. Recently, I started to co-tutor a PhD student in a project with Parkinson♦s disease patients and bilingual language control.

### Resumen del Currículum Vitae:

**Work Experience**  
June 2009 to date. Post-doc position (Juan de la Cierva Fellowship 2011-2013) at Universitat Pompeu Fabra, Barcelona Speech Production and Bilingualism (SPB)  
April 2004 ♦ April 2006. Research Assistant in Neuropsychology and Neurophysiology of Aging and Dementia at IRCCS Centro S. Giovanni di Dio-FBF, Brescia

**Teaching Experience**  
June 2010- November 2013. Master class on at University Pompeu Fabra, Master in Neurosciences  
April 2009-May 2010. ♦Methodological issues and data analysis in Cognitive neuroscience with ERPs (FSE course) at University of Padua

**Education**  
April 2009. PhD in Psychobiology at University of Padua, Department of General Psychology  
2004-2005. Master's Degree in Statistics (Biostatistics and Epidemiology) at University of Milano Bicocca, Italy.  
December 2002. Bachelor Degree in Experimental Psychology at University of Padua, Faculty of Psychology Padua, Italy.

**Training and experiences abroad**  
-July 2013. Workshop ♦A diffusion model analysis of cognitive flexibility in children♦ at University of the Balearic Islands (UIB),



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Palma de Mallorca (Spain)

- July 2007. Summer School in Statistics at Residential Center in Bertinoro, Italy (Prof. M Gallucci, University of Milan). Generalized linear model for nonlinear, direct and indirect effects. Theory, application and implementation with SAS.
- May 2007. Summer School **Transcranial Magnetic Stimulation** at Institute of Cognitive Neuroscience UCL, London.
- From March 2003 to September 2003. Post-lauream Internship at INSERM U534 **Espace et Action**, Bron, France (Prof. Y. Rossetti).
- From January 2001 to September 2001. Erasmus-Socrates Project. Université Catholique de Louvain (UCL), Belgium. EEG Lab Training (Dr. B. Jemel)

Languages spoken: Italian (Mother tongue); English; French; Spanish.

Papers (10 most recent ones)

1. Calabria M., Marne P., Romero-Pinel L., Juncadella M., & Costa A. Losing control of your languages: a case-study. In press in *Cognitive Neuropsychology*.
2. Calabria M., Branzi F.M., Marne P., Hernández M., & Costa A. (2013). Age-related effects over bilingual language control and executive control. *Bilingualism: Language and Cognition*,
3. Calabria M., Sabio A., Martin C., Hernandez M., Juncadella M., Reñé R., Ortiz J., Ugas L. & Costa A. (2012). The missing link between faces and names: evidence from Alzheimer's disease patients. *Brain and Cognition*, 80, 250-256.
4. Costa A., Calabria M., Marne P., et al. (2012). On the parallel deterioration of bilinguals' two languages: Evidence from Alzheimer's disease. *Neuropsychologia*, 50, 740-753.
5. Cotelli M., Calabria M., Manenti R., Rosini S., Maioli C., Zanetti O., & Miniussi C. (2012). Brain stimulation improves associative memory in an individual with amnesic mild cognitive impairment. *Neurocase*, 18(3):217-23.
6. Calabria M., Hernández M., Branzi F.M., & Costa A. (2011). Qualitative differences between bilingual language control and executive control: evidence from task switching. *Frontiers in Psychology*, 2:399.
7. Calabria M., Hernández M., Martin C.D., & Costa A. (2011). When the tail counts: the bilingualism advantage through the ex-Gaussian analysis. *Frontiers in Psychology*, 2: 250.
8. Calabria M., Jacquin-Courtois S., Miozzo M., Rossetti Y., Padovani A., Cotelli M. & Miniussi C. (2011). Time perception in spatial neglect: a distorted representation? *Neuropsychology*, 25(2), 193-200.



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### Título:

Motor-driven sensory predictions and their influence on perception

### Resumen de la Memoria:

Our perception of external stimuli is shaped by our potential to interact with them. Internal predictive models that aid perception need to take into account possible sensory consequences of our (even potential) actions. Therefore, own actions are an important source of sensory prediction. In the last years, I have investigated action-related prediction along three main lines. First, I have taken advantage of the fact that action-induced predictions are precisely time-locked to an externally observable event (i.e., the motor act) to unmask brain activity coding for sensory predictions and study it in detail. In a key study of this line (SanMiguel et al. 2013, JNeurosci), I found that when self-initiated sounds are omitted, an auditory-like response is elicited. The characteristics of this response are consistent with the interpretation that it directly reflects the neural expression of the underlying prediction. Thus, having gained access to this remarkable brain signature, I have conducted a series of tests in order to elucidate precisely how prediction is coded in the auditory system. These experiments have shown that the omission response reflects coding of the specific physical characteristics of the predicted stimulus, and is generated in early processing areas in the auditory cortex, overlapping the sites activated by presenting the sounds themselves. In short, omissions of self-initiated sounds have turned out to be a very useful tool for studying the nature of underlying prediction representations, and my findings match the predictions derived from current influential theoretical and computational models.

In a second line of studies, I have investigated the effects of action-driven prediction on the processing of self-initiated sounds. In these studies, we generally compare responses elicited by self-initiated sounds to responses elicited by the same sounds when they are not self-initiated. In my most relevant study in this line, I have challenged the claim that the suppression of the auditory N1 component of the event-related brain potential to self-initiated sounds reflects predictive modeling processes (SanMiguel et al. 2013, Psychophysiology).

Finally, one of the functions that are often assigned to the observable effects of action-driven prediction on the processing of self-initiated sounds is to be able to differentiate the consequences of own actions from those of others. However, there is actually little direct evidence unequivocally linking these two things. Hence, through my mentoring of Jana Timm's PhD studies, we have investigated the relationship between action-driven predictions and the sense of agency. In these studies, we investigate whether sensory suppression effects accompany the feeling of having caused the sound and whether there is a causal relationship between these two phenomena. For example, implementing a new approach (Timm et al. 2014, JCogNNeurosci), we manipulated the pre-reflective sense of agency using single pulse TMS over primary motor cortex to induce an involuntary motor act (a finger movement) that, in turn, generated a sound by pressing a button. Processing of the involuntarily self-initiated sounds was not attenuated under these circumstances, indicating that sensory attenuation of auditory brain responses to self-initiated sounds depends on motor intention.

### Resumen del Currículum Vitae:

I am a cognitive neuroscientist with scientific interests in the brain mechanisms underlying perception, attention, memory, etc., with a particular focus in the auditory domain. I obtained my degree in Psychology from University of Barcelona in 2004. After my Psychology studies, I had a 7-month contract at the Nijmegen Institute for Cognition and Information (NL) performing intracranial EEG sleep recordings in rats for the private enterprise Numico. Subsequently, I was awarded a doctoral scholarship in Spain. During my PhD studies (2005-2008) in the Cognitive Neuroscience Research Group at the University of Barcelona, supervised by Prof. Carles Escera, I investigated auditory distraction mainly using ERPs, and spent 8 months at the University of Wales, Bangor (UK) learning the fMRI technique under the supervision of Prof. David Linden, funded by two travel grants obtained competitively from the Generalitat de Catalunya.

Since 2009, I am a postdoctoral researcher at the University of Leipzig, hired under the Koselleck-Reinhart project Predictive Modelling in Audition, awarded to Prof. Erich Schröger. Within this project, I have developed a research line taking advantage of self-generated stimuli to investigate prediction. My backing of this line in the group has resulted in more than 18 studies so far, including two diploma and one PhD theses. Alongside, I have started collaborations with Prof. Marc Schönwiesner at the International Laboratory for Brain, Music and Sound Research (BRAMS, Université de Montréal, Canada) and Prof. Gergely Csibra, at the Cognitive Development Center (CDC, Central European University, Budapest, Hungary), respectively investigating tonotopic predictive auditory responses using high-resolution fMRI of auditory cortex; and developmental aspects of motor-sensory predictions, with EEG recordings in 7-month-old infants. Since 2009, I have given 11 invited and conference talks, I have chaired a



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symposium at the International Conference in Cognitive Neuroscience (ICON) and I have organized an international workshop on prediction in audition, after receiving funding from the German Academic Exchange Service (DAAD). With an H-index of 8, and a total of 278 citations in the scientific literature, I have a track of publications in high-impact journals, including seven out of 13 papers published in Q1 journals (Psychology and/or Neurosciences categories), in 4 of which I am first author.