NLC2012
NEUROBIOLOGY OF LANGUAGE CONFERENCE

DONOSTIA - SAN SEBASTIAN, SPAIN
OCTOBER 25TH - 27TH, 2012

ABSTRACTS

Welcome to NLC 2012, Donostia-San Sebastián

Welcome to the Fourth Annual Neurobiology of Language Conference (NLC) run by the Society for the Neurobiology of Language (SNL). All is working remarkably smoothly thanks to our past president (Greg Hickok), the Board of Directors, the Program Committee, the Nomination Committee, Society Officers, and our meeting planner, Shauney Wilson. A sincere round of thanks to them all! Indeed, another round of thanks to our founders Steve Small and Pascale Tremblay hardly suffices to acknowledge their role in bringing the Society and conference to life.

The 3rd Annual NLC in Annapolis was a great success – scientifically and fiscally – with great talks, posters, and a profit to boot (providing a little cushion for future meetings). There were 476 attendees, about one-third of which were students. Indeed, about 40% of SNL members are students – and that's great because you are the scientists of tomorrow! We want you engaged and present. We thank you and ask for your continued involvement. If there were any complaints, and there weren't very many, it was the lackluster venue. We believe that the natural beauty of San Sebastián will more than make up for that.

The past year has witnessed the launching of our new website (http://www.neurolang.org/) and a monthly newsletter. Read them regularly, and feel free to offer input.

It goes without saying that you are the reason this Society was formed and will flourish: please join the Society, please nominate officers and vote for them, please submit abstracts for posters and talks, and please attend the annual meeting whenever possible. Naturally, we want your feedback and suggestions along with your presence. Word of mouth is the best advertising, and we appreciate your spreading the news. This Society is for you, and it will be what you make of it.

We thank invited speakers – past and present – for coming, sharing, educating and inspiring us. Also, without the generous support from the Basque government and NIDCD there would be less and NLC 2012 would cost more. Finally, we want to extend special recognition to BCBL for their invaluable help in organizing this year's conference. We do not take anything for granted, and we are thankful.

On behalf of the Board and Organizers, welcome to San Sebastián!

Marta Kutas
Chair, Society for the Neurobiology of Language

TABLE OF CONTENTS

SNL Directors and Committees

2012 Board of Directors

Chair: Marta Kutas, Ph.D.,
University of California, San Diego, USA

Treasurer: Vincent L. Gracco, Ph.D.,
McGill University, Montréal, Canada

Secretary: Stefan Heim, Ph.D.,
RWTH Aachen University, Aachen, Germany

Meeting Liaison: Manuel Carreiras, Ph.D.,
Basque Center on Cognition, Brain and Language,
San Sebastián, Spain

Chair-Elect: Jeffrey Binder, M.D.,
Medical College of Wisconsin, USA

Treasurer-Elect: Sharon Thompson-Schill, Ph.D.,
University of Pennsylvania, USA

Secretary-Elect: Joe Devlin, Ph.D.,
University College London, UK

Meeting Liaison-Elect: Ellen Lau, Ph.D., Massachusetts
General Hospital and Tufts University, USA

Past Chair: Gregory Hickok, Ph.D.,
University of California, Irvine, USA

Past Treasurer: Cynthia Thompson, Ph.D.,
Northwestern University, Chicago, USA

Past Secretary: Murray Grossman, M.D., Ed.D.,
University of Pennsylvania, Philadelphia, USA

Past Meeting Liaison: Laura Menenti, Ph.D.,
University of Glasgow, Glasgow, UK

NLC 2012 Program Committee

Jeffrey Binder, M.D., Medical College of Wisconsin, USA

Manuel Carreiras, Ph.D., Basque Center on Cognition,
Brain and Language, San Sebastian, Spain

Gregory Hickok, Ph.D., University of California,
Irvine, USA

Marta Kutas, Ph.D., University of California,
San Diego, USA

Steven L. Small, Ph.D., M.D., University of California,
Irvine, USA

2012 Nomination Committee

David Poeppel, Ph.D., Chair, New York University, USA

Sonja Kotz, Ph.D., Max Planck Institute, Germany

Steven L. Small, Ph.D., M.D., University of California,
Irvine, USA

SNL Founders

Steven L. Small, Ph.D., M.D.,
University of California, Irvine, USA

Pascale Tremblay, Ph.D.,
Universite Laval, Quebec, Canada

NLC 2012 Review Committee

Daniel Acheson, Ph.D.
Venu Balasubramanian, Ph.D.
Deryk Beal, Ph.D.
Angelique Blackburn
Heather Bortfeld, Ph.D.
Veronique Boulenger, Ph.D.
Shanqing Cai, Ph.D.
Jungwon Choy, Ph.D.
Dirk-Bart Den Ouden, Ph.D.
Isabelle Deschamps, Ph.D.
Nai Ding
John Drury, Ph.D.
Julia Evans, Ph.D.
Evelina Fedorenko, Ph.D.
Xuefei Gao, Ph.D.
Krystyna Grabski
Stefan Heim, Ph.D.
Masako Hirotani, Ph.D.
Hsu-Wen Huang, Ph.D.
So-One Hwang
Xiaoming Jiang, Ph.D.
So-Hee Kim, Ph.D.
Pia Knoeferle, Ph.D.
Saloni Krishnan, Ph.D.
Bernd Kröeger, Ph.D.
Ellen Lau, Ph.D.
Hon Wah Lee, Ph.D.
Minna Lehtonen, Ph.D.
Christiana Leonard, Ph.D.
Anna MacDonald, Ph.D.
Jennifer Mack, Ph.D.
Mandy Maguire, Ph.D.
Evguenia Malaia, Ph.D.
Laura Menenti, Ph.D.
Daniel Mirman, Ph.D.
Philip Monahan, Ph.D.
Caroline Niziolek, Ph.D.
Polly O'Rourke, Ph.D.
Barbara Pastuszek-Lipinska, Ph.D.
Jonathan Peelle, Ph.D.
Tepring Piquado, Ph.D.
Kate Pirog Revill, Ph.D.
Steve Politzer-Ahles
Zhenghan Qi
Ariane Rhone
Katharina Sass, Ph.D.
Mathias Scharinger, Ph.D.
Tatiana Schnur, Ph.D.
Teresa Schubert
Valerie Shafer, Ph.D.
Roma Siugzdaite, Ph.D.
Linnaea Stockall, Ph.D.
Monica Wagner, Ph.D.
Yapeng Wang, Ph.D.
Roel Willems, Ph.D.
Stephen Wilson, Ph.D.
Edward Wlotko, Ph.D.
Jie Yang, Ph.D.
Ruo-Xiao Yang
Yan Yu
Zude Zhu, Ph.D.

Schedule of Events

All events are held at the Kursaal Congress Center.

Thursday, October 25th

2:00 - 6:30 pm	Pre-Registration Check-in and Onsite Registration *Ground Floor Foyer, Kursaal*

Friday, October 26th

7:00 am - 6:00 pm	Pre-Registration Check-in and Onsite Registration *Ground Floor Foyer, Kursaal*
7:45 - 8:15 am	Morning Coffee *1st Floor Foyer, Kursaal*
8:15 - 8:30 am	Opening Remarks: Marta Kutas, President *Kursaal Auditorium*
8:30 - 9:30 am	**Keynote Lecture: Barbara L. Finlay** Beyond columns and areas: developmental gradients and regionalization of the neocortex and their likely consequences for functional organization *Kursaal Auditorium*
9:30 - 11:30 am	Poster Session A *Ground Floor Foyer and 1st Floor, Kursaal*
11:00 - 11:30 am	Coffee Break *1st Floor Foyer, Kursaal*
11:30 am - 12:50 pm	Slide Session A - Speech Perception *Kursaal Auditorium*
12:50 - 2:00 pm	Buffet Lunch *1st Floor Foyer*
2:00 - 3:20 pm	Slide Session B - Language Disorders, Laterality, Meaning and Communication *Kursaal Auditorium*
3:20 - 5:20 pm	Poster Session B *Ground Floor Foyer and 1st Floor, Kursaal*
4:50 - 5:20 pm	Afternoon Coffee *1st Floor Foyer*
5:20 - 6:50 pm	Discussion Panel: Nina F. Dronkers vs Julius Fridriksson What is the role of the insula in speech and language? *Kursaal Auditorium*
7:00 - 8:00 pm	Welcome Reception

Saturday, October 27th

7:00 am - 6:45 pm	Pre-Registration Check-in and Onsite Registration *Ground Floor Foyer, Kursaal*
7:45 - 8:15 am	Morning Coffee *1st Floor Foyer, Kursaal*
8:30 - 9:30 am	**Keynote Lecture: Nikos K. Logothetis** In vivo Connectivity: Paramagnetic Tracers, Electrical Stimulation & Neural-Event Triggered fMRI *Kursaal Auditorium*
9:30 – 11:30 am	Poster Session C *Ground Floor Foyer and 1st Floor, Kursaal*
11:00 - 11:30 am	Coffee Break *1st Floor Foyer, Kursaal*
11:30 am - 12:50 pm	Slide Session C - Reading *Kursaal Auditorium*
12:50 - 2:00 pm	Buffet Lunch *1st Floor Foyer, Kursaal*
2:00 - 3:20 pm	Slide Session D - Lexical Semantics *Kursaal Auditorium*
3:20 - 5:20 pm	Poster Session D *Ground Floor Foyer and 1st Floor, Kursaal*
4:50 - 5:20 pm	Afternoon Coffee & Light Snack *1st Floor Foyer, Kursaal*
5:20 - 5:50pm	Business Meeting *Kursaal Auditorium*
5:50 - 7:20 pm	Discussion Panel: Matthew Lambon Ralph vs Jeffrey R. Binder Role of Angular Gyrus in Semantic Processing *Kursaal Auditorium*

Awards

Abstract Merit Awards

The Society for the Neurobiology of Language Graduate Student Abstract Merit Award is given to the two students who submitted the highest ranked abstracts.

The 2012 winners are:

Adeen Flinker, Helen Wills Neuroscience Institute, University of California, Berkeley

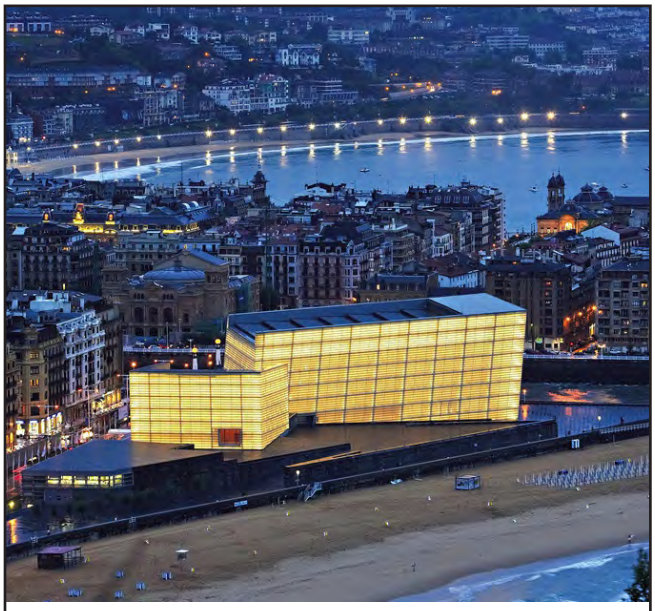
Dale Maddox, University of California, Irvine, Department of Cognitive Sciences

The Society for the Neurobiology of Language Post Doctoral Abstract Merit Award is given to the two postdocs who submitted the highest ranked abstracts.

The 2012 winners are:

Karine Marcotte, Toronto Rehabilitation Institute, Toronto, Canada

Corey McMillan, University of Pennsylvania, Department of Neurology



Kursaal Congress Centre

Overlooking the seafront in the heart of the city centre, the Kursaal Centre, designed by architect Rafael Moneo, winner of the 2001 Mies van der Rohe prize for the best building in Europe, is an avant-garde architechtural showpiece.

Travel Awards

This year, the Society for the Neurobiology of Language granted twenty Travel Awards. The awards, funded by the National Institutes of Health (NIH) and the Basque Government, help to cover travel and registration costs for the 2012 Neurobiology of Language Conference (NLC) in Donostia-San Sebastián, Spain.

Through the travel awards, SNL aims to encourage and foster the participation of junior scientists who are members of underrepresented groups.

The 2012 Travel Awards were given to:

Wing Yee Chow, University of Maryland

Emily Connally, University of Oxford

Samantha Cooper, University College London

Larissa Cuénoud, University College London

Elisabeth Fonteneau, University of Cambridge

Anna Holt, University of California, Irvine

Robert Hurley, Northwestern University

Saloni Krishnan, University of London

Juliane Mühlhaus, RWTH Aachen University

'Oiwi Parker Jones, University of Oxford

Jack Rogers, University of Oxford

Lesley Sand, University of Maryland

Hernando Santamaría, Universitat Pompeu Fabra

Laura Skipper, Temple University

Kenneth Vaden, Medical University of South Carolina, Charleston

Jane Warren, University College London

Dave Warren, University of Iowa Hospitals and Clinics

Jason Yeatman, Stanford University

Caicai Zhang, The Chinese University of Hong Kong

Camila Zugarramurdi, Universidad de la República, Uruguay

SAVE THE DATE!

NLC 2013

November 7 - 9, 2013
Southern California, USA

Keynote Lectures

BEYOND COLUMNS AND AREAS: DEVELOPMENTAL GRADIENTS AND REGIONALIZATION OF THE NEOCORTEX AND THEIR LIKELY CONSEQUENCES FOR FUNCTIONAL ORGANIZATION

Friday, October 26, 8:30 – 9:30 am, Kursaal Auditorium

Chair: Marta Kutas, University of California, San Diego, USA
Speaker: Barbara L. Finlay, Behavioral and Evolutionary Neuroscience Group, Cornell University, USA

Descriptions of the cerebral cortex may emphasize its modularity by highlighting the unique features of cortical areas, such as primary visual cortex or Broca's area, or may emphasize its uniformity, such as the repeating unit of the cortical column. Implicit in their research designs, current work in functional imaging emphasizes local specialization, while studies of functional connectivity feature the global organization of minimally-specified local units. The cortical sheet, however, has intrinsic organizational features than these two, notably a striking anterior-to–posterior gradient in neuron number per column, neuron size, process elaboration and neuronal density. This gradient interacts with a directionally-biased axonal output arising from primary visual, somatic and motor regions to progressively reduce the number of neurons coding each subsequent representation. This pervasive anterior-to-posterior reduction of neuron number and convergence of axonal projections may correspond directly to the increasing abstraction of information observed individually and collectively across sensory, motor and executive domains along the same anterior-posterior axis.

IN VIVO CONNECTIVITY: PARAMAGNETIC TRACERS, ELECTRICAL STIMULATION & NEURAL-EVENT TRIGGERED FMRI

Saturday, October 27, 8:30 – 9:30 am, Kursaal Auditorium

Chair: Marta Kutas, University of California, San Diego, USA
Speaker: Nikos K. Logothetis, Department Physiology of Cognitive Processes, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, and Imaging Science and Biomedical Engineering, University of Manchester, Manchester, UK

Neuroanatomical cortico-cortical and cortico-subcortical connections have been examined mainly by means of degeneration methods and anterograde and retrograde tracer techniques. Although such studies have demonstrated the value of the information gained from the investigation of the topographic connections between different brain areas, they do require fixed, processedtissue for data analysis and therefore cannot be applied to animals participating in longitudinal studies. Capacities such as plasticity and learning are indeed best studied with non-destructive techniques that can be applied repeatedly and, ideally, combined with neuroimaging or electrophysiology studies. The recent development of MR-visible tracers that can be infused into a specific brain region and are transported anterogradely transsynaptically is one such technique. Simultaneous electrical stimulation (ES) and fMRI (esfMRI) is another. In fact, esfMRI offers a unique opportunity for visualizing the networks underlying electrostimulation-induced behaviors, to map the neuromodulatory systems, or to study the effects of regional synaptic plasticity, e.g. LTP in hippocampus, on cortical connectivity.

In my talk I'll present new data on MR-visible tracers and esfMRI that show the capacity of these methods for the study of the organization of cortical microcircuits and effective connectivity. I shall also show first results from studies mapping network topologies by triggering imaging at structure specific events, e.g. hippocampal ripples or cross frequency coupling events.

Friday Discussion Panel

WHAT IS THE ROLE OF THE INSULA IN SPEECH AND LANGUAGE?

Friday, October 26, 5:20 - 6:50 pm, Kursaal Auditorium

Speakers: Nina F. Dronkers, University of California, Davis, USA and Julius Fridriksson, University of South Carolina, USA

Nina F. Dronkers and Julius Fridriksson

The role of the insula in processing speech and language has received relatively limited attention compared to that of other peri-sylvian regions in the left hemisphere. The strategic location of the insula within the peri-sylvian region was noted by Carl Wernicke who suggested that it represented a (functional?) continuum of the anterior and posterior speech areas. More recent studies suggest that the insula is crucial for motor control of speech; much of the supporting evidence comes from associating insula damage with impaired speech production and functional imaging studies showing that overt speech is related to recruitment of the anterior insula. Contrary to this evidence, others have found the insula to play a more limited role in speech production placing greater emphasis on the left inferior frontal gyrus. Several sources of discrepant findings can be identified and our goal is to identify and discuss where we agree and disagree. As importantly, we hope to identify areas where our disagreements can be adjudicated by testable hypotheses regarding the potential role of the insula in speech production.

Pintxos -- A Basque Tradition

Food is an art form in San Sebastian, and a sign of the city's identity.

San Sebastian is world famous as a food tourism destination, since it's collected more Michelin stars per square metre of its territory than anywhere else in the world.

Pintxos, miniature works of culinary art, are traditional small dishes, or tapas found only in the Basque country. Pintxos are typically "finger foods" which can include bite sized snacks of tiger mussels, foie gras with figs and grilled baby squid.

A trip to San Sebastian would not be complete without completing a Pintxo Stroll -- the custom is to have one drink and one pintxo per person in each bar, and then move on to the next, and so on.

Most pintxo sampling is done standing up at the bar, or feel free to join a communial table for sit-down sampling.

Saturday Discussion Panel

ROLE OF ANGULAR GYRUS IN SEMANTIC PROCESSING

Saturday, October 27, 5:50 - 7:20 pm, Kursaal Auditorium

Speakers: Matthew Lambon Ralph , University of Manchester, UK
and Jeffrey R. Binder, Department of Neurology, Medical College of Wisconsin, USA

Matthew A. Lambon Ralph

The role of the angular gyrus (AG) in semantic cognition (semantically-driven expressive and receptive behaviour) is firmly established from a long history of neuropsychological and, more latterly, functional neuroimaging studies. Its exact contribution to semantic processing is unclear, however. Two alternative accounts are found in the classic and contemporary neuroscience literatures. One view is that the transmodal AG's contribution is primarily representational. The alternative account is that the AG forms part of a distributed neural network that supports 'semantic control' – that is, the ability to manipulate underlying semantic knowledge within the current context in order to generate time- and task-appropriate behaviour (both verbal and nonverbal). Both classic and contemporary neuropsychological studies have found that, like patients with ventral prefrontal damage, lesions to posterior temporoparietal regions does not lead to a representational deficit but rather to poor semantic control (in both verbal and nonverbal tasks). Convergent evidence for this hypothesis has been found in contemporary functional neuroimaging and TMS studies – which also provide greater neuroanatomical specificity than that offered by neuropsychological investigations alone. This hypothesis about AG functioning offers the potential of a unified account, not only for semantic cognition, but also the role of the AG in episodic memory, cognitive control and syntactic processing.

Jeffrey R. Binder

An extensive body of evidence from functional imaging studies links the angular gyrus (AG) with semantic processing. This evidence shows stronger responses in both left and right AG with increasing information content, indicating a specific role in semantic representation. Other regions, including neighboring cortex in the intraparietal sulcus and posterior temporal lobe, show the opposite pattern, with stronger responses to semantically impoverished stimuli, which engage additional controlled search and attention mechanisms. Damage to the AG impairs sentence comprehension and retrieval of thematic relations, suggesting a role in representing associative and temporospatial knowledge. This role is consistent with the anatomical location of the AG at the convergence of high-level spatial, visual motion, and kinesthetic representational systems. Variation in performance with varying task procedures in patients with semantic aphasia has been interpreted as indicating a deficit of semantic control, but can be explained by accompanying damage to attentional and phonological systems. The relative lack of item consistency in tests of object knowledge in these patients is expected given that their core deficit does not involve object concepts, but rather relational and event concepts.

General Information

ATM

An ATM (cash machine) is located outside the Kursaal (to the left of the front doors as you leave the building).

Abstracts

The poster and slide abstracts can be found in the PDF which is downloadable from the neurolang.org website.

Audio-Visual

An LCD projector (e.g., for PowerPoint presentations) will be provided in the auditorium; however, computers will NOT be provided. Presenters must bring their own computers and set them up BEFORE the start of the session in which they are presenting. A switch box will be provided to allow several computers to be connected to the LCD projector in a room. Presenters are strongly encouraged to arrive at their scheduled room a minimum of 30 minutes before their talk so that they know how to set up their equipment.

Certificate of Attendance

To receive a Certificate of Attendance, please visit the registration desk. If you require any amendments, we will be happy to email/mail a copy after the meeting (info@neurolang.org).

Contact Us

To contact us onsite, visit the Registration Desk, or send an email to info@neurolang.org. We will respond to your email at our earliest opportunity.

Day of the Basque Country

October 25 is a holiday in San Sebastian. Banks and most shops will be closed. Restaurants will be open.

Disclaimer

The SNL Program Committee reserves the right to make changes to the meeting program at any time without notice. This program was correct at the time of printing.

Duplication / Recording / Photography

Photography, audiotaping, video recording, digital taping or any other form of duplication is strictly prohibited in the sessions and poster areas.

Food Service

Complimentary food and beverage service is available on the 1st floor of the Kursaal Auditorium to all registered attendees at the following times:

Friday

Morning Coffee, 7:45 – 8:15 am
Coffee Break, 11:00 – 11:30 am
Buffet Lunch, 12:50 – 2:00 pm
Afternoon Coffee, 4:50 – 5:20 pm
Welcome Reception, 7:00 – 8:00 pm

Saturday

Morning Coffee, 7:45 – 8:15 am
Coffee Break, 11:00 – 11:30 am
Buffet Lunch, 12:50 – 2:00 pm
Afternoon Coffee & Light Snack, 4:50 – 5:20 pm

Future Meetings

NLC 2013 will be held in Southern California, USA, November 7 - 9, 2013.

Getting Around San Sebastian

San Sebastian is a walking city and you can get most places on foot. If you want to take a taxi, taxis can only be taken at taxi stops.

Internet

Wireless Internet is available throughout the Kursaal Congress Center. An access code is available at the Registration desk.

Lost & Found

Please check with the NLC Registration Desk for lost and found items.

Meeting Rooms

All general sessions (Keynotes, Discussion Panels and Slides) will be held in the Kursaal Auditorium. There are entrances on both levels (ground and 1st floor).

Messages

A bulletin board will be available for messages and job postings near the NLC Registration Desk.

Mobile Phones

Attendees are asked to silence their mobile phones when in sessions.

Name Badges

For security purposes, all attendees must wear their name badges to all sessions and social functions. Entrance into sessions is restricted to registered attendees only. If you misplace your name badge, please go to the Registration Desk for a replacement.

Onsite Meeting Registration

The NLC Registration Desk is located on the ground floor foyer of the Kursaal Auditorium. The Registration Desk hours are:

- Thursday, October 25, 2:00 – 6:30 pm
- Friday, October 26, 7:00 am – 6:00 pm
- Saturday, October 27, 7:00 am – 6:45 pm

Parking

Self-parking is available at the Kursaal Congress Centre, 41.50 € for two days with in-and-out privileges.

Poster Sessions

Posters are located on the ground floor and 1st floor foyers of the Kursaal Congress Centre.

Reception

The Welcome Reception will be held on the 1st floor of the Kursaal, from 7:00 – 8:00 pm and will feature a selection of pinxtos—traditional tapas from the region (Basque country).

Smoking

Smoking is not permitted anywhere inside the Kursaal. There is a smoking area located on the Terrace.

Speakers

Please ensure that you are available at least thirty minutes before the start of the session. See "Audiovisial" for technical information.

Transportation - Airport

San Sebastian National Airport (20 km/12 miles)

- Radio Taxi Bidasosa is the only taxi company that has a permanent stop at the San Sebastian Airport. Call 943 63 33 03.
- Buses to and from the airport depart once an hour and the ride takes 30 minutes. The bus stop in downtown San Sebastian is located at the Plaza Gipuzkoa.

Biarritz International Airport: (40 km/25 miles)

- Biarritz Airport Transfers offers service into downtown from 15 euros per person. Call 0033 (0) 7 87 01 04 05 or email biarritzairporttransfers@gmail.com.
- There is a local bus from Biarritz to Bayonne and then a bus from Bayonne to San Sebastian. The Bayonne to San Sebastian route is run by ALSA and takes about 1 h 15. There is also an airport transfer service from Biarritz Airport to San Sebastian Airport.
- There is no direct train to San Sebastian. You must take a French SNCF train to Hendaye and then the Euskotren local train service to San Sebastian. Each ride is approximately 40 minutes, with the total train trip costing less than $15 (about 12 euros).

Bilboa International Airport (90 km/56 miles)

- Buses leave BIO every hour.
- The Basque Country has its own local train network, called Euskotren. It is very inexpensive and there are departures every hour, but it is very slow – taking about 2 h 30 to get from Bilbao to San Sebastian.

Donostia - San Sebastian

The beach resort of San Sebastian is a small city of 183,000 inhabitants, with a remarkably high level of cultural activity for its size.

The beauty of its Bay, known as the Pearl of the Cantabrian Sea; its situation in a natural amphitheatre facing the sea and protected by mountains; its quality of life; and its famous gastronomy have turned it into a world-class tourist destination.

Slide Sessions

Slide Session A

Friday, October 26, 11:30 am – 12:50 pm, Ground Floor Foyer and 1st Floor

Speech Perception

Speakers: Adeen Flinker, A. Lisette Isenberg, Emily Myers, Anthony Dick

A1 11:30 am

SIMULTANEOUS REPRESENTATION OF TASK CONTEXT AND STIMULUS IDENTITY IN THE HUMAN AUDITORY CORTEX

Adeen Flinker[1], Nathan E. Crone[3], Robert T. Knight[1,2]; [1]Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, [2]Psychology Department, Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, CA, [3]Neurology Department, Johns Hopkins University, Baltimore, MD

Auditory cortical fields are tuned to various spectrotemporal sound features representing a map of our auditory environment. Studies in both animals and humans have shown that task requirements as well as the stimulus class can modulate auditory cortex activity. However, it remains unclear how task and stimulus information are represented in auditory cortex. In order to address this issue we recorded electrocorticographic (ECoG) activity in neurosurgical patients performing two different tasks (target detection and repetition) with two different stimulus classes (words and phonemes). Subjects performed four different tasks: phoneme target detection, phoneme repetition, word target detection and word repetition. We found a double dissociation between stimulus class and task indexed by two distinct neural markers. High frequency power (γ-High: 70-150 Hz) robustly tracked spectrotemporal features of the stimulus regardless of task type (target detection vs. repetition). Stimulus identity was reconstructed by deriving spectrotemporal receptive fields (STRF) based on the γHigh responses. In contrast, event related potentials (ERP) showed similar waveforms for both stimuli types but showed increased ERP components for one task and not the other. A parallel increase, that also dissociated tasks, was found in coupling between the phase of the θ band and the amplitude of the γ-High band. This data suggests that stimulus identity is represented by high frequency activity that is coupled to low frequency oscillations modulated by task context. This oscillatory framework of auditory processing provides a simultaneous representation of task context and stimulus identity and a possible neuronal mechanism for top-down task-related modulations.

A2 11:50 am

DORSAL STREAM ORGANIZATION FOR SPATIALLY GUIDED SENSORY-MOTOR INTEGRATION

A. Lisette Isenberg[1], Kourosh Saberi[1], Greg Hickok[1]; [1]UC Irvine

Dorsal auditory stream function is still largely debated, with evidence from two distinct lines of research implicating it in spatial processing and sensory-motor integration. These seemingly dichotomous hypotheses suggest many of the fundamental properties underlying dorsal stream function remain poorly understood. One recent study identified discrete functional-anatomic regions for sensory-motor integration and spatial hearing processes (Isenberg et al, 2011). In contrast, analogous visuo-motor integration systems have been posited as sharing neural territory with spatially relevant processes for motor tasks such as reaching or grasping (White and Snyder, 2007). The task relevance of sensory information may provide a key to understanding this difference. Auditory spatial information is not particularly relevant for control of vocal tract gestures for speech, unlike the role of visual spatial information for saccades or reaching/grasping tasks. The goal of two studies presented here is to examine this question using a task in which an auditory spatial signal is critical for driving action of vocal tract, as well as other, motor effectors. These fMRI experiments employed a spatially guided auditory-motor integration task. Subjects were instructed to track a randomly moving noise with the visually cued modality. In experiment one, tracking was performed with three motor effectors: eye, hand and tongue. In experiment two, tracking was performed with two vocal tract effectors, the larynx and the tongue. Results suggest regions supporting sensory-motor integration engage for spatial auditory stimuli only when the information is relevant for guiding sensory to motor transformations.

A3 12:10 pm

NEURAL SYSTEMS UNDERLYING LEXICALLY-BIASED PERCEPTUAL LEARNING IN SPEECH

Emily Myers[1,2,3], Laura Mesite[2]; [1]University of Connecticut, [2]Brown University, [3]Haskins Laboratories

It has long been noted that listeners use top-down information from lexical status to resolve ambiguities in the perception of speech sounds. For instance, recent studies (e.g. Kraljic & Samuel, 2007), have shown that

listeners who are exposed to an ambiguous phonetic token (e.g. one between /s/ and /ʃ/) in an unambiguous lexical context (e.g. in the place of the /s/ in 'Tennessee'), show subsequent shifts in the categorization function for items along an unbiased continuum (e.g. /asi/ to /aʃi/). This effect, termed 'perceptual learning in speech,' suggests that listeners encode the idiosyncratic pronunciations of a talker for subsequent use during processing. Of interest are the neural systems which allow a listener to accommodate such talker-specific phonetic variants. The current study employed the perceptual learning in speech paradigm during fMRI in order to investigate the neural bases of this effect. Two groups of participants were exposed to lexical items in which a medial fricative (either /s/ or /ʃ/) was replaced by an ambiguous phonetic token. These subjects then categorized tokens sampled from an unbiased /asi/ to /aʃi/ continuum while in the scanner. Behavioral results replicated the perceptual learning in speech effect. Neural sensitivity to the phonetic boundary shift was evident in three right hemisphere regions: the inferior frontal gyrus, the middle frontal gyrus, and the middle temporal gyrus, suggesting that this effect is supported by both perceptual and executive processes. Results will be discussed with respect to current models of the neural bases of speech perception.

A4 12:30 pm

INDIVIDUAL DIFFERENCES IN AUDIOVISUAL SPEECH PERCEPTION: AN EYE-TRACKING AND FMRI STUDY.

Anthony Dick[1], Catherine Bradley[1], Barbara Junco[1], Iris Broce[1], André Maharaj[1]; [1]Florida International University

At least two mechanisms have been proposed to mediate visual speech (VS) contributions to audiovisual (AV) speech perception—visual-auditory and auditory-somatomotor interactions. However, there are individual differences in AV speech perception, and potentially each mechanism's contribution. Using eye-tracking and fMRI, we investigated a) whether individual differences in attention to a talker's mouth predict VS influence on categorical speech perception; b) which perisylvian regions are associated with these differences. To investigate this, we implemented a 2 x 2 design in a categorical speech perception task (with /ba/<->/da/ and /pa/<->/ka/ continua). All participants completed a pre-test to identify individual auditory category boundaries. They then passively viewed videos in which we manipulated a) VS information (VS and No-VS); and b) ambiguity of the auditory syllable (at the category boundary [Ambiguous] or not [Non-Ambiguous]). Gaze was tracked with a Tobii X60 eye-tracker (n = 24) or fMRI was performed (Pilot Study; n = 2). An AV post-test determined VS category boundary shift. For Study 1, looking to a talker's mouth predicted individual differences in VS influence but not No-VS category boundary (robust regressions p = .04 for VS; p = .87 for No-VS). Preliminary fMRI results (p < .05; corrected) showed that the VS and No-VS difference is greater during Ambiguous speech in posterior inferior frontal gyrus, and supramarginal gyrus/planum temporale. Both regions are implicated in auditory-somatomotor interactions. Taken together, the data suggest that individual differences in AV speech perception are dependent on both attention to a talker's mouth, and potentially on auditory-somatomotor interactions.

Slide Session B

Friday, October 26, 2:00 – 3:20 pm, Kursaal Auditorium

Language Disorders, Laterality, Meaning and Communication

Speakers: Zoe Woodhead, Joao Correia, Lise Van der Haegen, Laura Menenti

B1 2:00 pm

WORD-SPECIFIC TRAINING IN PATIENTS WITH ACQUIRED ALEXIA INDUCES INCREASED TOP-DOWN CONNECTIVITY FROM LEFT INFERIOR FRONTAL GYRUS TO LEFT OCCIPITAL CORTEX.

Zoe Woodhead[1], Sundeep Teki[1,2], Cathy Price[1], Richard Wise[3], Alex Leff[4]; [1]Wellcome Trust Centre for Neuroimaging, University College London, [2]Institute of Neuroscience, Newcastle University Medical School, [3]Cognitive, Computational and Clinical Neuroscience Laboratory, Imperial College, London, [4]Institute of Cognitive Neuroscience, University College London

Introduction: We tested whether computer-based, cross-modal, whole-word training could improve reading in patients with alexia after left occipitotemporal stroke (n=11). Magnetoencephalography (MEG) was used to investigate therapy-induced changes in directed connectivity within the reading network. Methods: Training was self-paced over 6-weeks (average=49 minutes/day). Spoken and written word pairs were presented repeatedly, with regular testing blocks using a same/different discrimination task. Written words were presented briefly (500ms) to encourage whole-word reading. Reading speed for trained and untrained words was assessed before and after training, with 2-4 weeks between assessments. MEG was acquired after training. Patients passively read trained and untrained words (200 items/condition), with a catch-trial detection task to maintain attention. Directed connectivity between bilateral visual, ventral occipitotemporal and inferior frontal sources was investigated using Dynamic Causal Modelling (DCM). Results: A repeated-measures ANOVA showed a significant time (pre vs. post training) by word type (trained vs. untrained) interaction ($F(3,30)=9.7$, $p<.01$).

The training was most effective for long words, thereby reducing the word length effect associated with acquired alexia. DCM revealed that the feedback connection from left IFG to left occipital cortex was stronger for trained than untrained words; the opposite (feed-forward) connection in the right hemisphere was stronger for untrained words. Conclusions: This study demonstrates that item-specific improvements in reading speed can be achieved using an intensive computer-based training approach. The DCM results indicate that this therapy is associated with a change in higher level representations in the left frontal cortex, leading to improved feedback predictions about incoming word stimuli.

B2 2:20 pm

BRAIN TRANSLATION OF WORDS: AN FMRI DECODING STUDY OF SPEECH RECOGNITION

Joao Correia[1], Milene Bonte[1], Giancarlo Valente[1], Lars Hausfeld[1], Elia Formisano[1], Bernadette Jansma[1]; [1]Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, and Maastricht Brain Imaging Center (M-BIC), Maastricht, The Netherlands

How do we represent the meaning of words independent of the language we are listening to? This fMRI study investigates the neural network of speech processing responsible for transforming sound to meaning, by exploring the semantic similarities between bilingual word-pairs. Eight native Dutch participants with high proficiency of English listened to four different nouns (animals), either spoken in Dutch or in English. These nouns were presented in separate runs for each language while participants were asked to detect non-animal targets (11% of the trials) within a list of animal non-target items. Activity patterns elicited by these non-target stimuli was analyzed using Machine-learning methods and multivariate classifiers. Firstly, to identify brain regions generally involved in spoken word processing, we let the classifier discriminate between word pairs within the same language (e.g. bull vs. horse). Secondly, to isolate language-independent semantic/conceptual representations in these regions, we assessed the ability of multivariate classifiers trained within one language (e.g. bull vs. horse) to generalize to the other language (e.g. the Dutch equivalents 'stier' vs. 'paard'). The results of our discrimination analysis show that word decoding involves a distributed network of brain regions consistent with the proposed 'dual-stream model' (Hickok and Poeppel, 2007). The results of our generalization analysis highlights a focal and specific role of a left anterior temporal area in semantic/concept decoding. Together, these distributed and focal brain activity patterns subserve the extraction of abstract semantic concepts from acoustically diverse English and Dutch words during bilingual speech comprehension.

B3 2:40 pm

CENTRAL VISUAL WORD RECOGNITION REQUIRES INTERHEMISPHERIC COMMUNICATION

Lise Van der Haegen[1], Marc Brysbaert[1]; [1]Department of Experimental Psychology, Ghent University, Belgium

The split fovea theory states that foveally presented words (i.e. within the central 3 visual degrees) are initially split and sent to the contralateral visual cortex. As such, letters presented in the left (LVF)/right (RVF) visual field are initially projected to the right (RH)/left (LH) hemisphere respectively. The present study tested the consequences of a foveal split for word reading in left- and right-handers with typical left or atypical right speech dominance. First, their speech lateralization was measured by a silent word generation task in fMRI. Lateralization indices were based on activity in Broca's area (pars opercularis/pars triangularis). All participants then named three-, four-, and six-letter words in isolation, while fixating at all possible letter positions. In addition, they were asked to read texts in silence. An eye tracking device monitored their eyes binocularly in both behavioral tasks. Results showed that left speech dominants named the words fastest while fixating at the word beginning (i.e. when most letters fall in RVF/LH), while the optimal viewing position of the right dominants was situated more towards the word end (i.e. with most letters in LVF/RH). Reading behavior also interacted with speech lateralization in the reading tests: The eyes of the left-dominant group landed more at the word beginning and less at the word end relative to the initial fixation positions of the right-dominant group. These findings demonstrate that interhemispheric communication is not only needed in central visual word recognition, but that reading behavior is also optimized in function of speech lateralization.

B4 3:00 pm

TAKE FIRST RIGHT SECOND LEFT: INTERSUBJECT FMRI CORRELATIONS PREDICT SUCCESS IN SPOKEN COMMUNICATION

Laura Menenti[1,2], Simon Garrod[1]; [1]University of Glasgow, Glasgow, United Kingdom, [2]Max Planck Institute for Psycholinguistics, Nijmegen, Netherlands

Common ground in conversation may be reflected as common patterns of neural activation between interlocutors. We investigated whether partners in spoken communication exhibit correlated patterns of brain activity, whether this correlation is predictive of the success of communication, and whether correlations are specific to the content on the conversation. Methods: During an fMRI scan, 12 speakers described, from memory, an easy and a difficult map of a zoo. Twelve listeners heard these descriptions during an fMRI scan and then drew the maps, providing a measure of communicative success. Brain

activity patterns of each speaker were correlated with those of the respective listener, and subjected to nonparametric randomization analyses to derive group level statistics, generalized over specifics of maps and descriptions. Results: Compared to rest, the zoo condition showed systematic correlations between interlocutors in bilateral auditory cortex, bilateral inferior frontal gyri, visual cortex and superior parietal regions. Correlations in visual and parietal areas, often involved in spatial imagery, as well as in left inferior frontal gyrus, were stronger in the easy than the difficult condition, showing that the underlying representations affect correlated brain activity in specific ways. Covarying communicative success with brain activity correlations confirmed that correlations in visual and parietal regions were greater when communication about the map was more successful. Conclusion: Interlocutors in spoken communication show both spatially and temporally correlated brain activity, not only in language areas, but also in areas processing the underlying (spatial) content of the conversation. Neural alignment in these regions reflects alignment in communication.

Slide Session C

Saturday, October 27, 11:30 am – 12:50 pm, Kursaal Auditorium

Reading

Speakers: Karen Emmorey, Carlos Hamamé, Jason Yeatman, Michele Diaz

C1 11:30 am

MAPPING THE READING CIRCUITRY FOR SKILLED DEAF READERS: AN FMRI STUDY OF SEMANTIC AND PHONOLOGICAL WORD-LEVEL PROCESSING

Karen Emmorey[1], Jill Weisberg[1], Stephen McCullough[1], Jennifer Petrich[1]; [1]San Diego State University

Many deaf individuals read in a language they cannot hear and do not speak, and the neural circuits that support reading in this population are poorly understood. We examined word-level semantic and phonological processing in 14 skilled deaf readers who were matched with 14 hearing readers for reading skill (college reading level; mean PIAT raw score = 93) and who use American Sign Language as their primary language. Participants performed a yes/no semantic decision (concrete concept?) and a phonological decision (two syllables?) for separate blocks of printed English words (10 words per block, ITI = 3s) while undergoing fMRI (3T GE scanner, 40 3.5mm axial slices, TR = 2s, FOV = 22.4mm, 240 volumes). Across two runs, six blocks of each task were interspersed with control blocks during which participants decided whether or not false font strings were underlined. Both groups performed equally well on the semantic task (Deaf = 94%; Hearing = 95%), but hearing readers outperformed deaf readers on the phonological task (95% vs. 76%, respectively). No group differences in neural activation were observed for the semantic task – both deaf and hearing readers engaged left frontal language regions. However, when access to English phonology was required, deaf readers recruited bilateral parietal and frontal cortices to a greater extent than hearing readers. Thus, skilled deaf and hearing readers rely on the same left hemisphere circuits when reading single words for meaning, but deaf readers recruit additional right hemisphere regions when required to make an explicit phonological judgment.

C2 11:50 am

HOW SPECIALIZED IS THE VISUAL WORD FORM AREA? NOVEL EVIDENCE FROM HUMAN INTRACRANIAL EEG

Carlos Hamamé[1,2], Marcin Szwed[3,2], Michael Sharman[4,5], Juan R. Vidal[2], Marcela Perrone-Bertolotti[2], Philippe Kahane[6], Olivier Bertrand[2], Jean-Philippe Lachaux[2]; [1]Laboratoire de Psychologie Cognitive, CNRS, Aix-Marseille Université, Marseille, France, [2]Lyon Neuroscience Research Center, Brain Dynamics and Cognition Team, CNRS (UMR5292), INSERM (U1028), Université Lyon 1, Lyon, France, [3]Department of Psychology, Jagiellonian University, Kraków, Poland, [4]Université Pierre et Marie Curie University, Paris, France, [5]Institut National de la Santé et de la Recherche Médicale, Institut du Cerveau et de la Moelle Épinière, UMRS 975, 75013 Paris, France, [6]Department of Epilepsy, Grenoble University Hospital (Centre Hospital du Grenoble), Grenoble, France

The visual word form area (VWFA) is a region in the human occipitotemporal cortex that develops a selective response to written language with the acquisition of reading skills. Interestingly, that functional specialization is largely preserved when manipulating basic features of the stimuli. It is debated whether this area is specialized for word recognition, or whether it is a general-purpose area that associates visual form (be it words or objects) with meaning. In order to clarify the level of specialization of the VWFA, we recorded the brain electrical activity (intracranial EEG, iEEG) from two epileptic patients with depth-electrodes implanted directly in the VWFA for clinical reasons. Patients performed an standard oddball task, whereby stimuli were drawn from nine semantic categories, namely: animals, houses, faces, scenes, man-made objects, fruits (target), pseudowords, consonant-strings and scrambled images. We calculated the high-frequency components of the iEEG signal (broadband gamma; 50-150 Hz) as an index of population-level spiking-rate, and found a region inside the VWFA which responded almost exclusively (five times larger than the response to any other category) to written text. With the

exception of the fusiform face area, the observed level of specificity has never been described before in the human visual system. Therefore, our results show the most selective brain response to words reported to the present date and provide novel evidence for functional specialization in the ventral visual stream.

C3 12:10 pm

DUAL PROCESS ACCOUNT OF THE JOINT DEVELOPMENT OF WHITE MATTER AND READING SKILLS

Jason Yeatman[1], Robert Dougherty[1], Michal Ben-Shachar[2], Brian Wandell[1]; [1]Stanford University, [2]Bar-Ilan University

Reading requires efficient communication within a network of visual, auditory and language processing regions that are separated by many centimeters. Hence, the white matter fascicles connecting these regions are critical for proficient reading. White matter development involves both myelination and pruning of axons, and the balance between these two active processes may differ between individuals and relate to reading development. We followed 39 children longitudinally for three years, and measured white matter development with diffusion imaging and reading development with age-normed psychometric tests. We used tractography to identify 20 white matter fascicles in each child and summarized the diffusion properties of each fascicle at each time point with its mean fractional anisotropy (FA). Age-normed reading scores were stable over time. While every child's reading skills increased from one year to the next, their skills relative to their peers did not change significantly. Diffusion properties, however, were not stable over time: Children with the highest FA in year one did not have the highest FA the next year. The rate of FA change of two tracts, the left arcuate fasciculus and the left inferior longitudinal fasciculus, covaried with children's reading skills. Children with above-average reading skills initially had low FA with a steady increase over the 3-year period, while children with below-average reading skills had higher initial FA that declined over time. A dual-process model of white matter development that balances biological processes that have opposing effects on FA, such as axonal myelination and pruning, can explain the pattern of results.

C4 12:30 pm

THE ROLE OF WHITE MATTER INTEGRITY IN EXPLAINING AGE-RELATED DIFFERENCES IN PHONOLOGICAL AND SEMANTIC PROCESSES

Michele Diaz[1], Micah Johnson[1], Deborah Burke[2], David Madden[1]; [1]Duke University, [2]Pomona College

Aging is characterized by neural, cognitive, and behavioral change. Within language there are well documented declines in phonological processes such as increased rates of tip-of-the-tongue phenomenon. In contrast, semantic processes are relatively stable as evidenced by maintained vocabulary and priming. This pattern of age-related change suggests a fundamental difference in the organization of these cognitive abilities. However, the relations between the neural variables that support cognition and behavior are still emerging. Here we investigated the relations between age, white matter (WM) integrity, and behavioral performance on a language task with older and younger adults in which participants made semantic and phonological decisions about pictures. We used whole-brain and region of interest analyses to examine 1) age-related decline in WM integrity and 2) how WM integrity relates to behavioral performance. Consistent with prior work, we found age-related decreases in fractional anisotropy (FA) throughout the brain. Behaviorally, older adults' were slower and less efficient when making phonological, but not semantic decisions. We then examined how age and WM integrity explained task performance. Incorporating global FA reduced the age-related variance in phonological decisions from 35.4% to 17.6%. This effect was strongest when incorporating FA values from bilateral frontal and left temporal regions. In the semantic task, there was no significant relation between performance and age, or between performance and global FA. However FA in left STG accounted for 15% of the variance in semantic decisions. Our findings highlight the role of WM integrity in age-related cognitive change.

Slide Session D

Saturday, October 27, 2:00 – 3:20 pm, Kursaal Auditorium

Lexical Semantics

Speakers: David Warren, Michael Bonner, Vicky Tzuyin Lai, Clara Martin

D1 2:00 pm

IMPAIRMENTS IN THE ACQUISITION OF NEW OBJECT-NAME ASSOCIATIONS AFTER UNILATERAL TEMPORAL LOBECTOMY DESPITE FAST-MAPPING ENCODING

David Warren[1], Kendra Schmitt[1], Melissa Duff[1]; [1]University of Iowa

Learning new object-name associations is crucial throughout life, perhaps best exemplified by the need to remember the names of new acquaintances. Research investigating the neural substrates of naming has shown that expression of known names relies on the anterolateral temporal lobes, while learning object-name associations relies on the hippocampus and surrounding medial temporal lobes (MTL). However, Sharon et al. (2010) suggested that non-MTL structures may support learning of new object-name associations under "fast-mapping"

conditions in which participants learn by contrasting novel and familiar objects. We tested this assertion by evaluating the ability of unilateral temporal lobectomy patients with early-onset epilepsy ("TL"; N=6) and healthy normal comparison participants ("NC"; N=6) to learn new object-name associations in two study conditions. Our sample of TL patients had uniform resections of the head and body of the left hippocampus accompanied by varying resection of left temporal pole and lateral/ventral temporal cortex. This variation in resection extent provided an opportunity to determine whether damage to the left hippocampus alone is sufficient to produce name-learning deficits. Novel object-name associations were presented in a traditional study format (e.g., "This is a numbat" presented with a novel object) or a fast-mapping format (e.g., "Click on the numbat" presented with one familiar and one unfamiliar object). In a delayed recognition test, NCs had learned many new associations irrespective of study condition, while TL patients performed at chance in both conditions. Our results indicate that left hippocampus supports the learning and expression of new object-name associations irrespective of learning conditions.

D2 2:20 pm

THE MEDIAL TEMPORAL LOBE SUPPORTS VISUAL SEMANTIC MEMORY

Michael Bonner[1], Murray Grossman[1]; [1]Department of Neurology, University of Pennsylvania

The ventral visual pathway processes a hierarchy of increasingly complex and abstract information. We tested the hypothesis that high-level regions at the apex of this hierarchy support representations of visual concepts in semantic memory. In an fMRI experiment, healthy adults (N=16) performed associativity judgments on words that varied in the strength of their visual representation (i.e., concreteness). Reaction times were faster for words with stronger visual associations (i.e., a concreteness effect). fMRI analysis showed that visual association strength parametrically modulated activity in the fusiform gyrus and anterior medial temporal lobe (MTL), such that stronger visual associations resulted in increased neural activation ($p<.05$, whole-brain corrected). Further, individual differences in the strength of the concreteness effect correlated with gray matter density of the MTL ($rho=.7$, $p<.005$). We next examined performance on this task in patients with semantic dementia (N=8), a neurodegenerative condition affecting anterior ventral temporal lobes. We compared performance on two subgroups of words: Visual (mean visual association strength=5.5) and Abstract (mean visual association strength=0.6). Controls made few errors but were worse on Abstract words ($p<.05$). Patients were impaired overall ($p<.001$). Half showed the expected concreteness effect, while the other half showed the opposite pattern of performance, a reverse concreteness effect. Regression analyses revealed that MTL atrophy predicted the degree of difficulty on Visual relative to Abstract concepts ($p<.05$, whole-brain corrected). These findings implicate high-level visual regions of the ventral and medial temporal lobe in semantic representation, and indicate that atrophy of these regions in semantic dementia can degrade visual concepts.

D3 2:40 pm

WHEN DOES CONTEXT SHAPE WORD MEANINGS?

Vicky Tzuyin Lai[1], Irina Simanova[2], Daniel Casasanto[3], Peter Hagoort[4]; [1]Max Planck Institute for Psycholinguistics, Nijmegen; Donders Center for Cognitive Neuroimaging; Radboud University Nijmegen, [2]Max Planck Institute for Psycholinguistics, Nijmegen; Donders Center for Cognitive Neuroimaging; Radboud University Nijmegen, [3]The New School for Social Research, [4]Max Planck Institute for Psycholinguistics, Nijmegen; Donders Center for Cognitive Neuroimaging; Radboud University Nijmegen

Words' meanings vary with context. When do context effects arise? The answer is critical for deciding between theories assuming that meanings are accessed from a stable mental lexicon and theories that suggest meanings are constructed ad hoc. On the first view, a word form activates an invariant core semantic representation, which is subsequently tailored to fit the context (e.g., Machery, 2010). On an alternative view, word forms are cues to construct meaning; the information that gets activated is always co-determined by the word and its context (Elman, 2004; 2009; Lai, Hagoort, & Casasanto, 2012). To distinguish between these theories, we used EEG to investigate the neurocognitive representations cued by words in different contexts. Participants (N=30) read words (e.g., puppy, murderer) and made affective (positive/negative) and ontological (animal/human) judgments about them. The judgment cue was either provided before the word (word-in-context condition) or after the word (word-without-context). An EEG pattern classifier was trained to discriminate signals from affective vs. ontological trials (segmented in 100-ms-interval post word onset). In the word-without-context condition, percentage of correctly classified trials stayed at chance for all intervals (50%), as expected, serving as baseline. By contrast, classification accuracy in word-in-context condition was 55% ($p=0.0006$, against chance) in 200-300 ms. EEG patterns already differed between the two contexts during early stages of meaning construction, inconsistent with the view that invariant, default meanings are first accessed from a mental lexicon and later modified by context. Rather, from their inception semantic representations are co-determined by word and context.

D4 3:00 pm

FROM LITERAL MEANING TO VERACITY IN TWO HUNDRED MILLISECONDS

Clara Martin[1,2], Xavier Garcia[3], Audrey Breton[4], Guillaume Thierry[5,6], Albert Costa[3,7]; [1]Basque Center on Cognition, Brain and Language, Donostia-San Sebastian, Spain, [2]IKERBASQUE, Basque Foundation for Science, Bilbao, Spain, [3]University Pompeu Fabra, Barcelona, Spain, [4]Institut des Sciences Cognitives, Université de Lyon – CNRS, France, [5]School of Psychology, Bangor University, UK, [6]Economic and Social Research Council Centre for Research on Bilingualism in theory and Practice, Bangor University, Bangor, UK, [7]ICREA, Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

During language processing, comprehenders do not only rely on definitional knowledge of words (i.e., literal semantics), they also constantly confront semantic content against factual information about the world stored in long-term memory (i.e., world knowledge). Understanding the cognitive mechanisms underlying language comprehension therefore requires a detailed understanding of the way in which literal semantics and world knowledge are accessed and integrated. Here, we investigated whether readers retrieve and integrate literal semantic and world knowledge information simultaneously or in sequence during sentence comprehension. We investigated event-related brain potentials (ERPs) elicited by the critical word of English sentences in three conditions: (1) correct; (2) semantic violation; (3) world knowledge violation (semantically correct but factually incorrect). Critically, we opted for low constraint sentence contexts (i.e., critical words were unpredictable in the sentence context) and we analysed ERP data based on individual world knowledge rather than common world knowledge. In the N400 time-window, the processing of both semantic and world knowledge violations differed significantly from that of correct sentences and from each other. This observation suggests that, at some point in time, both types of information are concurrently processed (Hagoort et al., 2004). However, the processing of semantic violations differed from that of correct sentences as early as the P2 time-window (150 ms after the critical word onset). We conclude that speakers access literal meaning before sentential truth value rather than simultaneously. The brain needs on average 200 ms more to show sensitivity to a world knowledge violation than for semantic violation detection.

Poster Schedule

Poster sessions are scheduled on Friday, October 26 and Saturday, October 27. Poster sessions are 2 hours, and presenting authors are expected to be present the entire time. Posters are located on the Ground Floor Foyer and 1st Floor. You may post your materials on the board assigned to you starting at the scheduled "Set-up Begins" time shown below. Please note that any posters not removed by "Take-down Complete" time will be discarded. Do not leave personal items in the poster room.

Date & Time	Posters	Topics
Poster Session A	A1 - A12	Auditory Perception, Speech Perception, Audiovisual Integration
Friday, October 26	A13 - A20	Control, Selection, Working Memory
9:30 - 11:30 am	A21 - A26	Discourse, Combinatorial Semantics
	A27 - A32	Gesture, Prosody, Social and Emotional Processes
Setup Begins: 7:00 am	A33 - A40	Language Development, Plasticity, Multilingualism
Teardown Complete: 1:30 pm	A41 - A49	Language Disorders
	A50 - A60	Lexical Semantics
	A61 - A69	Motor Control, Speech Production, Sensorimotor Integration
Poster Session B	B1 - B13	Auditory Perception, Speech Perception, Audiovisual Integration
Friday, October 26	B14 - B19	Discourse, Combinatorial Semantics
3:20 - 5:20 pm	B20 - B25	Gesture, Prosody, Social and Emotional Processes
	B26 - B35	Language Development, Plasticity, Multilingualism
Setup Begins: 1:30 pm	B37 - B45	Language Disorders
Teardown Complete: 8:00 pm	B46 - B55	Lexical Semantics
	B56 - B60	Motor Control, Speech Production, Sensorimotor Integration
	B61 - B69	Orthographic Processing, Writing, Spelling
Poster Session C	C1 - C12	Auditory Perception, Speech Perception, Audiovisual Integration
Saturday, October 27	C13 - C22	Language Development, Plasticity, Multilingualism
9:30 - 11:30 am	C23 - C33	Language Disorders
	C34 - C42	Lexical Semantics
Setup Begins: 7:00 am	C43 - C47	Motor Control, Speech Production, Sensorimotor Integration
Teardown Complete: 1:30 pm	C48 - C54	Orthographic Processing, Writing, Spelling
	C55 - C57	Phonology, Phonological Working Memory
	C58 - C59	Signed Language
	C60 - C69	Syntax, Morphology
Poster Session D	D1 - D9	Auditory Perception, Speech Perception, Audiovisual Integration
Saturday, October 27	D10 - D24	Lexical Semantics
3:20 - 5:20 pm	D25 - D34	Motor Control, Speech Production, Sensorimotor Integration
	D35 - D40	Orthographic Processing, Writing, Spelling
Setup Begins: 1:30 pm	D42 - D50	Syntax, Morphology
Teardown Complete: 7:30 pm	D51 - D60	Discourse, Combinatorial Semantics
	D61 - D68	Methods

Poster Sessions

Poster Session A

Friday, October 26, 9:30 am – 11:30 am,
Ground Floor Foyer and 1st Floor

Auditory Perception, Speech Perception, Audiovisual Integration

A1 EFFECT OF SENTENCE STRUCTURE ON THE NEURAL RESPONSE OF AUDITORY CORTEX

Dale Maddox[1], Jon Venezia[1], Greg Hickok[1]; [1]The University of California-Irvine, Department of Cognitive Sciences, Irvine, CA, USA.

The predictability of a stimulus modulates both behavioral response and neural activation in sensory areas. For example, previous behavioral work has shown that sentence structure facilitates word recognition: listeners are faster to detect a target word in a structured sentence than in a scrambled sentence, presumably via a top-down predictive mechanism. Here we investigate the effects of predictability due to sentence structure on the analysis of speech in auditory cortex. Twenty right-handed native English speakers participated in a 3T fMRI experiment using a block design. The stimuli consisted of either structured sentences or unstructured lists of words presented auditorily. The same words were used in both conditions: individual words were recorded in isolation then concatenated to form sentences or randomly concatenated to form lists. Both conditions had the same list-like prosody and analysis of the temporal envelope modulation rates yielded no differences. Thus, acoustically and lexically the stimuli did not differ. The subjects were instructed to listen for unintelligible (rotated) speech. We found robust activation differences between the conditions in auditory cortex with unstructured lists of words yielding greater activation, presumably reflecting an increase in processing load. This effect held even in core auditory areas. Sentence structure not only facilitates word recognition compared to unstructured words lists but also seems to facilitate early acoustic analysis of speech. This could reflect some form of top-down predictive coding or an attentional modulation.

A2 THE TIMECOURSE OF THE NEURAL RESPONSE TO EFFORTFUL LISTENING IN SPEECH COMPREHENSION

Jonathan Peelle[1], Ediz Sohoglu[2], Matthew Davis[2]; [1]University of Pennsylvania, [2]MRC Cognition and Brain Sciences Unit

In everyday speech comprehension, listeners overcome challenges such as background noise or age-related hearing loss which can act to obscure the stimulus and increase listening effort. How do our brains make sense of speech when acoustic information is unclear? Here we assess the timecourse over which additional neural resources are recruited when listeners process degraded, yet fully intelligible, speech. We presented listeners with spoken sentences that varied in their perceptual clarity, achieved through noise vocoding. Participants listened attentively and answered simple probe questions following each sentence. We measured neural responses using interleaved silent steady state (ISSS) fMRI, which allowed us to present the stimuli in the absence of scanner noise while still obtaining information about the temporal profile of the BOLD response. We modeled the beginning and end of each sentence separately, resulting in a 2x2 factorial design (clear/degraded x beginning/end). Overall, responses to intelligible speech were evident in both temporal and frontal cortex. Significant increases due to listening effort were evident in left inferior frontal gyrus (pars triangularis), motor cortex, and bilateral caudate. A significant condition x time interaction indicates that these increases were more evident at the end of the sentence, consistent with a contribution to linguistic processes. Together these findings support the hypothesis that listening effort is associated with increased dependence on non-auditory neural resources, consistent with working memory and executive processes required to recover meaning from an impoverished acoustic signal.

A3 ACOUSTIC AND SEMANTIC PREDICTABILITY MODULATE OMISSION RESPONSE TO MISSING SPEECH SEGMENTS

Mathias Scharinger[1], Alexandra Bendixen[2], Antje Strauss[1], Jonas Obleser[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Institute of Psychology, University of Leipzig, Germany

In the present study, we examine the effects of word-final missing speech segments that differed in predictability either as a result of statistic stimulus probability or as a result of sentence context. In Experiment 1, we omitted the final consonants of the German nouns Lachs (salmon) or Latz (bib), resulting in the syllable La. In three different conditions, only Lachs or Latz was repeatedly presented, or both words occurred in random arrangement with equal probability. Stimuli were presented outside the focus of attention. In Experiment 2, predictability was modulated by a preceding sentence context that either matched the meaning of either of the two nouns, Lachs or Latz, or was neutral in this regard. In both experiments, brain responses were measured with electroencephalogram (EEG) recordings. In Experiment 1, the occasional omission of the final consonant cluster elicited an omission response from 125 to 165 ms with enhanced amplitudes in the two predictable conditions compared to the unpredictable condition. In Experiment 2, sentences ending in the fragment La in the two predictable conditions showed an omission response in a similar time frame as in Experiment 1, whereas sentences in which La occurred in a neutral context did not. Altogether, we conclude that omission responses on a segment level can be modulated by

predictions derived from sensory, lower-level probabilities or by predictions derived from higher-level sentence context. These results are particularly important for compensatory processes in adverse listening situations, where missing information can be recovered by forward predictions from different processing levels.

A4 RE-VISIONING LANGUAGE AND THE BRAIN: AUDITORY LANGUAGE COMPREHENSION IS DYNAMICALLY SUPPORTED BY VISUAL CORTEX

Samuel Briggs[1], Jeremy Skipper[1]; [1]Hamilton College

Most models of the organization of language and the brain maintain that auditory language comprehension statically relies on regions surrounding primary auditory cortex. An alternative is that the neural architecture underlying comprehension is more dynamic and can rely on areas outside of auditory cortex. For example, comprehension could be supported by the visual system when listeners' prior experience with heard speech occurred when reading. This hypothesis was tested with high-density electroencephalography. In Phase I participants listened to unfamiliar music clips paired with sung or written lyrics (e.g., "We sailed the wet seas by boat"). The clips were heard again in Phase II but without accompanying lyrics. A spoken sentence followed each clip. The final word of the sentences was semantically related to the lyrics that originally accompanied the clips (e.g., "She thought about the water"). Alternately, unfamiliar clips preceded sentences. When lyrics accompanying the music had been previously heard in Phase I, auditory cortex was less active (i.e., neurally primed) during the final word when compared to final words accompanied by unfamiliar clips. When lyrics accompanying music had been read, visual cortex (including the fusiform gyrus) was less active during the final word. These results demonstrate that instrumental music can reinstate visual word forms that previously accompanied music and that these activate related words and support auditory language comprehension. Results require a revision of existing models of language comprehension and the brain to correspond to a more active, dynamic, and distributed model that includes the effects of recent (visual) experience.

A5 CAN OFFLINE AUDIOVISUAL TRAINING AID PERCEPTUAL ADAPTATION TO ACCENTED SPEECH?

Briony Banks[1], Patti Adank[1], Emma Gowen[1], Kevin Munro[1]; [1]University of Manchester

The ability to adapt to hearing accented speech is often rapid and robust, allowing adults to increasingly comprehend an unfamiliar accent over time. The presence of audiovisual cues (seeing and hearing a speaker) can facilitate comprehension of speech in adverse listening conditions. However, it is unclear whether this 'enhancement' effect is transferable, or if it would aid adaptation to an unfamiliar accent. This experiment compared adaptation to a novel, unfamiliar accent after a period of training with and without visual speech cues and background noise. An adaptive staircase procedure was used to ascertain Speech Reception Thresholds for 60 young, normal-hearing adults while listening to accented sentences in noise, before and after training. Training was presented in Audiovisual or Audio-only conditions in quiet or with a fixed level of background noise. A Visual-only (lip-reading) control condition was also included. Analyses of variance revealed that although comprehension significantly improved over time, there was no significant effect of training condition on adaptation. Data from the training periods revealed that overall comprehension was better for audiovisual speech only when stimuli were presented in background noise. Thus, the results show no cross-modal offline learning effect for audiovisual speech stimuli. Furthermore, we found that visual speech cues only enhance comprehension when background noise is present, and may not benefit comprehension of an unfamiliar accent. Results are discussed in the context of theories of perceptual adaptation of speech comprehension.

A6 THE GENETIC INFLUENCE IN SPEECH PERCEPTION AND LEARNING

Anna Basora[1], Yu Jin[1], Núria Sebastián-Gallés[1]; [1]Universitat Pompeu Fabra

It is known that humans differ in their ability to master a new language. Previous studies showed that the age of acquisition, the amount of experience and the motivation are important factors. However, individual differences in language learning ability are usually understood in terms of "aptitude", which is related to genetic differences. What is the determinant factor in mastering a language? Is it the environment or the genes? In this study, we aimed at finding the relevance of genetic factors in speech perception and learning. In order to do that, we recorded event-related potentials (ERPs) from both monozygotic and dizygotic twins. They performed two tasks; one was related to word segmentation and the other was related to phoneme change detection. A Wavelet analysis was carried out from the ERP data and the cross-correlation was calculated to compare the brain activity from each pair of twins. The results showed a significant genetic influence during the first minute of word learning and a marginal significance in native phoneme perception. From this, we conclude that genetics might play a role when people start segmenting a new language as well as when they perceive speech sounds from their own language.

A7 STRUCTURAL BRAIN DIFFERENCES BETWEEN MONOLINGUALS AND BILINGUALS

Volker Ressel[1], Christophe Pallier[2], Noelia Ventura-Campos[3], Begoña Díaz[4], Abeba Roessler[1], César Ávila[3], Núria Sebastián-Gallés[1]; [1]Universitat Pompeu Fabra, [2]INSERM-CEA, Neurospin Center, [3]Universitat Jaume I, [4]Max Planck Institute for Cognitive and Brain Science

Studies have reported a positive correlation between the ability to perceive foreign speech sounds and the volume of Heschl's gyrus (HG) (e.g. Golestani et al., 2007). More precisely, participants with larger left HG learned consonantal or tonal contrasts faster than those with

smaller HG. These studies leave open the question of the impact of experience on HG volumes. In the current study, we investigated the effect of early language exposure (mono-, bilingual) on the volume of HG. We compared Spanish-Catalan bilinguals (n=22, 11 females) who have been exposed to two languages since childhood to a group of Spanish monolinguals (n=22, 11 females) matched in education, socio-economic status and musical experience. Anatomical magnetic resonance images were taken for each participant and HG were manually marked in the left and right hemispheres. Two skilled raters were blind to group (monolinguals and bilinguals), gender (male and female) and hemisphere (left and right). Inter-rater reliability was assessed comparing all drawings ($r=0.873$, $p<0.001$). The analysis of variance on the HG total volume with the factors Group (monolinguals vs. bilinguals); Gender (male vs. female) and Side (left vs. right) showed that the manually marked HG volumes were significantly larger in bilinguals than in monolinguals ($F(1,40)=5.4$; $p<0.05$). This was corroborated by a whole brain analysis using Voxel-Based-Morphometry. Since the bilinguals in this study were not a 'self-selected' group, this result provides a clear demonstration that learning a second language is a causal factor in the increased size of HG, or more generally, of the auditory cortex.

A8 BILINGUALISM AND NEURAL STABILITY: EXAMINING THE INTERSECTION OF COGNITIVE AND SENSORY PROCESSING

Jennifer Krizman[1,2,3], Erika Skoe[1,3], Viorica Marian[2,3], Nina Kraus[1,3]; [1]1Auditory Neuroscience Laboratory (www.brainvolts.northwestern.edu), [2]Bilingualism and Psycholinguistics Laboratory, [3]Northwestern University, Evanston, Illinois USA

Experience using two languages enhances cognitive functions, including attention, and; attention, through top-down signaling, influences sensory processing in the auditory brainstem. One possible mechanism for attention-mediated brainstem tuning is that it leads to more synchronous and consistent neural firing. Therefore, we predicted that early bilingual experience would result in both enhanced sustained attention and more consistent subcortical neural processing of sound during adolescence. Indeed, relative to monolinguals, early bilinguals demonstrated better auditory attention, as measured by a test of integrated visual and auditory sustained attention, as well as higher response consistency, as indexed by the trial-by-trial repeatability of the auditory brainstem response evoked by a speech syllable. In bilinguals, but not monolinguals, performance on these two measures was correlated, suggesting that bilingual experience shapes both processes, and in a reciprocally interactive manner. Additionally, given that sound processing involves both subcortical and cortical structures, we hypothesized that the attention-mediated enhancements in the trial-by-trial synchronicity of the brainstem response would facilitate the early cortical response to that speech syllable. As predicted, brainstem response consistency related to the cortical onset response (P1), such that bilinguals had a larger cortical response than monolinguals. We demonstrate that early experience with two languages leads to consistent and robust neural encoding of auditory signals during adolescence, which we interpret as being driven by bilinguals' fined-tuned auditory attention abilities. Thus, real-world experience with a rich diversity of sounds fine-tunes the auditory system by promoting enhanced subcortical speech processing via both sensory and cognitive processes.

A9 FUNCTIONAL SEGREGATION IN SECONDARY AUDITORY CORTICES DURING PROCESSING OF MUSIC AND SPEECH: THE EFFECTS OF MUSICIANSHIP

Arafat Angulo[1], William Aubé[2,3], Isabelle Peretz[2,3], Fernando Barrios[1], Jorge Armony[2,4], Luis Concha[1,2]; [1]Universidad Nacional Autónoma de México, Querétaro, México, [2]International Laboratory for Brain, Music and Sound Research (BRAMS), Montréal, Canada, [3]Université de Montréal, Montréal, Canada,, [4]Douglas Institute, McGill University, Montréal, Canada

Music and voices are particularly relevant auditory stimuli with several brain regions (within and beyond the auditory cortices) recruited for their analysis. Therefore, it has been argued that the neural resources necessary to processes them may be shared all along the auditory stream (Patel, 2003). Yet it is also possible that for higher order processing they engage distinct regions within the auditory cortices. Our objective was to identify cortical areas showing increased activity in response to musical stimuli, compared to voices, and to assess if musical experience influences the response of such regions. By using functional magnetic resonance, we examined 53 volunteers, divided into two groups (formal-musicians and non-musicians). The fMRI paradigm consisted of blocks (10 s duration) of acoustic stimuli (~1.5 s. each) of different categories: speech (in several languages), human non-linguistic vocalizations (e.g. laughs) , music excerpts (played by a violinist, pianist and a mechanical piano), non-vocal sounds (e.g. car-honk) and monkey vocalizations. Total paradigm duration was 8 minutes. We found a bilateral region in the anterior portion of the superior temporal gyrus (planum polare) (right 50, -2, -6, and left hemisphere -48, -4, -2 [MNI x,y,z coordinates in mm]), showing preferential activity in response to musical stimuli as compared to speech and human non-linguistic vocalizations. Furthermore, only the musicians showed increased activity of the right planum temporale (58, -14, 4), secondary to musical listening. We provide evidence showing that music listening can engage discrete regions within the auditory cortices and that prior experience can modulate their activity.

A10 TRAINING MODULATES COMPENSATORY FRONTOTEMPORAL RESPONSES TO SIMULATED DEFICITS OF SPEECH PROCESSING

Jane Warren[1], Sonia Brownsett[1], Fatemeh Geranmayeh[1], Richard Wise[1]; [1]Imperial College London

In the normal brain, successful speech comprehension under adversity is assumed to depend upon the recruitment of compensatory neural resources. These compensatory systems are likely to make a crucial contribution to the recovery of language function after focal brain lesions, yet their functional organization and capacity for plasticity remain poorly understood. In this functional MRI study involving 18 subjects, we investigated: 1) the neural systems engaged in the normal brain during simulated deficits of speech comprehension, and 2) changes in activation in these systems after behavioural training. In an initial fMRI session, haemodynamic responses during attempted comprehension of low-intelligibility (noise-vocoded) sentences and comprehension of natural spoken sentences were compared. A second fMRI scan was conducted after completion of a prolonged training program designed to improve comprehension of the low-intelligibility stimuli. Prior to training, impeded speech comprehension was associated with significantly greater activity at strategic cortical sites associated with the dorsal auditory pathway, including planum temporale and inferior frontal gyrus (IFG) bilaterally. Accurate comprehension of low-intelligibility stimuli correlated with activation in right IFG, and inaccurate comprehension with left IFG activity. Training resulted in significantly improved comprehension of low-intelligibility speech and significantly reduced activation in brain regions that showed compensatory responses prior to training. This study demonstrates compensatory engagement of the dorsal auditory pathway when speech comprehension is difficult, which can be modulated by behavioural training. These findings suggest that the dorsal auditory pathway may provide a key substrate for language recovery and a target for therapeutic intervention after aphasic brain lesions.

A11 CORTICAL THICKNESS PREDICTS INDIVIDUAL DIFFERENCES IN LEXICO-PHONOLOGICAL REPRESENTATION IN HIGHLY-SKILLED BILINGUALS

Miguel Burgaleta[1], Cristina Baus[1], Begoña Díaz[2], Nuria Sebastián-Gallés[1]; [1]Center for Brain and Cognition, Universitat Pompeu Fabra, [2]Max Planck Institute for Human Cognitive and Brain Sciences

Variations in morphology of the cerebral cortex are related to individual differences in learning rates of novel speech sounds. However, available evidence mainly comes from short-term laboratory training studies of adult samples, thus raising the question of whether such particular language exposures reproduce the complex L2 learning mechanisms that take place in real-life situations since early stages of development. In this study we investigated two samples of highly-proficient Spanish-Catalan bilinguals, who had Catalan as their second language. Participants were selected according to their ability to perceive the Catalan-specific contrast /e - ɛ/ in a set of three behavioral tasks tapping prelexical and lexical domains. Structural MRI were acquired and processed to estimate vertex-wise indices of cortical thickness, and the association between cortical morphology and performance in the three tasks was inspected. Results revealed a significant negative association for the task requiring fine-grained lexical representations, located primarily in the left middle and inferior temporal gyri. This finding, consistently with previous fMRI studies, suggests that morphology of the left MTG/ITG is important for word recognition based on phonological information. Further, we argue that thicker cortices in sound-to-meaning mapping regions, found for poor non-native phoneme perceivers, plastically arise after extended periods of increased functional activity during L2 exposure. Specifically, phonetic discrimination difficulties would result in the concurrent activation of an enlarged number of lexical candidates and increase lexical competition during word recognition and, ultimately, affect morphology of structures involved in accessing the mental lexicon.

A12 PERCEPTION OF DURATION IN NATIVE AND FOREIGN LANGUAGES: EVENT-RELATED BRAIN POTENTIALS TO CONSONANT LENGTH

Carson Dance[1], Sarah Creel[1], Marta Kutas[1]; [1]University of California, San Diego

Does learning a language shape your perceptual processes? Given findings that show decreased discrimination abilities for late learned second languages, it has been hypothesized that the development of native speech perception may include the loss or fine-tuning of some perceptual processes early on in auditory or speech perception pathways. To address this question, we use the mismatch negativity (MMN) component of event-related brain potentials to investigate processing of consonant duration in Korean-English bilingual listeners (who use duration contrastively) and English monolingual listeners (who do not). In a passive listening paradigm (attention directed to silent video), we record the pre-attentive neural response to a change in the duration of a /n/ sound in the context of a pseudoword and to a duration change in a pure tone (both deviants against a background of frequent standards). In a second task, participants responded with a button press to these same deviants (targets). Korean-English bilinguals elicit a slightly earlier MMN to a duration deviants in the pseudowords than the English monolinguals ($F(1, 21)=15.53$ $p<.001$), despite no reaction time differences to the deviant targets. The Korean speakers, for whom the contrast is potentially informative, seem to pre-attentively process the duration change more rapidly than the English speakers, who do not have extensive experience with a duration contrast. This suggests that with language experience, perceptual processes may become finely tuned for important aspects of language use.

Control, Selection, Working Memory

A13 THE USE OF TRANSCRANIAL DIRECT CURRENT STIMULATION TO ENHANCE LEXICAL RETRIEVAL AND WORKING MEMORY IN SCHIZOPHRENIA

Joseph J van Steenburgh[1], Mark Varvaris[1], Tracy D Vannorsdall[1], Barry Gordon[1,2], David J Schretlen[1]; [1]The Johns Hopkins University School of Medicine, [2]The Johns Hopkins University

Background: Cognitive impairment is common in schizophrenia (SZ). First-degree relatives of SZ probands show similar but milder impairment. Transcranial direct current stimulation (tDCS) noninvasively modulates neural activity using weak direct current. Whether it can alter cognitive function in persons with SZ or their first-degree relatives (SZR) is unknown. Method: Five adults with SZ and 6 SZR completed several tasks during two 30-minute sessions of tDCS applied to the dorsolateral prefrontal cortex (DLPFC) bilaterally. Participants received left anodal and cathodal stimulation in counterbalanced order. Results: In the combined sample, left DLPFC anodal stimulation decreased the number of words in semantic subcategories on category-cued (left anodal: 2.24 +/- 0.30 vs. left cathodal: 2.65 +/- 0.43; p=.017) and letter-cued (left anodal: 3.05 +/- 0.34 vs. left cathodal: 3.49 +/- 0.52; p=.008) word fluency tasks. A trend toward increased retrieval of high-frequency words during left DLPFC anodal stimulation also was found. Left DLPFC anodal stimulation led to the production of more unique designs (12.4 +/- 5.9 vs. 10.0 +/- 4.8; p=.024) in patients, but not relatives. Finally, left anodal DLPFC stimulation also enhanced backward span (12.82 +/- 3.92 vs. 11.2 +/- 3.23; p=.018) in the combined sample. Conclusions: TDCS can alter cognition in those with a genetic predisposition to SZ. Participants tolerated tDCS well. Compared to cathodal stimulation, anodal stimulation of left DLPFC facilitated controlled aspects of verbal fluency, design fluency and working memory. More research is needed to explore using tDCS to treat language dysfunction and other cognitive deficits in SZ.

A14 CEREBRAL FUNCTIONAL CONNECTIVITY PREDICTS EFFECT OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON WORKING MEMORY IN SCHIZOPHRENIA

David J Schretlen[1], Mark Varvaris[1], Paul G Unschuld[1], Joseph J van Steenburgh[1], Tracy D Vannorsdall[1], Barry Gordon[1,2]; [1]The Johns Hopkins School of Medicine, [2]The Johns Hopkins University

Background: Precisely how transcranial direct current stimulation (tDCS) alters brain functioning remains unclear. We hypothesized that individual differences in functional connectivity of selected brain networks would mediate the cognitive effects of tDCS in persons with schizophrenia and unaffected relatives of persons with schizophrenia. Method: Six adults (4 with schizophrenia, 2 unaffected relatives) underwent resting state functional MRI and later completed several tasks during two 30-minute sessions of tDCS applied to the dorsolateral prefrontal cortex (DLPFC) bilaterally. Participants received left anodal and cathodal stimulation in counterbalanced order. Results: Four participants (responders) showed better working memory during anodal left DLPFC stimulation, while 2 (non-responders) did not. A seed-to-voxel analysis of synchronous blood-oxygen-level-dependent (BOLD) signal activity revealed that anodal tDCS responders showed significantly greater synchrony between the left DLPFC and the left supramarginal/angular gyrus (attentional/task-positive network). Conversely, responders showed decreased BOLD synchrony between a seed in the precuneus and the left supramarginal/angular gyrus region (default mode network). A seed was placed in the left mid-temporal region, an area that has been associated with working memory dysfunction and auditory processing deficits in schizophrenia. The mid-temporal seed showed increased BOLD synchrony with bilateral DLPFC and supramarginal/angular gyri in tDCS responders. Conclusions: Functional connectivity between the left DLPFC (directly beneath the tDCS electrode) and distal brain regions thought to constitute a task-positive attentional network appears to mediate the enhancement of working memory test performance in response to anodal tDCS over this region.

A15 NEUROANATOMIC CORRELATES OF VERBAL FLUENCY IN SCHIZOPHRENIA

Jacqueline Weaver[1], Mark Varvaris[1], Barry Gordon[1,2], David Schretlen[1]; [1]The Johns Hopkins University School of Medicine, Baltimore, MD, [2]The Johns Hopkins University, Baltimore, MD

Objective: Verbal fluency (VF) is frequently impaired in schizophrenia. The aim of this study was to examine the neural correlates of VF productivity, as well as controlled (i.e., switching) and automatic (i.e., clustering) aspects of word retrieval, in persons with schizophrenia. Methods: Thirty-five adults with schizophrenia completed two phonemic (s, p), two semantic (animals, supermarket items) VF tasks and underwent brain MRI. Verbal fluency measures were correlated with regional gray matter volume (GMV) co-varied for intracranial volume using voxel-based morphometry (uncorrected p<0.001). Results: Semantic VF productivity correlated with greater GMV in the left cingulate, bilateral precuneus and right thalamus. Phonemic productivity correlated with GMV in the bilateral thalamus, left precuneus, left cingulate gyrus, bilateral medial frontal gyri, right superior frontal gyrus, and left middle temporal gyrus. Switching on semantic VF correlated with the left inferior frontal gyrus, left precuneus, and right posterior cingulate. Switching on phonemic fluency correlated with the bilateral thalamus and left precuneus. Clustering on semantic fluency correlated with greater GMV in the right thalamus. Clustering on phonemic VF correlated with the bilateral medial frontal gyri, left superior and right middle frontal gyri, left middle temporal gyrus, left cingulate, and left precuneus. Conclusions: Switching and clustering likely

depend on many brain structures beyond the left frontal and temporal cortex in schizophrenia. Most of the neural correlates found here have been associated with VF in healthy adults. Given that schizophrenia is characterized by decreased frontal and temporal GMV, the contributions of these other structures may be particularly important.

A16 SEMANTIC PROCESSING AND THE EXECUTIVE CONTROL SYSTEM: A STUDY OF SEMANTIC DEFICITS IN STROKE PATIENTS

Tatiana Schnur[1], Ting Feng[2], Randi Martin[1], ZaiZhu Han[2], Yanchao Bi[2]; [1]Rice University, [2]Beijing Normal University

A recent theory of conceptual representation (e.g., Jefferies et al., 2007) proposes that semantic impairments following stroke are due to an inability to select appropriate semantic information from multiple sources, described as a deficit in a semantic control network distributed across multiple brain regions. Support for this proposal comes from blocked-cyclic naming and comprehension tasks, where stroke patients with semantic deficits showed "refractory effects" in both production and comprehension tasks (e.g., decreasing performance across repetitions and/or an increasing effect of semantic relatedness with repetition). However, the results suffer from methodological limitations. In the current study, we assessed the methodological issues by examining the performance of 11 stroke patients with distributed lesion patterns and various levels of semantic performance on blocked-cyclic naming and comprehension tasks relative to that of controls. In blocked-cyclic naming, all patients showed significantly stronger "refractory effects" (significant main effects of semantic blocking, repetition, and an increase of semantic blocking over repetitions) when individually compared to controls. In comprehension (associative matching), only a few patients showed significantly different "refractory effects" from controls. Patients with and without semantic deficits did not differ in performance from each other either in production nor comprehension tasks. Further analysis showed that there was no correlation between the degree of semantic impairment and the magnitude of refractory effects. Together, these results indicate that either the semantic impairments in stroke patients cannot be attributed to a single cause of semantic control disruption, or the cyclic tests do not reveal semantic control deficits.

A17 ROLE OF THE HIPPOCAMPUS IN LANGUAGE PRODUCTION: NOVEL EVIDENCE FROM INTRACRANIAL EEG

Carlos Hamame[1], F.-Xavier Alario[1], Anais Llorens[1,2], Catherine Liegeois-Chauvel[2], Agnes Trebuchon-Da Fonseca[2]; [1]Laboratoire de Psychologie Cognitive, CNRS, Aix-Marseille Université, Marseille, France, [2]INSERM UMR751, Aix-MarseilleUniversité, Marseille, France

The functional role of the hippocampus has been extensively described in memory and object recognition processes. However, and despite the fact that both, memory and object recognition are required for naming a visual object, to the date there is no direct evidence relating hippocampal activity to language production in general nor picture naming in particular. We hypothesize that the hippocampus should be actively involved in picture naming to the point that it would allow to predict behavior. Furthermore, since language is strongly lateralized in the brain, we believe that the left hippocampus should be more involved than the right one. We tested this hypothesis in three epileptic patients, with depth-electrodes directly implanted in the hippocampus for clinical reasons. We recorded hippocampal local field potentials (LFP, equivalent to intracranial-EEG) and obtained broadband gamma (50-150 Hz) activity, as an index of multi-unit activity, during a standard picture naming task. Our results show for the first time the dynamics of hippocampal activity in the period between picture presentation and speech production (naming). We show that the latency of the stimulus-related hippocampal response can predict naming reaction time and that failure to activate the hippocampus leads to a failure in naming the depicted object, which is not related to recognition or attentional difficulties (tip of the tongue). We believe that the current study provides sufficient evidence for updating picture-naming models in order to include the hippocampus as an important node of the speech production network.

A18 SIMILARITY-BASED COMPETITION IN SENTENCE PRODUCTION AND COMPREHENSION

Gina Humphreys[1], Silvia Gennari[1]; [1]University of York

Research suggests that language production and comprehension share lexical and grammatical knowledge. However, these tasks might differ in their component processes, e.g., word retrieval vs. word recognition, as reflected by distinct production and comprehension models proposed in the psycholinguistic literature. Here we used behavioural measures and fMRI to investigate the extent to which these tasks share similarity-based competition processes. Similarity-based competition was manipulated by varying the degree of conceptual similarity between the nouns in relative-clause structures that should be mapped into agent and patient roles (e.g., The girl that the woman is touching vs. The dog that the woman is touching). In production, we used a picture-based relative-clause elicitation task, where participants describe visual entities. In comprehension, they read relative clauses that described the pictures. The behavioural studies showed that high-similarity nouns are harder to process than low-similarity ones in both production and comprehension, suggesting competition when mapping similar entities into semantic roles for which both animate nouns are equally good candidates. fMRI results suggest a common effect of competition across production and comprehension within the left inferior frontal gyrus, but production recruits a wider network of areas to resolve competition including motor and subcortical structures, which reflect task-specific component processes, e.g. sentence planning. Therefore, despite parallel behavioural effects, the neural substrates underlying the competition processes partially differ

across production and comprehension. This suggests that similarity-based competition reverberates across different networks as a function of task demands, but a core fronto-temporal network computes the mapping from words to sentential roles.

A19 SOCIAL INTERFERENCE IN BILINGUAL PROCESSING: AN FMRI STUDY

Yapeng Wang[1], Qi Dong[1], Patricia Kuhl[2]; [1]National Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, PR China, [2]Institute for Learning and Brain Sciences, University of Washington, Seattle, USA

The bilingual speaker should not simply be considered the sum of two monolingual speakers. Several lines of evidence show that the cognitive and neural mechanisms of bilingual processing and control are affected by many factors, including individual factors (AOA, L2 proficiency, etc), environmental factors (background of bilingual processing, circumstance of language communication, etc), and language mode (bilingual or monolingual mode). Social information, such as the sight of a person who speaks one language as opposed to another, may also play a quite important role in language control. However, there has been little research into the role of social information in language control. The present study aims to explore the role of social information in bilingual processing and control by involving different kinds of social cues when bilingual speakers with different language backgrounds process and control their two languages. The results show that, for English-Chinese bilinguals, when they process English task (L1) with different social cues, no significant activation was noted across different contrasts. However, when they process Chinese task (L2), relative to the Chinese social cue and no social cue conditions, the English social cue induced increased activation in the frontal executive areas, and no additional activation was found for other contrasts. Our results suggest that, social information might interfere with bilingual process. More importantly, the social interference is asymmetric.

A20 CORTICAL MECHANISMS UNDERLYING THE PROCESSING OF JAPANESE HIERARCHICALLY EMBEDDED SENTENCE STRUCTURE

Toshiki Iwabuchi[1,2], Toshio Inui[1], Kenji Ogawa[3]; [1]Kyoto University, Japan, [2]Japan Society for the Promotion of Science, Japan, [3]ATR Cognitive Mechanisms Laboratories, Japan

Humans are capable of producing and comprehending sentences with hierarchically embedded structure. In the present study, we used functional magnetic resonance imaging to investigate the brain mechanisms underlying the processing of hierarchical structure in Japanese. Participants (N = 16) read a center-embedded, a left-branching, or a coordinated sentence in each trial. These complex sentences were visually presented in a segment-by-segment fashion, with each sentence divided into six segments. Each segment was displayed for 1,700 ms (= repetition time, in our experiment). Participants were subsequently required to read a simple sentence probe and to indicate whether the meaning of the probe was consistent with the previous complex sentence by pressing a button. To understand a center-embedded sentence, a reader needs to separate each segment into two clauses for appropriate syntactic unification; controlling the syntactic unification process, in other words, is needed. Comprehending a center-embedded sentence will impose greater control demands for the syntactic unification process than will comprehending a left-branching and coordinated sentence. We found that the left inferior frontal gyrus, left superior precentral sulcus, left posterior superior temporal sulcus, left supramarginal gyrus, right superior precentral sulcus, and precuneus were more activated ($p < .001$, uncorrected for multiple comparison) when comparing the center-embedded condition to the left-branching and the coordinated conditions. We speculate that the left superior precentral sulcus is involved in the control process of syntactic unification, because it has been suggested that this region is important for cognitive control, such as inhibition of irrelevant information.

Discourse, Combinatorial Semantics

A21 UNIVERSAL BRAIN NETWORK IN READING AND LISTENING TO CONTINUOUS NARRATIVES ACROSS CHINESE AND ENGLISH

Jianfeng Yang[1], Xiaojuan Wang[2], Einar Mencl[3], Jie Yang[4], Hua Shu[2], Jason Zevin[3,5]; [1]Institute of Psychology, Chinese Academy of Sciences, Beijing, China, [2]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [3]Haskins Laboratories, New Haven, CT, United States, [4]Department of Neurology, U.C. Irvine, CA, United States, [5]Sackler Institute for Developmental Psychobiology, New York, NY, United States

The surface features of writing systems differ greatly, shaped by history, culture and language. Many researchers have thus far assumed that different writing systems require different processing assumptions in terms of both cognitive theory (Coltheart et al., 2006) and neuroanatomical models (Bolger et al., 2005; Tan et al., 2005). However, these conclusions rest largely on the studies at word or sentences level, in which brain activation is strongly driven by the interactions between task demands and stimulus-selectivity (Yang et al., 2012). Further, task demands can interact with writing systems themselves, for example, when the "no" stimuli in a lexical decision task depend on specific features of the writing system. Here we study natural language processing both in Chinese and English, by comparing the brain activity in reading and listening to continuous narratives. Two experiments with the same materials and procedures were conducted for Chinese and English native speakers (16 university students in each language). Six fairy tales were translated from Chinese to English sentence by sentence to match the difficulty of meaning processing, and presented in alternating minute-long blocks of text and speech. Analyses focused on identifying regions active to speech

and reading vs. rest, and overlap of the two. Strikingly, the overlapping brain regions for reading and listening are common across languages. Those regions included bilateral IFG and a large area along STS. Thus, in contrast to studies with single word or character reading, we find a nearly identical network for reading of connected text across languages.

A22 SINGULAR AND PLURAL REFERENCES TO CONJOINED AND NON-CONJOINED ANTECEDENTS: AN FMRI STUDY

Tim W Boiteau[1], Amit Almor[1]; [1]University of South Carolina

The Repeated Name Penalty (Gordon, Grosz, & Gilliom, 1993), the slower processing of a repeated name relative to a pronoun when referring back to a salient discourse entity, has been shown to involve brain regions in the temporal and parietal lobes (Almor et al., 2007). The functions of these regions have been hypothesized to be the creation and integration of new entities into the discourse model through the use of linguistic and spatial attentional processes. We further tested this hypothesis by conducting an fMRI experiment using plural and singular pronominal references to conjoined and non-conjoined antecedent phrases. We scanned 26 participants in a Siemens 3T MRI while they read two-sentence discourses presented sentence by sentence using a 2 x 2 design with factors Conjunction (Conjoined vs. Non-conjoined) and Number (Plural vs. Singular): 1. Conjoined Steve and Nicole walked to school. Non-conjoined Steve walked with Nicole to school. 2. Plural They enjoyed the nice weather. Singular He enjoyed the nice weather. Our analyses focused on the BOLD activation in sentence 2 of every discourse. We found that the Non-conjoined Singular condition in comparison with the Conjoined Plural resulted in activation in the left Inferior Parietal Lobule, the Superior Parietal Lobule bilaterally, and inferior occipital regions ($z>1.8$, $p<.05$ cluster threshold in FSL). Non-conjoined Plural relative to Conjoined Singular resulted in activation in the right Insula, right Supramarginal Gyrus, and the Inferior Parietal Lobule bilaterally. Results point to two distinct binding mechanisms: one for integration and the other for separation of discourse entities.

A23 INDIVIDUAL DIFFERENCES IN VERBAL WORKING MEMORY DETERMINE N400 AND P600 EFFECTS TO SEMANTIC ANOMALIES

Albert Kim[1], Leif Oines[1]; [1]University of Colorado at Boulder

ERP studies of language comprehension find that sentence-embedded semantic anomalies enhance the N400 component, while syntactic anomalies elicit a P600 effect. While this dissociation is robust across numerous studies, there are notable and sometimes systematic exceptions to this pattern. Among the complexities in the functional antecedents of N400 and P600 during sentence processing are reports that subject samples can be divided into subgroups eliciting N400 or P600 effects (Nakano, Saron & Swaab, 2010; Bornkessel, Fiebach & Friederici, 2004). We recorded ERPs to "semantic attraction" anomalies (Kim & Osterhout 2005) which pit syntactic against semantic cues, while measuring multiple cognitive abilities in a large sample (N=60) of participants, including verbal working memory, spatial working memory, and language experience, with multiple measures of each construct. Regression analyses examined which construct best accounted for individual differences in brain responses. As verbal WM increased, participants showed larger P600 and smaller N400 effects semantic anomalies. Only verbal WM predicted N400 or P600 effects magnitude, suggesting that the individual differences are specific to verbal WM. We suggest that N400 and P600 reflect a tradeoff between 1) attempts to semantically integrate a syntactically licensed but implausible interpretation, reflected in N400 or 2) attempts to restructure the sentence, reflected in P600, and that the latter response requires processing resources that are more available in high-capacity individuals than low-capacity individuals. Thus, verbal working memory plays a critical role in the language processing system's management of linguistic information and is at the heart of sometimes-qualitative inter-individual differences in language processing.

A24 REFERENTIAL PROCESSING PLACES HIGH DEMANDS ON HIPPOCAMPAL DECLARATIVE MEMORY

Melissa Duff[1], Jake Kurczek; [1]University of Iowa

Establishing and maintaining reference is a central component of language processing, as much of what we talk about involves referring to entities. Referential processing requires maintaining a representation of the unfolding discourse history and potential referents, and integration of information about referential form with rich representations of referential context. Much of this work has focused on working memory or executive control processes, functions putatively associated with prefrontal cortex mechanisms. We propose that the rapid relational binding and representational flexibility of the hippocampal declarative memory system affords the informational binding and integration necessary for referential processing. We tested this proposal by examining the spoken narratives of six (1 female) individuals with bilateral hippocampal damage and severe declarative memory impairment (HC) and 12 healthy comparison participants (CP). Participants described events (real and imagined) in response to neutral cue words (e.g., snow). Narratives were coded for frequency of pronouns and anaphoric nouns (e.g., The boy and man are having lunch and the child respects the adult), the completeness of each referent (e.g., complete = referent is easily located in preceding text; incomplete = referent was not in the discourse, not evident from the context; or multiple referents could be identified), and the overall coherence of the discourse. In comparison to CPs, the narratives of HCs contained fewer pronouns and anaphoric nouns, their referents were coded as incomplete more often, and their

samples were judged to be less coherent. These findings suggest that referential processing places high demands on the hippocampal declarative memory system.

A25 TWO ROUTES TO SILENT MEANING DISTINGUISHED IN THE BRAIN

E. Matthew Husband[1], Fernanda Ferreira[1]; [1]University of South Carolina

Research on the online composition of sentence meanings has started to investigate the neural regions that process silent meanings. Sentences like "The reporter (1) began/ (2) needed the article" both assert an implicit activity ("writing"). While these assertions appear to be similar, different computations are thought to derive them: (1) requires semantic enrichment, (2) requires syntactic enrichment (Pylkkänen 2008). These computational differences may recruit different brain regions as semantic processing is thought to recruit left inferior frontal gyrus (LIFG) and left angular gyrus (LAG) while syntactic processing is thought to recruit LIFG and left anterior temporal cortex (LATC) (Lau et-al. 2008). We report results from an event-related fMRI study contrasting sentences requiring semantic or syntactic enrichment with unenriched control sentences (also included: implausible sentences). Thirteen adults read 336 sentences (84/condition) using word-by-word rapid serial visual presentation in four 8min 37sec blocks. Acceptability was judged after each sentence. fMRI data were acquired with echo planar imaging on a Siemens 3T scanner (8 channel head coil, 36 slices, 35msec TE, 2130msec TR, 90° flip angle, 208mm FOV, 64×64 matrix). fMRI preprocessing/ analyses were conducted in FSL. Semantic enrichment (vs. control) sentences elicited increased activity in LIFG (but not LAG). Syntactic enrichment (vs. control) sentences elicited increased activity in LIFG, LATC, and the anterior cingulate cortex (ACC). These results suggest that different neural circuits process computationally different silent meanings. While semantic and syntactic enrichment both recruit LIFG, syntactic enrichment further recruits LATC, supporting syntactic computation, and ACC, which may aid in detection of syntactic requirements.

A26 WHEN HAVING MORE TIME DOESN'T HELP: PREDICTIONS ARE NECESSARY FOR "SMART" N400S

Wing Yee Chow[1], Colin Phillips[1], Suiping Wang[2]; [1]University of Maryland College Park, [2]South China Normal University

Previous reports of the N400's insensitivity to thematic role-reversals (e.g., The thief arrested the cop…) have been interpreted as a "temporary semantic illusion" (Kim & Osterhout, 2005; Kolk et al., 2003; Kuperberg, 2007). An alternative possibility is that role-reversals consistently fail to elicit N400 effects because the processor cannot generate compositionally well-informed predictions quickly enough. When the critical word is slightly delayed, the N400 becomes sensitive to role reversals ("Smart" N400s; Chow et al., 2012). The present study examined whether the N400's re-emerged sensitivity is entirely attributable to additional processing time. Using the subject-object-verb BA-construction in Mandarin Chinese, we manipulated the predictability of the target verb in canonical sentences (cloze probability; High: .41-.97; Low: .03-.21) and examined the effects of role-reversals. In Experiment 1 (n=23) the verb immediately followed its arguments (Short Distance:[yesterday afternoon]-cop-BA-thief-arrest). Even when the verb was highly predictable given its arguments, the N400 remained blind to role-reversals, though a P600 effect was observed consistently . In Experiment 2 (n=22) a temporal phrase was placed between the verb and its arguments, thereby increasing the time between them from 600ms to 1800ms (Long Distance: cop-BA-thief-[yesterday afternoon]-arrest). Role-reversals again elicited a significant P600 effect, but a significant N400 effect was observed only when the verb was highly predictable in the canonical condition. The delay was insufficient to elicit an N400 in the lower cloze conditions, despite the implausibility of the role-reversed sentences. Taken together, these results show that predictions are needed to elicit an N400 effect; mere implausibility is insufficient.

Gesture, Prosody, Social and Emotional Processes

A27 INTEGRATING PITCH ACCENT AND BEAT GESTURE DURING SPEECH COMPREHENSION

Lin Wang[1], Mingyuan Chu[2]; [1]Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, [2]Max Planck Institute for Psycholinguistics

Pitch accent and beat gesture highlight relevant information by means of acoustic and visual prominence, respectively. They often co-occur in speech production, with the stressed syllable of the pitch accented words in speech aligning with the most prominent part of the gesture. Here, we used Event-related Potentials to examine how pitch accent and beat gesture interact during speech comprehension. Twenty four Dutch speakers listened to sentences while they watched video clips. The critical words in the spoken sentences were realized with or without pitch accent. Meanwhile, the critical words were accompanied by a beat gesture, or a non-beat-like hand movement, or no hand movement. We found that words with pitch accent elicited smaller N400s than those without pitch accent. In addition, relative to the no hand movement condition, both kinds of hand movements elicited smaller N400s. The reduced N400s elicited by pitch accent and hand movements might indicate facilitated semantic processing as a result of additional amount of attention allocated to the critical words. Interestingly, the words in the beat gesture condition elicited smaller N400s than those in the non-beat-like hand movement condition over right posterior electrodes, suggesting the privileged role of beat gesture in drawing attention during speech comprehension. Importantly, no interaction was observed between pitch accent and beat gesture, indicating that they independently affect the semantic processing by triggering the attention system separately.

A28 THE EFFECTS OF SOCIAL HIERARCHIES ON NEURAL MECHANISMS OF REPETITION SUPPRESSION

Alba Ayneto[1], Hernando Santamaria[1], Núria Sebastián-Gallés[1]; [1]Universitat Pompeu Fabra

In our daily life we are constantly receiving information from people around us. This information can come from our boss, also our neighbours or other people. Some of them can be from different social status compared to us. But, do we process the information according to social status? Deaner et al (2005) showed the existence of preferential attention capture by high rank individuals in monkeys. Zink et al (2008) showed that viewing a superior individual differentially engaged perceptual-attention, saliency and cognitive systems in humans. However, how the social status of a speaker influences basic mechanisms of linguistic processing remains unknown. We designed an Event Related Potential study where we analyzed how the repetition suppression effect in the N400 can be modulated by the hierarchical status of a speaker. We tested 16 female University Students (mean age= 23,6 , std= 2,7). First, we established a hierarchical context through a video game and then we presented a string of auditory Spanish words, with a CVCV structure. Different tokens of the same words were consecutively repeated four times (filler words up to three times). Stimuli could be uttered by a high-rank or a low-rank speaker (as determined in the video game). We observed differences in the suppression of the N400 response as a function of the speaker rank, being stronger for the superior one. This result suggests that the social status of the speaker affects basic mechanisms involved in lexical processing.

A29 "YOU SAY SO, WHO KNOWS IF IT IS TRUE" EFFECTS OF SPEAKER'S SOCIAL HIERARCHY ON THE SENTENCE COMPREHENSION

Hernando Santamaría García[1], Alba Ayneto[1], Nuria Sebastian[1]; [1]Brain and Cognition Center Pompeu Fabra University Barcelona Spain

Recent studies have shown the relevance of establishing comparisons with other members of the social hierarchy to modulate different aspects of cognition (Smith et al., 2008; Zink et al., 2008). The influence of social hierarchy in sentence comprehension is scarce. Studies in sociolinguistics have indicated that the perceived social hierarchy is important in making judgments about others and it can be a determinant factor of trust (Lount et al., 2012). In the present study, we analyzed sentence comprehension within a hierarchical social context. We presented sentences with different levels of plausibility uttered by speakers with different hierarchical status (as previously established through a hierarchical video game) and measured the modulations of the N400 component. We tested 40 participants (mean age =23 years; 20 males). Participants heard three subsets of sentences with different plausibility value, depending on the last word (high, intermediate and low plausibility). Sentences could be spoken by a superior or by an inferior status player. When listening to the superior player, the modulation of the N400 component followed the expected pattern (inverse relationship between amplitudes and sentence plausibility). However, when participants heard the Inferior speaker the amplitude of the N400 in highly plausible sentences matched that of intermediate plausibility (increased). This result indicated that participants' did not trust low rank speakers, even when the sentence was highly plausible. Our results expose the influences of social hierarchy in the sentence comprehension processing and their impact on the confidence in speaker.

A30 EYE'M TALKING TO YOU: SPEAKERS' GAZE DIRECTION MODULATES THE INTEGRATION OF SPEECH AND ICONIC GESTURES IN THE RIGHT MTG

Idil Kokal[1], Judith Holler[2], Asli Ozyurek[3], Spencer Kelly[4], Ivan Toni[1], Peter Hagoort[1]; [1]Donders Institute for Brain, Cognition and Behaviour, Centre for Cognitive Neuroimaging, Radboud University Nijmegen, Nijmegen, the Netherlands, [2]MPI Nijmegen, [3]Radboud University Nijmegen, [4]Colgate University USA

Recipients integrate information from speech and co-speech gestures, a function known to rely on the middle temporal gyrus as well as left inferior frontal gyrus (e.g., Willems et al., 2009). However, it is currently unknown how this integration process is influenced by the presence of other important social cues, such as eye gaze direction, which is linked to the perception of communicative intent (Senju & Johnson, 2009). This is a first investigation of how eye gaze may modulate recipients' neural processing of speech-gesture utterances. Participants were scanned (fMRI) while taking part in triadic communication involving two recipients (themselves and a fictitious other) and a speaker. The speaker uttered sentences containing manner unspecific verbs (e.g.,'she trained the horse'). Half of the sentences were accompanied by complementary iconic gestures specifying the manner of action (e.g., a whipping gesture). With each sentence, the speaker alternated her gaze direction, thus creating two recipient roles: addressed (direct gaze) vs. unaddressed (averted gaze) recipient. The comprehension of sentences accompanied by complementary iconic gestures ("speech&gesture") recruited middle occipital, middle temporal, and inferior frontal gyri, bilaterally. The right calcarine sulcus was involved in processing direct compared to averted gaze. Most importantly, processing speech&gesture utterances while being addressed (direct gaze) lead to additional activity in the right MTG, as compared to the other elements of the interaction between gaze (directed, averted) and communicative modality (speech-only, speech&gesture). Marking communicative intent with gaze direction modulates the integration of speech and gestures through computations implemented in the right MTG.

A31 NEGATIVE "GOSSIP" STIMULI MODULATE LEFT-LATERALIZED P1 COMPONENT WHILE VIEWING NEUTRAL FACES.

Ethan Weed[1], Micah Allen[1], Daniel Gramm[1]; [1]Aarhus University

Language allows us to operate more efficiently in the world. By hearing about others' experiences, we are able to orient toward things that could be beneficial to us, and avoid hazards. This sharing of experiences is particularly prominent in the social realm. Using a binocular rivalry paradigm, Anderson et al. (2011) showed that short "gossip" phrases modulated the length of time faces remained perceptually dominant. However, binocular rivalry is measured by self-report. We used EEG to investigate the timing of gossip's early effect on face perception. Gossip stimuli were those used by Anderson et al. (2011), translated to Danish. Neutral faces were taken from the PUT database (Kasiński et al., 2008). Participants (n=30) viewed each face together with the gossip stimuli a total of six times. Following this encoding period, 32 channels of EEG were recorded while participants viewed the faces mixed with unfamiliar faces, and performed a distracter task. A post-test checked participants' memory of the individual faces. We hypothesized that negative gossip would modulate the face-sensitive N170 component at electrodes P7 and P8. No differences were observed in the N170, and no memory effect was found. However, a secondary analysis showed that an even earlier left-lateralized component, the P1, was modulated by negative gossip stimuli. Supporting the results of Anderson et al. (2011), we found that linguistic information modulates early processing of faces. Although the N170 appears impervious to the influence of gossip, an effect of negative social information was measured at 100 ms. after stimulus onset.

A32 INDIVIDUAL DIFFERENCES IN FRONTAL AND TEMPORAL CONTRIBUTIONS PREDICT CHILDREN'S COMPREHENSION OF ICONIC CO-SPEECH GESTURE

Anna E. Holt[1], Anjali R. Beharelle[2,3], Susan Goldin-Meadow[4], Steven L. Small[1,4]; [1]University of California Irvine, [2]Rotman Research Institute, Baycrest Centre, Toronto, [3]University of Toronto, [4]The University of Chicago

Using a combination of Partial Least Squares regression (PLS) and additional regions of interest (ROI) analyses, we identified neural activity associated with integrating co-speech gesture in 24 typically developing children. Our stimuli consisted of ambiguous and unambiguous stories. Stories were made unambiguous using words (e.g., "parrot" vs. "pet") or iconic gestures (e.g., wings flapping). Children showed greater activity in the left anterior superior temporal gyrus (aSTG) and the left superior temporal sulcus (STS) (both anterior and posterior) when gesture disambiguated a story (i.e. co-occurred with "pet.") than when gesture was redundant (i.e., co-occurred with "parrot"). We found greater activity in intrapartietal sulcus (IP), left ventral precentral gyrus and left supramarginal gyrus (SMG) when gesture was redundant. Activity in pSTS, pMTG and aSTG correlated with post hoc story comprehension. Only children who correctly used gesture to disambiguate story information showed increased frontal activation, in the pars triangularis (IFGTr) of the inferior frontal gyrus. Unlike adults, this activity was right lateralized. Right IFGTr has been previously shown to be active in children when the semantic content of a gesture is unrelated to concurrent spoken language (Dick et. al, 2009). Our results suggest that individual differences in IFG maturation and recruitment may predict developmental differences when there is a high demand for semantic integration.

Language Development, Plasticity, Multilingualism

A33 EARLY MATERNAL USE OF DECONTEXTUALIZED LANGUAGE PREDICTS INDIVIDUAL DIFFERENCES IN CHILDREN'S WHITE MATTER AT AGE 7-9

Anna E. Holt[1], Jeffrey D. Riley[1], Özlem E. Demir[2], Susan Goldin-Meadow[2], Steven L. Small[1,2]; [1]University of California, Irvine, [2]University of Chicago

Experience plays an important role in the neurobiology of language. Maternal language input predicts children's early growth of vocabulary and grammar and later development of literacy and complex syntax. Individual differences in children's language skills are reflected in differences in white matter connectivity in left temporo-parietal regions by at least age 8-9 years (Beaulieu et al 2005). Our research addressed whether, and how, differences in the early language environment of typically developing children predict later white matter differences. We used diffusion tensor imaging to study a demographically balanced cohort of 19 children (aged 7-9). We used Tract-Based Spatial Statistics (TBSS) from the Oxford FMRIB package to identify regions where differences in fractional anisotropy (FA) were significantly associated with maternal input. In particular, controlling for IQ and SES, we investigated the relationship between children's white matter structure at age 7-9 and measures of early maternal use of decontextualized language (i.e., not from the contemporaneous space and/or time). This was coded from free play sessions when the children were aged 14 months and was mostly comprised of references to actions or people not present in the mother/child interaction. Mothers' use of abstracted language predicted FA values in regions associated with the posterior limbs of the internal capsules (IC), the superior longitudinal fasciculus (SLF), and the left inferior fronto-occiptal fasiculus (IFOF). FA increases in the IC, the SLF and IFOF have been previously associated with better literacy (Doughtery et. al, 2007) and language outcomes (Ben-Schachar et. al, 2007).

A34 FUNCTIONAL REORGANISATION IN THE DYSLEXIC BRAIN AFTER DEFICIT-SPECIFIC TRAINING IN COGNITIVE SUBTYPES OF DYSLEXIA

Stefan Heim[1,2,3], Muna van Ermingen-Marbach[1], Moti Brinkhaus[3], Julia Reimers[3], Julia Pape-Neumann[3], Marion Grande[3]; [1]Section Structural-functional Brain Mapping, Department of Psychiatry, Psychotherapy and Psychosomatics, Medical School, RWTH Aachen University, [2]Institute for Neuroscience and Medicine (INM-1), Research Centre Jülich, [3]Section Clinical and Cognitive Neurosciences, Department of Neurology, Medical School, RWTH Aachen University

Cognitive subtypes of dyslexia with phonological vs. visuo-attentional processing difficulties have recently been identified and linked to differential involvement of left and right frontal brain areas. Here, we investigated how 4-week dyslexia trainings focussing on phonology, attention, or reading differentially induce neurofunctional changes in phonological and visuo-attentional dyslexia subtypes in the Posner paradigm and phonological awareness. Overall, and in line with the literature, there was activation increase in left area 44 for both tasks. This effect was mainly observed in the attention and reading training, not phonology. Moreover, right area 45 showed increased activation for the reading training. Together, these findings suggest that differential dyslexia trainings recruit brain areas contralaterally to those normally involved in attention shifting (usually right) and reading-based phonology (usually left). Moreover, the differential pattern may explain why previous dyslexia training studies only found heterogeneous brain activation changes due to different cognitive subtypes of dyslexia.

A35 THE ROLE OF MEDIAL-FRONTAL CORTEX IN LANGUAGE ACQUISITION

Olave Krigolson[1], Cameron Hassall[1], Paul Gosset[2], Todd Handy[2]; [1]Department of Psychology and Neuroscience, Dalhousie University, [2]Department of Psychology, University of British Columbia

Recent experimental evidence suggests that a reinforcement learning system within medial-frontal cortex plays a key role in several different types of learning. For instance, recent studies have demonstrated that the medial-frontal system plays a role in the development of perceptual expertise (Krigolson, Pierce, Tanaka, & Holroyd, 2009) and in the acquisition of motor skill (Krigolson & Holroyd, 2007). In the present study, we sought to assess whether or not the medial-frontal reinforcement learning system plays a role in language acquisition. The feedback error-related negativity (fERN) is a component of the event-related brain potential (ERP) thought to reflect the evaluation of performance feedback by the medial-frontal system. To examine the role of medial-frontal cortex in language acquisition, we recorded ERP data while participants learned symbol-word pairings for a novel language via a trial and error shaping process. Further, to assess semantic processing participants viewed short "sentences" in which some of the learned symbols reflected a semantic mismatch. Behaviorally, participants demonstrated learning in terms of improvements in response accuracy and the number of symbols known. Analysis of feedback-averaged waveforms showed differences between correct and error trials consistent with previous accounts of the fERN. Interestingly, analysis of the stimulus averaged waveforms revealed activations over left temporal regions of cortex that increased with learning. Finally, semantic inaccuracies in viewed sentences evoked a N400, an ERP component typically associated with the evaluation of semantic mismatch. In sum, our results suggest that the medial-frontal reinforcement learning system plays a key role in language acquisition.

A36 GRAY MATTER DENSITY DIFFERENCES IN THE LEFT PUTAMEN CORRELATE WITH AGE OF SECOND LANGUAGE ACQUISITION: A VOXEL-BASED MORPHOMETRY STUDY

Denise Klein[1,2], Jonathan Berken[1,2], Jen-Kai Chen[1], Vincent L. Gracco[2], Shari Baum[2], Kelvin Mok[1]; [1]Cognitive Neuroscience Unit, Montréal Neurological Institute, McGill University, [2]Centre for Research on Brain, Language, and Music, McGill University

Speech motor control is essential for bilinguals to articulate in their two languages. While previous literature has implicated the left basal ganglia as an important region for speech initiation and pronunciation, no structural brain studies to date have focused on the role of this area in bilinguals. Here, we apply voxel-based morphometry, an in vivo anatomical magnetic resonance approach, to evaluate brain structure in right-handed simultaneous and sequential bilinguals matched for age, intelligence, and proficiency in their two languages. We show, using both group contrast and regression analyses, a negative correlation between gray matter density of the left putamen and age of acquisition. That is, the earlier the acquisition of the second language, the greater the gray matter density in this region. These findings suggest an effect of early second language learning on the structural plasticity of the human brain and underscore the importance of the left putamen in bilingual speech production.

A37 MOTOR ACTIVITY IN THE HUMAN BRAIN WHILE READING ACTION LANGUAGE. EEG DESYNCHRONIZATION IN THE μ RHYTHMS

Ivan Moreno[1], Manuel de Vega[1], Inmaculada León[1]; [1]La Laguna University, Tenerife, Spain

Mu (μ) rhythms are EEG oscillations between 8-13 Hz distinguished from alpha by having more anterior distribution and being desynchronized when participants perform a manual action, when they observe another's manual action or even when they imagined manual actions. This has led researchers to consider that mu rhythms are electrophysiological markers of the motor neuron activity in humans. Our direct goal was to test whether mu desynchronization is restricted to the comprehension of action language or whether it is a general phenomenon associated with language processing. For this, we analyzed the time-frequency modulation of mu rhythms while

participants read action language ("You will cut the strawberry cake") or abstract language ("You will admire risk sport"). The processing of action language was found accompanied by activation of motor-related brain areas, as reflected by desynchronization in the mu frequency band which was localized in motor (central electrodes) and premotor (fronto central electrodes) brain areas. Also, the onset of the motor effects was not found around the action verb. For the abstract language mu desynchronization was not found. The present study suggests two main conclusions: the understanding action language activates motor networks in the human brain and the motor activation in the action language processing reflects lexical-semantic integration. The result of this study language is compatible with the embodiment approach to linguistic meaning.

A38 EXPLORING FIGURATIVE LANGUAGE PROCESSING IN MANDARIN-ENGLISH BILINGUALS: AN FMRI STUDY

Yu-Chen Chang[1], Fan-pei Yang[1]; [1]National Tsing Hua University

The present study investigated the neural network of similes, anomalous and literal language processing in Mandarin- English bilinguals during interpretation of English comparison statements. We characterized the neural networks involved for processing English similes. We also compared the neural activations of similies with those of anomalous and literal sentences to see whether processing of anomaly and literal sentences involves different networks. Three healthy bilingual speakers aged between 20 to 22 (2 females, 1 male) participated in the fMRI experiment. Images were acquired on a 3 T MR scanner (Brucker, Germany). Stimuli consisted of 200 short English sentences created for three conditions: literal sentences (e.g., he is a donor), anomalous sentences (e.g., a school is a sandwich), and similes (e.g., jealousy is like acid). Our imaging results revealed that, in the simile>literal condition, significantly higher activations were evoked in the left medal frontal gyrus, middle occipital gyrus, and supplementary motor area. In the anomalous>literal condition, significantly higher activations in the bilateral superior frontal gyrus, middle occipital gyrus, parahippocampal gyrus were observed. Thus, the neural basis underlying processing of similes is different from neural mechanisms employed in understanding the literal and anomalous sentences. Also, anomalous sentences invoked bilateral activations in both hemispheres, suggesting more cognitive efforts are required to analyze grammatically correct but semantically anomalous linguistic stimuli. Above findings suggest that processing of anomaly, similes, and literal sentences demand different loads of cognitive resources and may involve different networks during sentence comprehension in bilingual brains.

A39 PUTTING THE CRITICAL PERIOD HYPOTHESIS TO THE TEST: A NEW PARADIGM ALLOWS A CRITICAL VIEW ON THE ELAN IN L1 AND L2 SPEAKERS

Stefanie Nickels[1], Karsten Steinhauer[1]; [1]McGill University

Much debate surrounds the temporal dynamics of second language processing. One prominent neurocognitive sentence processing model has been used to account for differences between first (L1) and second language (L2) processing (Friederici, 2002). The model assumes serial stages of (1) phrase structure (PS) construction using word category information, (2) semantic analysis and (3) overall integration, with violations at each stage resulting in an ELAN, an N400 and a P600 respectively. Reports for ELANs in L2 speakers are contradictory; some studies find no ELAN (Hahne, 2001) while others do even in subjects that do not know the target language (Mueller, 2005). Additionally, the validity of the ELAN as a marker of PS violations has recently been challenged by Steinhauer and Drury (2011) who argue that context-related factors and not a PS violation itself trigger the component. In this study we employ a novel paradigm that can disentangle context and PS violation effects and thus reveal unconfounded differences between L1 and high-proficient late L2 speakers. Preliminary results show that context is indeed mostly responsible for eliciting an ELAN. After eliminating those effects, we find an N400 which precedes a sustained frontal negativity and a P600. Whereas there seems to be a small reduction in the frontal negativity in the L2 group, N400 and P600 do not differ. The N400 being the first elicited component provides evidence against the proposed serial nature of the model. Furthermore, the striking similarity between both groups supports proficiency- and not critical period-related approaches to L2 acquisition.

A40 BRAIN RESPONSES TO MORPHOSYNTAX AT EARLY STAGES OF SECOND LANGUAGE DEVELOPMENT

Robert Fiorentino[1], Alison Gabriele[1], Jose Aleman Banon[1], Kristi Bond[1,2], Maria Martinez-Garcia[1]; [1]University of Kansas, [2]Harding University

The present study examines the role of the native language in the processing of gender and number agreement in English-speaking learners of Spanish, tracking development at three points during their first year of university Spanish classes. Learners were tested after two months (Session 1), six months (Session 2), and eight months (Session 3) of exposure. The experiment targeted three types of agreement: number agreement on verbs, which is similar in Spanish and English; number agreement on adjectives, a context in which agreement is not realized in English, and gender agreement on adjectives, which is unique to Spanish. Results for the Spanish native controls (n=12) revealed reliable P600s for all conditions. For the learners (n=15), no reliable effects emerged in Session 1 or Session 3, but in Session 2, violations of subject-verb agreement elicited a significant P600. To further explore responses to subject-verb agreement violations at an

individual level, we examined the correlation between N400 effect size and P600 effect size for each learner (see McLaughlin et al., 2010). Correlations within each session illustrate a transition from N400 to P600 responses; N400 and P600 effect sizes correlate positively in Session 1(r=.810, p<0.001), Session 2 (r=.699, p<.005), and Session 3 (r=.682, p<.005) showing that as the N400 effect size becomes less negative, the P600 effect size likewise becomes more positive. The ERP data will also be discussed with respect to a range of verbal and nonverbal cognitive measures, which we have obtained for each learner.

Language Disorders

A41 STRUCTURAL NEURAL BASES OF PERFORMANCE IN CHRONIC STROKE APHASIA AS REVEALED BY PRINCIPAL COMPONENTS ANALYSIS AND VOXEL-BASED CORRELATIONS

Rebecca A Butler[1], Matthew A Lambon Ralph[1], Geoffrey J M Parker[2], Anna M Woollams[1]; [1]Neuroscience and Research Unit, University of Manchester, UK, [2]Biomedical Imaging Institute, University of Manchester, UK

Stroke aphasia is a multidimensional disorder in which different aspects of language performance can be relatively impaired or intact to differing degrees. For example, semantic and phonological processing ability have been shown to affect performance of participants with aphasia on language assessments and to influence response to therapeutic interventions. We present a novel approach to teasing apart different aspects of aphasic performance and locating their neural bases. We used principal components analysis (PCA) to extract core factors underlying performance on a battery of language tests in a group of 27 participants with chronic stroke aphasia (Figure 1a: Lesion Overlap Map). The rotated PCA revealed that three factors contributed to participants' performance, their abilities on 'phonology', 'semantics', and 'cognition'. When participants' scores on these three orthogonal factors were entered simultaneously into a voxel-based correlational analysis with their lesion data, 'phonology' related to temporo-parietal regions including superior temporal gyrus, middle temporal gyrus, supramarginal gyrus, angular gyrus, and pars opercularis in the inferior frontal lobe (Figure 1b). 'Semantics' related to the left superior and middle temporal gyri and underlying white matter, the temporal pole, middle frontal gyrus (MFG), pars orbitalis, and inferior anterior white matter corresponding to the location of the extreme capsule fibre system. General 'cognition' correlated with integrity of frontal regions including MFG and inferior frontal white matter. These results are consistent with those obtained using other methodologies such as functional neuroimaging. We suggest that continuous orthogonal PCA-extracted scores could be used to better understand brain-behaviour relationships in other cognitive disorders.

A42 DISRUPTED WHITE MATTER CONNECTIVITY IN LANGUAGE AND MOTOR TRACTS IN DEVELOPMENTAL STUTTERING

Emily Connally[1], David Ward[2], Peter Howell[3], Kate Watkins[1]; [1]University of Oxford, [2]University of Reading, [3]University College London

People who stutter (PWS) show both structural and functional abnormalities of brain areas involved in speech and motor control. Here, we explored white matter integrity using diffusion-tensor imaging in 29 PWS (aged 14 - 42) and 37 controls (CON, aged 14 - 45). We restricted our initial analysis to the largest subsample of this group, namely the right-handed males. Tract-based spatial statistics revealed reduced fractional anisotropy (FA) in PWS relative to CON (p<.005, uncorrected) in white matter underlying several cortical language areas in the left hemisphere including the ventral premotor area previously reported and primary motor cortex bilaterally. Probabilistic tractography of the arcuate fasciculus and cortico-spinal tracts did not reveal any group differences in measures of tract volume and mean FA. Slice-by-slice comparisons for the arcuate fasciculus revealed reduced FA in PWS in portions of the tract underlying the parietal and central operculum on the left and at the level of the supramarginal gyrus on the right. In the cortico-spinal tract, PWS had increased FA on the right at the level of the posterior limb of the internal capsule. Measures of white matter integrity obtained in left-handed male and female PWS fell within the range of values of the right-handed male group of PWS. Our analysis of a large homogeneous sample of PWS reveals patterns of white matter disruption in motor and language tracts similar to those seen previously. These results are consistent, therefore, with notions of a white-matter "disconnection" between motor and auditory cortex as a correlate of stuttering.

A43 THE EFFECT OF A MUTATION IN FOXP2 ON MOTOR AND SPEECH AND LANGUAGE TRACTS IN THE HUMAN BRAIN

Kate Watkins[1], Faraneh Vargha-Khadem[2]; [1]University of Oxford, [2]University College London

The mutation in the FOXP2 gene carried by members of the KE family results in a behavioural phenotype of verbal and orofacial dyspraxia that manifests as impaired speech production. Affected members have abnormal structure and function of the striatum and cortical areas involved in oromotor control and speech and language. Here, we examined white matter fibre tracts using diffusion tensor images (60 directions) obtained in 6 affected family members and 5 controls. Tract-Based Spatial Statistics revealed reduced fractional anisotropy (FA) in bilaterally symmetrical portions of tracts underlying superior temporal cortex, face motor cortex, and ventral premotor cortex (p<0.05, uncorrected). To evaluate this further, we used probabilistic tractography to track the arcuate fasciculus and cortico- spinal tracts. FA was significantly reduced in the left arcuate fasciculus in affected members, who also did not show the leftwards asymmetry of this

tract that we observed in controls. The volume of the arcuate fasciulus was significantly reduced on the right but not the left in affected members. There were no group differences in FA or volume of the cortico-spinal tracts. The arcuate fasciculus links posterior temporal and inferior frontal language areas in the left hemisphere and is thought to support auditory-motor interactions necessary for fluent speech production. A disruption to the integrity of this tract, revealed by this preliminary analysis, is consistent, therefore, with the phenotype of verbal and orofacial dyspraxia in the affected KE family members.

A44 WHITE MATTER DIFFERENCES IN DORSAL AND VENTRAL LANGUAGE PATHWAYS OF ADULTS WHO STUTTER

Michal Ben-Shachar[1], Vered Kronfeld-Duenias[1], Ruth Ezrati[2], Ofer Amir[2]; [1]Bar-Ilan University, [2]Tel-Aviv University

Stuttering is a common developmental disorder affecting individuals' ability to express themselves in speech fluently. People who stutter (PWS) vary in their symptoms, exhibiting a range of sensory, linguistic and motor deficits. Recent imaging studies report several foci of white matter differences between groups of PWS and controls. It is still unknown which pathways underlie these white matter differences, and which cognitive functions are served by these pathways. The current study approaches these questions by isolating dorsal and ventral language tracts in individual participants, comparing their quantitative properties, and relating these properties to cognitive measures. We collected diffusion MRI data and cognitive measures in 13 adult PWS and 11 age-matched controls. In each participant, we used fiber tracking to define two dorsal and two ventral pathways in each hemisphere: anterior and long superior longitudinal fasciculus (SLF), uncinate and inferior fronto-occipital fasciculus. We compared pathway properties (volume and fractional anisotropy (FA) along the tract) between PWS and controls, and correlated these properties with cognitive measurements. Dorsally, we found that PWS show reduced volume of the left long-SLF, and reduced FA in the right long-SLF. Ventrally, we found increased FA in PWS in a segment of the left uncinate. Further, FA in that segment correlated with individual's written phonemic fluency scores. We conclude that stuttering is a heterogeneous deficit at both the behavioral and brain level. It is therefore important to go beyond voxel-based group comparisons, towards individualized definition of pathways, and assessment of the relation between pathway properties and cognitive measures.

A45 ACUTE APHASIA SYNDROMES IN THE CONTEXT OF THE DUAL PATHWAY MODEL

Dorothee Kuemmerer[1], Tobias Bormann[1], Volkmar Glauche[1], Irina Mader[2], Michel Rijntjes[1], Dorothee Saur[3], Bjoern Schelter[1], Cornelius Weiller[1]; [1]Neurology, Freiburg, Germany, [2]Neuroradiology, Freiburg, Germany, [3]Neurology, Leipzig, Germany

Recent neuroscience literature suggests that language is processed within a dual pathway network (Rauschecker and Tian 2000, Wise 2003, Hickok and Poeppel 2004, Saur et al 2008, Weiller et al 2011, Ueno et al. 2011) with a dorsal pathway subserving auditory-motor integration (Hickok and Poeppel, 2007; Rauschecker and Scott, 2009) and a ventral pathway extracting meaning from the acoustic-phonological input (Hickok and Poeppel, 2007; Scott et al., 2000). The aim of this study was to investigate the neuroanatomical basis of acute aphasia syndromes and symptoms in the context of this model in acute stroke patients (n=123), using the Aachen Aphasia Test as behavioural measure, structural imaging from high-resolution MRI as well as novel multinomial logistic regression for lesion-behaviour mapping. Lesions of global aphasics overlapped in the Insula, inferior frontal gyrus (IFG) and almost the complete left hemisphere. Lesions for Broca's aphasia were in the IFG, Insula and supramarginal gyrus (SMG); lesions for anomic aphasia were mainly in STG, SMG and Insula. Lesions for Wernicke's aphasia were in the superior temporal gyrus (STG), postcentral gyrus and Insula. With regard to symptoms, comprehension deficits and semantic paraphasia in Wernicke's aphasia were associated with the temporal lesion and affection of the ventral stream, while phonemic paraphasia were due to lesions of the dorsal stream. These results provide important insights in the lesion patterns of aphasia syndromes and aphasic symptoms in the context of the dual pathway model.

A46 MEASURING STRUCTURAL CONNECTIVITY TO PREDICT LANGUAGE IMPAIRMENT IN APHASIA

Jessica Richardson[1], Astrid Fridriksson[1], Della Franklin[1], Emily Graczyk[1], Julius Fridriksson[1]; [1]University of South Carolina, Columbia, SC

During the past few years much focus has been given to cortical connectivity in relation to language processing. We suggest that one of the most salient means to test the importance of structural connectivity in language is to examine the relationship between damage to specific white matter tracts and language impairment. Our study related structural integrity of dorsal and ventral speech streams to impairment-based measures of language processing in 35 patients with left hemisphere damage. Using DTI images from 17 normal subjects, we created dorsal and ventral streams by placing tractography seeds in left hemisphere anterior and posterior regions (BA 44/45 <> MTG/STG = dorsal stream; BA 44/45 <> BA 37 = ventral stream). To understand whether integrity of dorsal and ventral streams was related to aphasic language impairment, the

anatomical maps (dorsal and ventral streams) created in the tractography analysis were overlaid onto patients DTI images in native space and mean diffusivity (MD; measure of mean displacement of water molecules in a given voxel) values were recorded in each of the two streams. Overall, a stronger relationship was found between language impairment measures (Western Aphasia Battery; Kertesz, 1982) and MD in the dorsal stream. Importantly, the only measure that did not involve speech production (auditory comprehension) showed a robust association with not only the dorsal but also the ventral stream. Our data show that measures of speech production tend to load onto the dorsal stream whereas auditory comprehension is also reliant on the ventral stream.

A47 OVERCOMING NON-FLUENT APHASIA: DIFFERENTIAL CONTRIBUTION OF CORTEX AND CEREBELLUM *Olga Dragoy[1,2,3], Svetlana Malyutina[4], Maria Ivanova[1,3,5], Elena Kozintseva[3,5], Daniil Sevan[5], Svetlana Kuptsova[3,5], Aleksey Petrushevsky[5], Oksana Fedina[5], Evgeny Gutyrchik[6]; [1]Moscow Research Institute of Psychiatry, Russia, [2]National Research Center 'Kurchatov Institute', [3]National Research University Higher School of Economics, Russia, [4]University of South Carolina, USA, [5]Center for Speech Pathology and Neurorehabilitation, Russia, [6]Ludwig Maximilian University of Munich, Germany*

The key characteristics of non-fluent aphasia – effortful speech output and verb finding difficulties – are related to different underlying mechanisms: motor execution and lexical retrieval. This fMRI study was aimed at identifying normative brain activation related to verb production in 18 healthy Russian individuals and patterns of its reorganization in four patients with non-fluent aphasia due to different underlying deficits. Two patients' major problem was articulatory; the other two had a core linguistic impairment – agrammatism. An overt picture naming task was used in a block-design paradigm. For the experimental condition, participants were presented with drawings of actions and had to name an action with one verb. For the baseline condition, the task was to utter the pseudo-verb 'kávaet' in response to abstract pictures constructed by digital distortion of real drawings. Extra brain activation in the left ventral visual stream was found in all participants and reflects greater visual complexity of action pictures compared to the baseline. Also, in healthy participants, action naming elicited greater activation in the left BA 45, which supports its critical role in verb production. The additional activation found in patients was dependent on their neurolinguistic profiles. Patients with motor execution problems activated right cerebellum regions, while patients with agrammatism showed frontotemporal activation in both hemispheres. The results demonstrate neural mechanisms of overcoming non-fluency in two different underlying disorders: the right cerebellum is recruited to overcome motor execution problems; bilateral wide-spread cortical network is used when verb finding difficulties are dominant.

A48 IMPLICIT AND EXPLICIT LEARNING IN APHASIA *Julia Schuchard[1], Cynthia K. Thompson[1]; [1]Northwestern University*

Implicit learning is a process of acquiring knowledge that occurs without conscious awareness of learning, whereas explicit learning involves the use of overt strategies. To date, research related to implicit learning following stroke has been largely restricted to the motor domain and has rarely addressed implications for language. The present study investigated implicit and explicit learning of an auditory word sequence in 10 individuals with stroke-induced agrammatic aphasia and 18 healthy age-matched participants. The study used an adaptation of the Serial Reaction Time task, in which learning is indicated by a significant reaction time advantage for sequenced as compared to random trials. Each participant completed the task under implicit conditions (i.e., without conscious awareness of the presence of a sequence) and explicit conditions (i.e., with explicit knowledge of the sequence provided prior to beginning the task). Individuals with aphasia showed significant learning under implicit, but not explicit, conditions, whereas age-matched participants learned under both conditions. These results suggest significant implicit learning ability in individuals with agrammatic aphasia and have important implications for the role of procedural memory in aphasia. Furthermore, results of an auditory sentence span task indicated working memory deficits in individuals with agrammatic aphasia, which are discussed in relation to explicit and implicit learning processes.

A49 CONNECTED SPEECH PRODUCTION IN PRIMARY PROGRESSIVE APHASIAS *Sharon Ash[1], Emily Evans[1], Jessica O'Shea[1], John Powers[1], Ashley Boller[1], Lisa Burkholder[1], Emily Camp[1], Danielle Weinberg[1], Jenna Haley[1], Jessica Kitain[1], Corey McMillan[1], Murray Grossman[1]; [1]Perelman School of Medicine of the University of Pennsylvania*

Background: The core diagnostic features of non-fluent/agrammatic variant primary progressive aphasia (naPPA) are effortful, non-fluent speech and impaired production and comprehension of grammar. Patients with logopenic variant PPA (lvPPA) demonstrate impaired word retrieval and slowed speech, without conspicuous agrammatism. Patients with semantic variant PPA (svPPA) exhibit impaired semantics. We used a brief speech sample to identify qualitative and quantitative differences among the connected speech productions of these groups. Methods: We studied patients with naPPA (n=15), lvPPA (n=29), svPPA (n=16), behavioral-variant FTD (n=17), and healthy seniors (n=12). Up to 90 seconds of speech was recorded while subjects described the Cookie Theft scene. The recordings were transcribed and coded for fluency, grammar, and lexicon. Voxel-based morphometry (VBM) analysis of structural MRI images was available for a subset of PPA patients. Results: Patients with naPPA exhibited reduced speech rate, frequent speech-sound errors, and reduced grammatical complexity. lvPPA patients made few speech-sound errors but produced ungrammatical

and incomplete sentences, with impaired lexical access. svPPA patients were prominently impaired in lexical access. VBM analysis revealed a relation of slowed speech rate to left middle and inferior frontal regions and insula in naPPA and to left dorsolateral prefrontal cortex and posterior portions of middle and superior temporal gyri in lvPPA. Lexical impairments were related to temporal regions in svPPA. Conclusions: PPA patient groups differ qualitatively on measures of fluency, grammar, and lexical retrieval, which may help distinguish them. Their speech impairments are associated with atrophy in different portions of a left hemisphere language network.

Lexical Semantics

A50 WORD–PSEUDO-WORD CONFUSION IN NOISE REVEALS EARLY RECOGNITION BUT LATER DENIAL

Antje Strauss[1], Jonas Obleser[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

In everyday communication, listeners not only deal with noisy environments but also with ambiguous linguistic inputs. Here we asked how neural oscillatory processes reflect the cascade of perceptual and decision processes that make up word comprehension. In an electroencephalography study (EEG; N=20) and a lexical decision task, the ease of lexical access was parametrically varied: Stimuli were three-syllabic German nouns ("real" words); pseudo-words with an exchanged vowel in the second syllable ("ambiguous" pseudo-words); and syllable-scrambled ("opaque") pseudo-words. All stimuli were embedded in white noise at an individually determined signal-to-noise-ratio (based on 70% accuracy in vowel-in-noise discrimination). Participants detected well opaque pseudo-words (89% accuracy) but were significantly worse in evaluating ambiguous pseudo-words and real words (60% and 71% resp.). Nevertheless, the brain response differentiated these two perceptually close stimulus classes: First, real words were marked by an enhanced phase coherence in the alpha frequency range (500–570 ms), followed by ambiguous pseudo-words eliciting a more negative event-related potential (ERP) and enhanced alpha (8–12 Hz) power than real words. In contrast, when analysed by response ("word" vs. "not a word"), more negative ERPs, higher alpha power, and stronger alpha coherence for "not a word" responses were observed (all > 800 ms, i.e. after stimulus offset). To conclude, a left-lateralised alpha-frequency network is sensitive to uncertainties at the perception and at the decision level. The late, stimulus-independent effects highlight the interesting hypothesis that lexical decisions in speech are not entirely based on perceptual evidence but critically depend on internal brain state.

A51 MAPPING THE SIMILARITY SPACE OF MEANING IN SENSORIMOTOR CORTEX

Eiling Yee[1], Elizabeth Musz[2], Sharon L. Thompson-Schill[2]; [1]Basque Center on Cognition, Brain and Language, [2]University of Pennsylvania

How are the meanings of words referring to concrete objects represented across sensory and motor cortex? It is well-established that retrieving a feature of an object concept, such as its shape, activates a relevant sensorimotor region, such as occipitotemporal cortex. However, sensorimotor-based theories of meaning make a stronger prediction—namely that the similarity of the neural representations of two concepts in a given region should reflect their similarity on a specific dimension. We tested this prediction by measuring the magnitude of fMRI-adaptation (our index of neural similarity) to word pairs that varied according to their similarity on shape (e.g., "bagel" — "tire") and manipulation (e.g., "key" — "screwdriver"). We found that degree of shape similarity was positively correlated with the magnitude of fMRI-adaptation in a region involved in visual object recognition (left posterior fusiform gyrus), whereas degree of manipulation similarity was positively correlated with adaptation in two regions involved in planning and performing object-related actions (left inferior frontal gyrus and left precentral gyrus). That is, we identified two anatomically distinct neural similarity spaces that map onto conceptual similarity in different ways. Hence, conceptual "similarity" can vary depending upon the feature in question.

A52 LINKING LANGUAGE TO MOTOR STRUCTURES THROUGH WORDS: THE PRIVILEGED STATUS OF VERBAL STIMULI

Raphaël Fargier[1], Mathilde Ménoret[1], Anne Reboul[1], Yves Paulignan[1], Tatjana A. Nazir[1]; [1]L2C2 CNRS-Université Claude Bernard Lyon1, Lyon, France

Growing evidence suggest that the referential meaning of action words encompasses part of the motor program of actions they stand for. However, the role ascribed to modality-specific information in meaning representation differs across studies. We investigated through EEG the degree of similarity between neural dynamics of action observation, listening to common action words and processing novel words that have acquired an action or a visual content. Participants were requested to associate novel auditory stimuli with either the execution of bimanual hand movements or with visual images. In order to determine whether language provides a privileged substrate for word-referents relations, auditory stimuli to be learned consisted of pseudowords, reversed speech and nonverbal tones. All stimuli were presented in isolation before (Day1) and after (Day2) training. We found that (i) common action verbs (but not concrete nouns) induced a similar suppression of beta oscillations (18-25 Hz) than action observation. However, language-induced motor effects were restricted to only a subset of electrodes involved in action observation. (ii) Listening to

pseudowords that have acquired an action content was sufficient to induce nearly identical desynchronization of beta oscillations than common action verbs. Yet, no such effects were seen for reversed speech or tones. Our results suggest that motor activity observed during listening to action verbs or newly acquired action pseudowords might be confined to modality-specific convergence zones that bind information from language and motor structures. This specificity for verbal stimuli further indicates that these effects might build on prewired networks linking perisylvian and motor regions.

A53 WHEN THE SUN MEETS THE RAIN: NEURAL CORRELATES OF SEMANTIC PRIMING ARE INFLUENCED BY EMOTIONAL ASSOCIATIONS

Katharina Sass[1,2,4], Klaus Mathiak[1,2,4], Siegfried Gauggel[1], Tilo Kircher[3], Ute Habel[1,4]; [1]RWTH Aachen University, Germany, [2]Research Centre Jülich, Germany, [3]Philipps-University Marburg, Germany, [4]JARA - Translational Brain Medicine

During semantic processing, several important influences have been examined. However, there is growing evidence that the context plays an important role. The goal of the current study was to examine the impact of emotional valence on the neural correlates of semantic priming. Stimuli were presented (SOA = 200ms) while 16 subjects performed a lexical decision task during fMRI measurement. Six experimental conditions were compared: positive/negative/neutral related; positive/negative/neutral unrelated, nonword. The behavioral data revealed a priming effect for positive and neutral stimuli, the negative condition showed no effect. On neural level, emotional > neutral associations induced signal changes in left anterior medial/superior frontal gyri and the posterior cingulate. Interactions of different relations were located in left anterior part of medial frontal cortex and right hippocampus (positive > neutral and negative) and left posterior part of medial frontal cortex (negative > positive and neutral). The results showed that emotional valence regulates the effects of semantic processing. There might be a shared semantic network for positive and neutral stimuli, i.e., emotional and non-emotional aspects of semantic information can be processed in parallel. In contrast, negative emotions might induce compensatory mechanisms that inhibit the spread of activation between related concepts. The neural correlates highlighted a distributed neural network, primarily involving attention, memory and emotion related processing areas in medial fronto-parietal cortices. The differentiation between the anterior (positive) and posterior (negative) medial frontal cortex was linked to the type of affective manipulation with more cognitive demands being involved in the automatic processing of negative information.

A54 HOW DOES SOCIAL ABILITY AFFECT SEMANTIC PROCESSING IN YOUTHS WITH AUTISM?

Yu-Hsuan Sun[1], Susan Shur-Fen Gau[1,2], Tai-Li Chou[1]; [1]National Taiwan University, [2]National Taiwan University Hospital and College of Medicine

Both communication and social interaction deficits are core features of Autistic Spectrum Disorder (ASD). However, little is known about the involvement of social deficits on semantic processing. The goal of this study was to investigate the relationship between semantic processing and social interaction deficits in ASD by using functional magnetic resonance imaging (fMRI) to examine brain activation in youths with ASD who had different social abilities during semantic processing and to correlate the measures of social ability with brain activation. We assessed 32 youths with ASD (age range: 9-18) and 16 neurotypical controls. The ASD group was divided into the mild and severe groups according to their current scores of the reciprocal social interaction on the Autism Diagnostic Interview-Revised. The three groups were matched in age, gender, IQ, and handedness. Participants were asked to judge if two Chinese words were related in meaning, and the brain activations for semantically-related pairs between groups were compared. Additionally, the magnitudes of brain activations were correlated with the Social Responsiveness Scale (SRS) scores. Compared with controls, both ASD groups showed reduced activation in left anterior insula cortex (AIC) and left middle temporal gyrus (MTG), suggesting abnormality in processing the meaning and subjective feelings of words. The severe group showed greater activation in left superior temporal gyrus than other groups, suggesting that they might spend more effort on processing the shape and sound of words. Finally, there were negative correlations between AIC/MTG activations and SRS scores across groups, implying social deficits on semantic processing.

A55 FUNCTIONAL CONNECTIVITY OF THE LEFT INFERIOR FRONTAL GYRUS WHILE READING ABSTRACT AND CONCRETE WORDS

Ingrid Olson[1], Laura Skipper[1]; [1]Temple University, Philadelphia, PA, USA

Concreteness is a critical organizing factor in semantic memory. While many neuroimaging studies have been carried out that contrast activations in response to abstract versus concrete concepts, there is very little consistency in findings. The semantic system in the human brain is likely made up of networks, not individual localizations (Binder et al, 2008). Despite this, virtually no neuroimaging studies have used appropriate methods to discover these networks, and search instead for individual activity sites. To explore the functional networks for abstract and concrete concepts, we had subjects carry out a semantic task while undergoing functional MRI. Word stimuli varied on two factors: concreteness (abstract, concrete) and social content (social, nonsocial). Nonword trials were also included as a baseline task. In each block, subjects viewed three words

consecutively, all belonging to the same concreteness and social content condition, for a total of 12s. Following each block, participants answered a meaningful question (e.g. Was one a vegetable?). In order to explore functional networks produced by abstract and concrete words, we carried out a Psychophysical Interaction Analysis. The left inferior frontal gyrus (IFG) was selected as the seed region. Preliminary results reveal that during the abstract condition, the IFG was functionally connected to a network that included the bilateral posterior superior temporal sulcus, and the right temporal pole. In contrast, the network for concrete words was much more left lateralized. These results suggest that abstract and concrete concepts may be critically differentiated in the brain through differing functionally connected networks.

A56 DEVELOPMENTAL CHANGES IN EFFECTIVE CONNECTIVITY DURING SEMANTIC JUDGMENTS TO CHINESE CHARACTERS

Li-Ying Fan[1], Tai-Li Chou[1,2,3]; [1]Department of Psychology, National Taiwan University, Taiwan, [2]Neurobiology and Cognitive Science Center, National Taiwan University, Taiwan, [3]Graduate Institute of Brain and Mind Sciences, National Taiwan University, Taiwan

Previous studies have investigated developmental changes of semantic processing regarding neural correlates between adults and children. However, it is little known whether the patterns of effective connectivity differ between adults and children during semantic processing. Dynamic causal modelling (DCM) was used to investigate the effective connectivity during semantic judgments to visual Chinese characters. Seventeen children (10- to 13-year-olds) and seventeen adults were asked to indicate if character pairs were related in meaning. Three regions of interest were left inferior frontal gyrus (IFG), left middle temporal gyrus (MTG), and left fusiform gyrus (FG). Experimental stimuli included high associated, low associated and unrelated pairs. Bayesian Model Selection (BMS) was used to find a winning family of DCM models separately for children and adults, and Bayesian Model Averaging (BMA) was used to calculate across models in the winning family. Our results showed that the modulatory effects were significantly stronger for low associated than for high associated pairs in adults, and that the modulatory effects were significantly stronger for low associated pairs in adults than in children. In addition, the bottom-up effect from FG to IFG was stronger than the top-down effect from IFG to FG in adults, and that the bottom-up effect from FG to IFG was stronger in adults compared to children. In conclusion, our connectivity findings suggest developmental changes in semantic processing to low associated pairs and in bottom-up influences of orthographic representations on semantic representations for processing Chinese characters.

A57 HIERARCHICAL ORGANIZATION OF ABSTRACT NOUNS: IMPLICATIONS FOR NEUROLINGUISTIC THEORY

Joshua Troche[1], Alison Paris[1], Sebastian Crutch[2], Jamie Reilly[1]; [1]University of Florida, [2]University College London

The organization and neural representation of concrete words has long been an intense area of interest in neurolinguistics. Many theories stress the importance of hierarchical organization of the lexical networks of concrete words (e.g., labrador–dog-animal). Hierarchical lexical organization maps well to the structure of the brain and provides a compelling account of the graceful degradation of naming seen in many neurological disorders. Very little remains known about abstract words (e.g., truth); however, converging evidence suggests that concrete and abstract words are unique in their neural representation. One possibility is that abstract words show a "loose" or non-hierarchical organization relative to concrete words. We investigated clustering of 400 highly abstract and concrete words in multi-dimensional space. Using a 7-pt Likert scale, participants (N==365) rated each target word on the following 12 dimensions: sensation, morality, ease-of-teaching, ease-of-modifying, action, thought, emotion, social interaction, time, space, quantity, polarity. Data reduction using factor analysis revealed three latent factors, corresponding roughly to: concreteness, emotion/social cognition, and magnitude. We then plotted similarities in 3-dimensional space using hierarchical cluster analysis. These analyses showed that abstract words do cluster in hierarchies, but that these hierarchies are qualitatively distinct from concrete words. At the most superordinate levels, emotion/social cognition are important grouping factors while at the most subordinate it is magnitude. These putative "clusters" encompass cognitive dimensions that are represented in unique regions of the brain (e.g., magnitude as parietally mediated, emotion as right hemisphere or amygdala mediated). We discuss implications for theory of abstract and concrete word representation.

A58 NEURAL AND BEHAVIOURAL CONSOLIDATION OF SPOKEN WORDS AND MEANINGS IN L1 AND L2

Viktoria Havas[1,2], Joanne Taylor[3], Lucía Vaquero[1], Ruth de Diego-Balaguer[1,2,4,5,6], Antoni Rodríguez-Fornells[1,2,4]; [1]Bellvitge Biomedical Research Institute, [2]University of Barcelona, [3]MRC Cognition and Brain Sciences Unit, [4]Institució Catalana de Recerca i Estudis Avançats, [5]Ecole Normale Superieure, [6]Institut National de la Santé et de la Recherche Mé dicale

Two experiments investigated the neural and cognitive processes underlying word learning and consolidation. In Experiment 1, 65 adults learned: i) novel words associated with pictures of everyday objects, ii) novel words associated with novel objects, iii) novel words without picture associations. Half the participants learned novel words that were phonologically similar to their native language (L1), the other half learned novel words from Hungarian, an unfamiliar language with

very different phonology (L2). Within each group half the participants were trained in the morning and tested in the evening of the same day, and half trained in the evening and tested in the morning the next day, allowing an opportunity for overnight consolidation. Training involved 5 presentations of each novel word paired with associated pictures (sets ii and iii), or a blank screen (set i). Tests included old-new decision, to evaluate learning of the novel words' phonological form and a 4-alternative forced choice task, to evaluate picture-word associative learning. In old-new decision, phonological forms were more accurately recognized when they had been paired with everyday objects, relative to novel objects or unpaired items. Overnight sleep increased old-new decision accuracy only for novel words with unfamiliar phonology (L2 group). Results show associated meanings benefit phonological learning, and that consolidation enhances episodic knowledge of phonologically dissimilar novel words. In Experiment 2 we examined the influence of these manipulations on fMRI responses in 22 participants. Implications for theories of medial temporal lobe contributions to associative memory and word learning will be discussed.

A59 ROLE OF THE LEFT ANGULAR GYRUS IN SEMANTIC PROCESSING DURING VISUAL WORD RECOGNITION

Magdalena W. Sliwinska[1], Alyson James[1], Joseph T. Devlin[1]; [1]Cognitive, Perceptual & Brain Sciences, UCL, London, UK

Reading is a surprisingly difficult task that, at a minimum, requires recognizing a visual stimulus and linking it with its corresponding sound and meaning. Neurologically, this involves an anatomically distributed set of brain regions cooperating to solve the problem. Among these, it has been hypothesized that the angular gyrus (ANG) contributes to semantic aspects of word processing. Here, we used on-line repetitive transcranial magnetic stimulation (rTMS, 10 Hz, 500 msec) to investigate this hypothesis using visually presented pairs of words. Participants performed a category decision task ("Do the two words belong to the same category?") while receiving rTMS to one of three anatomically defined sites within left ANG. When stimulation consistently slowed reaction times (RTs), that site was used for further testing. The main task then used a different semantic decision task ("Do the two words mean the same thing?") and a control task ("Are the two consonant strings identical?"). In each participant it was possible to identify an ANG site where rTMS slowed RTs. Over the group, rTMS trials were, on average, 38msec slower than no TMS trials. In the main task, stimulation significantly increased RTs by an average of 52 msec relative to baseline. In contrast, stimulation had no significant effect on the control task (19 msec). These findings are consistent with claims that the left ANG contributes to semantic processing. Key words: reading, semantics; angular gyrus

A60 INDUCED MOOD MODULATES THE ERP N400 COMPONENT IN VISUAL WORD RECOGNITION

Maartje van der Meij[1], Pedro Javier López Pérez[1], Steffen Wiegert[1], Horacio A. Barber[1]; [1]University of La Laguna

Transient mood is known to affect sentence comprehension modulating both semantic (Federmeier et al., 2001, Neuroscience Letters, 305, 149-152) and syntactic (Vissers et al., 2010, Neuropsychologia, 48, 3521-3531) integration processes. The present study was designed to investigate if transient mood also affects low-level processes of visual word recognition. The study consisted of three separate blocks in which the participants had to read single words presented in the centre of the screen and perform a semantic categorization in a go-no go task. 300 experimental words were presented in three blocks. Each block contained 100 no-go trials: 50 high and 50 low lexical frequency words. Before each block participants evaluated 20 pictures that depending on the block were sad (valence=2.37, arousal=5.09), happy (valence=7.89, arousal=4.90) or neutral (valence=5.08, arousal=2.71). The results showed the classical lexical frequency effect in the N400 component, with more negative amplitude for low frequency words as compared to high frequency words. Interestingly, transient mood manipulation also modulated the N400 component; amplitudes under the sad induced mood were more negative than under the happy mood, whereas the neutral condition produced amplitudes in-between. This pattern of effects suggests that the costs associated to meaning activation increases under sad mood and can be facilitated under happy mood. Moreover, this mood effect was determined by the emotional valance and not the arousal associated to the words. These findings extend previous reports about the relation between mood and language during sentence reading to the level of single word processing.

Motor Control, Speech Production, Sensorimotor Integration

A61 THE NEURAL REPRESENTATION OF A SPEECH ACTION REPOSITORY

Cornelia Eckers[1], Bernd J. Kröger[1,2], Stefan Heim[3,4,5,6]; [1]Department of Phoniatrics, Pedaudiology, and Communication Disorders, RWTH Aachen University, Aachen, Germany, [2]School of Computer Science and Technology, Tianjin University, Tianjin, P.R.China, [3]Structural-Functional Brain Mapping at the Department of Psychiatry, Psychotherapy, and Psychosomatics, Medical School, RWTH Aachen University, Aachen, Germany, [4]Clinical and Cognitive Neurosciences at the Department of Neurology, Medical School, RWTH Aachen University, Aachen, Germany, [5]Research Centre Jülich, Institute of Neuroscience and Medicine (INM-1), Jülich, Germany, [6]Jülich-Aachen Research Alliance – Translational Brain Medicine,Jülich and Aachen, Germany

A speech-action-repository (SAR) has been proposed by Kröger et al. (2011, LNCS 6800, pp.287-293) as a central system for efficient speech production. Frequently

occurring syllables are assumed to be stored as motor as well as sensory neural patterns which are simply activated when needed. Whereas several behavioral psycholinguistic studies provided evidence in support of the existence of a SAR, studies using fMRI failed to demonstrate its neural representation. Thus, the present study uses fMRI in 2 healthy volunteers in order to investigate this problem. In particular, we set out to test whether reproducible activation patterns are individually repeatedly observed and whether these are comparable over subjects. We designed reaction paradigms using homogeneous- and heterogeneous-syllable-blocks including [ba:]-[be:]-[bi:]-[bo:]-[bu:] or [?a:]-[?e:]-[?i:]-[?o:]-[?u:] (each block ten stimuli) during overt/covert speech within two (auditory/visual) presentation modes. Homogeneous blocks are assumed to decrease the BOLD-signal (priming effect) in the SAR. Thus, contrasting homogeneous with heterogeneous blocks reflects the neural process of locating a specific syllable within the SAR. This indicates its neural representation, which is supposed to lie within the shared activation network of auditory and visual syllable processing. Data was collected on a Siemens-3T-Magnetom-Trio scanner and analyzed using the logical conjunction analysis of visual and auditory blocks provided in SPM8. Within the resulting regions, we observed a priming effect in left PMC, BA 44, and IPC. This preliminary evidence is compatible with the notion of the SAR, in which the region of IPC is assumed to represent an interface of different information of syllabic speechactions.

A62 REPETITION SUPPRESSION DURING PERCEPTION AND PRODUCTION OF SINGLE-SYLLABLES: AN FMRI ADAPTATION PARADIGM

Jack Rogers[1], Riikka Mottonen[1], Rowan Boyles[1], Kate E Watkins[1]; [1]University of Oxford, UK

Single-cell recordings in the monkey revealed populations of premotor cortical neurons that fire during both execution of actions and auditory perception of the same actions (Kohler et al., 2002). The existence of such "auditory mirror neurons" in the human brain is unknown but they might support sensorimotor integration of speech. We used FMRI adaptation to examine articulatory feature-specific processes during speech perception and production. The paradigm made use of the repetition-suppression (RS) effect, elicited by adaptation of the response of a specific neuronal population to repeated stimuli. Pairs of speech syllables were used that were either the "same" (e.g., "pup"-"pup"; "tut"-"tut") or "different" (e.g., "pup"-"tut"; "tut"-"pup") with respect to their articulatory features (lip- or tongue-articulated). 15 participants either passively listened to or silently articulated the syllable pairs while scanned. Whole-brain analysis revealed significant RS effects within superior temporal cortex bilaterally when participants listened to "same" vs. "different" syllable pairs; the effect was not feature-specific. However, during silent speech production, RS effects were observed in the left precentral gyrus in a feature-specific manner consistent with the known somatotopy of primary motor cortex. To examine whether there is an "auditory mirror neuron"-like system in the human brain, we tested whether RS effects were also observed for the syllable pairs when one of the syllables was heard and the other was silently articulated or vice-versa. Such auditory-motor RS effects for "same" vs. "different" pairs are most likely to occur in inferior frontal gyrus, a presumed human homologue of monkey ventral premotor cortex.

A63 IMITATIVE LEARNING IN SPEECH COMPREHENSION: AN FMRI STUDY

Patti Adank[1], Shirley-Ann Rueschemeyer[2], Harold Bekkering[3]; [1]School of Psychological Sciences, University of Manchester, United Kingdom, [2]Department of Psychology, University of York, United Kingdom, [3]Donders Institute for Brain, Cognition and Behaviour, University of Nijmegen, The Netherlands

Recent theories on the mechanisms through which listeners manage to maintain perceptual invariance despite variation in the speech signal allocate a prominent role for imitation processes during comprehension [1]. Indeed, imitation of accented speech aids subsequent comprehension of accented sentences in background noise [2]. However, the neural bases underlying these imitation processes are unclear. The prediction that brain areas involved in perceptual learning - left Inferior Frontal Gyrus (LIFG) and Left Posterior Superior Temporal Gyrus (STG) and imitation (LIFG) was tested using fMRI. Two listener groups took a pre-test in which they rated the intelligibility sentences spoken in an unfamiliar accent in a staircase procedure. This resulted in a score in decibel (dB) representing the signal-to-noise (SNR) value at which participants found the sentences to be about 50% intelligible. Second, one group (N 16) repeated the sentences in their own accent, and the other group (N 17) imitated the speaker's accent. Next, both group took a post-test, which was similar to the pre-test. The behavioural results showed that the imitation group could tolerate more background noise in the post-test. The neuroimaging results showed an interaction between training (repeat or imitate) and test (pre or post-test) in LIFG and left STG. These results will be discussed in terms of imitation learning in speech processing. References 1. Pickering & Garrod, TiCS, 2007, 11(3): 105-110. 2. Adank, Hagoort, & Bekkering, Psychological Science, 2010, 21(12), 1903-1909.

A64 INTRA- AND INTERHEMISPHERIC FUNCTIONAL COUPLING FOR INNER AND OVERT SPEECH

Christian Keller[1], Christian Kell[1]; [1]Department of Neurology and Brain Imaging Center Goethe University Frankfurt, Germany

Current thinking proposes a dual-stream model for speech processing: a left lateralized dorsal and a bilateral ventral stream. A fundamental question with regard to overall brain function is the interaction of hemisphere, stream and function for speech processing. We propose different levels of interhemispheric control and frontotemporal interactions for inner and overt speech. We performed an fMRI experiment on 39 healthy right-handed participants. Our

cue-target paradigm involved reading sentences overtly or covertly, contrasted against a visual control condition. The variable instruction delay (2-4s) allowed for a dissociation of task preparation from execution. Lateralization of activity and functional connectivity (psycho-physiological interactions, PPI) was analyzed in SPM8. Results were family wise error corrected at $p<0.05$. Covert reading involves the bilateral ventral and left dorsal phonological streams that all disconnect from bilateral articulatory regions. Overt reading additionally left-lateralizes activity in sensory cortices together with functional connectivity in an auditorymotor loop involving planum temporale, the sylvian parietotemporal area, and the primary motor cortex. Thus, left-lateralization during speech production is observed in two dorsal loops: A lower level articulatory- and a higher level phonology-related one. Processing in right dorsal speech regions is controlled by left dorsal premotor cortex reflecting dominance of left speech motor representations. The right-hemispheric speech network instead connects more strongly to the bilateral ventral streams. Our results support the view that parallel processing in the two streams with differently sized signal chunks (shorter ones preferably being analyzed in the dorsal stream and thus left hemisphere) underlies the lateralization of brain function.

A65 NEURAL PREDICTIONS OF AUDITORY VOCAL FEEDBACK ARE TASK-SPECIFIC

Caroline Niziolek[1], Srikantan S. Nagarajan[1], John F. Houde[1]; [1]University of California, San Francisco

In models of speech motor control, external auditory feedback is compared with an internal prediction. If the feedback matches the prediction, the sensory response is suppressed, a phenomenon known as speaking-induced suppression (SIS). Is the auditory prediction an internal, task-specific target, or does it reflect the expected sensory consequences of articulatory commands? Production variability enables us to test these alternatives in natural speech. In this study, we used magnetoencephalography (MEG) to measure how SIS varied over repeated word productions in two different contexts. In Experiment 1, subjects produced three different vowels; in Experiment 2, subjects were cued by tonal prompts to produce a single vowel on three different pitches. SIS was defined as the suppression of the auditory M100 response to spoken vowels relative to an audio playback condition. We found that SIS was reduced in the productions farthest from the median formants. In other words, natural vowel productions at the edges of the distribution appear more error-like, suggesting that not all output variation is built into the neural prediction. Furthermore, this reduction in SIS depends on task context. When comparing productions based on distance from the median pitch, we found that SIS varied only in Experiment 2, in which pitch was an explicit target. Our results demonstrate that SIS varies across normal, unperturbed utterances based on the goodness of the match with an task-specific target. This is consistent with an auditory target model, or with a forward model in which articulatory variation is introduced downstream of the auditory prediction.

A66 ARE NEUROANATOMICAL CHANGES DRIVING NEUROPHYSIOLOGICAL CHANGES IN THE SPEECH SENSORIMOTOR NEURAL SYSTEM IN AGING? AN FMRI STUDY

Pascale Tremblay[1,2], Anthony S. Dick[3], Steven L. Small[4]; [1]Universite Laval, [2]Centre de Recherche de l'Institut Universitaire en Santé Mentale de Québec, [3]Florida International University, [4]University of California, Irvine

Despite the enormous contribution of the ability to communicate on the character and quality of life, very little is known about age-related changes in the neural control of speech The goal of the present study was to examine, using fMRI, potential age-related functional (BOLD) differences in the perception and production of audio-visual speech (single word perception and production) in a group of 20 young and 19 older adults. Within a regression framework, in which we controlled for sex, education, and hearing sensitivity, we examined (1) Age differences within Perception; (2) Age differences within Production; (3) and the Task (Perception, Production) x Age interaction. The regression also allows us to report the correlation between hearing sensitivity scores and these effects. We also examined the relationship, using multiple mediation analyses, between functional and morphological (surface-based cortical thickness, grey matter volume) age-related changes. Our results reveal several regions showing age differences within Perception including the left primary auditory cortex (A1), the right planum temporale (PT), and the right STS. Age differences within production were found in the right ventral premotor cortex (PMv), right STS and right SMA-proper. Task x Age interactions were found in the bilateral PMv and right SMA-proper. While the mediation analyses confirmed the existence of a relationship between age and task-related BOLD signal, and between age and thickness/ gray matter volume, several regions showed unexpected morphology-independent decrease in task-related BOLD signal. The importance of these results for understanding normative brain aging process and their effect of verbal communication will be discussed.

A67 CORTICAL NETWORKS INVOLVED IN SPEECH RECOVERY AFTER INTRA-ORAL SURGERY: AN FMRI STUDY

Audrey Acher[1], Marc Sato[1], Laurent Lamalle[2], Coriandre Vilain[1], Arnaud Attye[2], Alexandre Krainik[2], Georges Bettega[3], Christian Adrien Righini[4], Brice Carlot[3], Muriel Brix[3], Pascal Perrier[1]; [1]Gipsa-Lab, Département Parole & Cognition, UMR 5216 CNRS/Grenoble Universités, [2]SFR1 RMN Biomédicale et Neurosciences – Unité IRM Recherche 3T, CHU de Grenoble, [3]Service de chirurgie plastique et maxillo-faciale – CHU de Grenoble, [4]Clinique ORL, Pôle Tête et cou et Chirurgie Réparatrice – CHU de Grenoble

Speech production after intra-oral surgery often requires the patient to go through a long speech recovery process. This study aims at better understanding the reorganization process of the control underlying the functional recovery of speech after resection in the vocal tract region (i.e. carcinologic resection of mobile tongue, mouth floor and lips). In order to determine how the brain integrates new relationships between motor commands, auditory and oro-sensory feedbacks, we designed a longitudinal sparse-sampling fMRI study on 5 patients one week before and one month after surgery. One month after intra-oral resection, an increase of activity was observed in the supplementary motor area, the cingulate cortex, the globus pallidus (both involved in selection and initiation process suggesting more competitive mechanisms between motor strategies after surgery), the superior parietal lobule (somatosensory-motor control), the somatosensory and primary motor cortices (for proprioception and execution of movement). Additional patients are currently recruited and we expect the speech recovery process to be also associated with significant activity changes in the cerebellum in relation with changes in motor plant. In our view and based on previous studies on internal models, cerebellar activity should be stronger during the first part of the process, as the results of the learning, before returning to a normal level in the second part. These preliminary results contribute to better understand the neural reorganization of sensory-motor structures associated with the speech production recovery process and brain mechanisms involved in relearning speech with a focus on internal model development and perceptuo-motor coupling.

A68 AN MEG STUDY OF MULTI-WORD SEQUENCE FREQUENCY EFFECTS ON SPEECH PRODUCTION.

Antoine Tremblay[1], Anne Johnson[1], Timothy Bardouille[2], Aaron J. Newman[1]; [1]Dalhousie University, [2]NRC Biodiagnostics (Atlantic)

We sought to gain a better understanding of multi-word frequency effects on speech production by running an unconstrained scene description task with magneto-encephalographic (MEG) recordings. Pictures depicting a wide variety of scenes were presented to participants, who were asked to name the pictures using a single word in one block, and produce a full-sentence descirption in a later block. We investigated whether scenes presented in the naming block primed the first four words that were later uttered in the describing block, and, again in the naming block, whether the frequency of use of these four-word sequences was associated with greater activity in areas thought to support lexical-semantic retrieval than syntactic processing. For instance, in the naming block, "bagpipes" was used to name the picture, and later the sentence "Two young men are playing the bagpipes on the side of the street" was uttered to describe it. We asked whether "Two young men are" was primed by the picture presented in the naming block. We used signal space separation beamformers to reconstruct the time course of activation in regions of interest, which were analyzed using generalized additive mixed-effects modelling. Preliminary analyses revealed that the scenes presented in the naming block primed the first four-word sequence that would later be uttered in the describing block. More specifically, high frequency sequences elicited widespread activity in the semantic system but very little activity in the syntactic system. These results suggest that at least some compositional multi-word sequences are stored and retrieved as wholes.

A69 NEUROPHYSIOLOGY OF SPEECH ACT PROCESSING: AN MEG STUDY.

Natalia Egorova[1,2], Friedemann Pulvermuller[3], Yury Shtyrov[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, [2]University of Cambridge, [3]Free University of Berlin

The ultimate goal of linguistic communication is to interact with other individuals to pass information onto them, often in order to cause them to act in response to the spoken message. However, there is rarely a strict one-to-one mapping between what is said and what is communicated. Often, the same linguistic expression could serve multiple communicative functions. For example, the same utterance "Water!" could mean either "This is water" (naming an object) or "Give me some water" (requesting an object), depending on the wider conversation context. While most research in neuroscience of language is devoted to studying the neural underpinnings of meaning contained in single words and sentences, little is known about how various linguistic communicative functions/intentions, or so-called "speech acts", are processed in the brain. This question has been addressed in a combined MEG-EEG experiment, in which neural responses to two different speech acts ("Naming" and "Requesting") expressed by identical single words were compared to determine the neural basis and temporal dynamics of speech act comprehension in the brain of healthy participants who observed scenes depicting communication between two people. The results suggest that dissociation between neural processing of Naming and Request commences very early (the first divergence point at 50 ms after visually presented stimulus words) and continues as a dynamic interplay between several brain areas in both cerebral hemispheres over the course of a few hundred milliseconds. Processing of

Naming-specific information predominantly engages perisylvian areas, while Requests additionally require motor engagement.

Poster Session B

Friday, October 26, 3:20 pm – 5:20 pm, Ground Floor Foyer and 1st Floor

Auditory Perception, Speech Perception, Audiovisual Integration

B1 RELATING SPECTRAL AND TEMPORAL TASK PERFORMANCE TO DEGRADED SENTENCE COMPREHENSION IN CHRONIC STROKE

Paul Fillmore[1], Sigridur Magnusdottir[2], Helga Thors[1,2], Taylor Hanayik[1], Kimberly Smith[1], Daniel Fogerty[1], Julius Fridriksson[1]; [1]University of South Carolina, Columbia, SC., [2]University of Iceland, Reykjavik, Iceland.

There has been a long-standing effort in auditory brain research to relate patterns of hemispheric dominance for language and musical stimuli to a dependence on the spectral and temporal components inherent in these stimulus classes. Despite a great body of work on the topic, many contradictory results exist in the literature, and the picture is still far from clear. Much recent work has focused on functional neuroimaging methods in healthy individuals; however neuropsychological methods which relate brain damage to behavior can also play a key role in identifying brain areas crucial for particular cognitive operations. In the present study, we tested chronic stroke patients with both left and right hemisphere damage on a set of non-linguistic auditory perceptual tasks, as well as on sentence comprehension tasks in several degraded listening conditions. Tasks were presented in an adaptive thresholding context, so as to ascertain patients' true level of within-task competence. We found that both spectral and temporal task performance was highly correlated with sentence comprehension abilities, both for speech in noise (in which primarily spectral cues are degraded) and time-compressed speech (in which primarily temporal cues are degraded); double dissociations in task type and sentence type were not observed. Additionally, few differences between left and right hemisphere patients were noted. In terms of localizing neural modules associated with task performance, we found that impaired sentence comprehension was associated with both posterior temporal and inferior frontal lesions in the left hemisphere, while patterns for the non-linguistic tasks were less clear.

B2 AUDITORY PROCESSING CHANGES FOLLOWING NEUROPLASTICITY-BASED COMPUTERIZED TRAINING IN A PERSON WITH APHASIA: A PILOT STUDY

Brea Chouinard[1], Crystal Zhou[1], Yvonne Y. Chen[1], Claire Rollans[2], Esther Kim[1], Jacqueline Cummine[1]; [1]University of Alberta, [2]McGill University

BrainFitness (BF) is a commercially available computer program, developed according to the principles of neuroplasticity, and was found to improve auditory processing in typically aging adults. The current study examined neural and behavioural changes following completion of BF in a person with aphasia (PWA). TH, a 66 year-old right-handed male was 36 months post left CVA. Lesion involved primarily middle temporal gyrus extending partially into posterior superior temporal gyrus (STG). TH completed BF (40 hours total: 1 hr/day; 5 days/week; 8 weeks). Neuroimaging and behavioural assessments occurred at three time points (baseline: ~ 8 weeks before starting BF; pre-: within one week of starting BF; and post-: within one week of completing BF). An auditory sentence plausibility task (i.e., button response) was used during fMRI acquisition (Siemens 1.5T) to assess auditory processing. Diffusion tensor imaging (DTI) was used to measure changes in fractional anisotropy (FA) in select white matter pathways. Compared to baseline, post fMRI showed increased bilateral activation in IFG for plausible and implausible stimuli, while activation increased in left posterior STG for plausible stimuli and right STG for implausible stimuli. Over the same time period, DTI showed increased FA in the cortico-spinal tract. TH's behavioural outcomes also reflected improvement, with notable changes on BF measures including increased auditory processing speed (30%) and working memory (40%) comparing post to pre. Completing a cognitive training program specifically designed according to the principles of neuroplasticity resulted in neural auditory processing changes concurrent with increased behavioural scores, in a PWA.

B3 FUNCTIONAL CORRELATES OF THE SPEECH IN NOISE COMPREHENSION DEFICIT IN DYSLEXIA

Michel Hoen[1], Marjorie Dole[1], Fanny Meunier[1]; [1]Centre de Recherche en Neurosciences de Lyon Equipe Dynamique Cérébrale et Cognition INSERM U1028 - CNRS UMR5292 - Lyon France

Dyslexia is a deficit in the acquisition of written language abilities associated to impaired representation and/or use of phonological information. This trouble could rely on a deficit of speech perception (Boets et al., 2011), an idea corroborated by impairments in the perception of speech in noise (Ziegler et al., 2009; Dole et al., 2012). In normal readers, speech-in-noise comprehension mainly involves superior and middle temporal gyrus, where activation and/or lateralization deficits have been shown in dyslexic subjects. The purpose of this series of studies was to further investigate behavioural, functional and anatomical correlates of this phenomenon. 14 dyslexic and 14 control participants took part in this experiment in which we

acquired high-res anatomical, functional and DTI images. Participants had to determine subjective intelligibility of isolated target-words presented in babble noise along 3 listening configurations. Dyslexics were more disturbed by the background than controls in a listening configuration maximizing energetic masking, but showed no clear deficit when spatial unmasking was made possible. fMRI results showed that the speech-in-speech task involved bilateral STG, whatever the configuration. In this spatialized configuration, the right anterior STG seemed to be more activated for dyslexic than for control participants. A vowel-based morphometry analysis and an analysis of WM and GM asymmetries confirmed this observation by showing a decrease of GM density in dyslexics compared to matched normal in this anterior part of right-STG. Altogether, these results offer a broad explanatory view on the speech in noise comprehension deficit observed in dyslexia.

B4 RESPONSES TO AUDITORY, VISUAL, AND AUDIOVISUAL SPEECH AND NONSPEECH RECORDED FROM AUDITORY CORTEX

Ariane E. Rhone[1], Hiroyuki Oya[1], Bob McMurray[1], Richard A. Reale[1], Kirill V. Nourski[1], Hiroto Kawasaki[1], Matthew A Howard, III[1]; [1]University of Iowa

The present study examined electrocorticography (ECoG) responses to audio, visual, and audiovisual stimuli recorded from subdural grids overlying the temporal lobe and depth electrodes implanted in Heschl's gyrus in subjects undergoing monitoring for medically intractable epilepsy. Stimuli were adapted from Reale et al. (2007): audio /da/, visual /da/, audiovisual /da/, audio /da/ paired with gurning, /da/-shaped noise paired with visual /da/, and /da/-shaped noise paired with gurning. Each stimulus was repeated at least 20 times in randomized order. Cortical activity was characterized by high gamma (70-150 Hz) and beta (14-30 Hz) event related band power. High gamma responses to all experimental stimuli were observed in the posterior lateral portion of superior temporal gyrus (PLST). Responses to conditions containing visual speech were characterized by an earlier onset than audio-alone conditions. Visual /da/ paired with either auditory stimulus elicited high gamma responses prior to or near the onset of the auditory stimulus. However, auditory stimuli paired with gurning did not show early activity. High gamma responses to visual-alone stimuli were observed on PLST, with early onset latency similar to the audiovisual conditions, but smaller power changes compared to any condition containing auditory information. Reduction of beta band power was observed near onset of visual motion. Depth electrodes recording from Heschl's gyrus showed similar high gamma responses to all conditions containing an auditory signal, but no response to visual-alone stimuli. Results are consistent with a model of audiovisual processing in which visual information interacts with auditory information as early as non-primary auditory cortex.

B5 NEURAL CORRELATES OF CONTEXT-TUNING MECHANISM FOR NORMALIZING TALKER VARIABILITY: AN EVENT-RELATED POTENTIAL (ERP) STUDY OF CANTONESE LEVEL TONES

Caicai Zhang[1], Gang Peng[1], William Shi-Yuan Wang[1]; [1]Language Engineering Laboratory, The Chinese University of Hong Kong

A full answer remains to be achieved to the question how listeners recover speech message from acoustic signals, given the immense variability between talkers. According to the context tuning mechanism, listeners rescale speech signals against a talker's phonetic space built from the context so that variable signals can be mapped onto invariant representation. Despite its plausibility, neural correlates of context-tuning mechanism are largely unknown. To fill in this gap, this ERP study examines the neural processing of a target word following a speech and nonspeech context with identical F0 trajectory. Cantonese has three distinctive level tones. Behavioral results confirmed that the identical target (/ji33/ 'meaning', mid level tone) was perceived as a word with low level tone, mid level tone and high level tone respectively in conditions that the F0 of speech context was raised, unshifted and lowered, indicating attunement to the relative pitch height of speech context. Contrarily, shifting the F0 of nonspeech context did not change the perception. Lack of tuning to nonspeech context allowed us to use it as baseline to probe the neural correlates of context-tuning. We found that top-down influence from speech and nonspeech contexts differentially modulated the processing of the target in three time-windows: N1 (100-220 ms), N400 (250-500 ms) and Late Positive Component (500-800 ms). It implies that speech context eases the activation of long-term memory associated with the target, facilitating accurate selection of intended word out of competing candidates. Our findings shed light on temporal aspects of neural activities underlying context-tuning mechanism.

B6 INDEPENDENT PROCESSING OF STRESS AND PHONEMES IN READING AND NON-READING CHILDREN

Ulrike Schild[1], Brigitte Röder[1], Claudia K. Friedrich[1]; [1]University of Hamburg

Recent results revealed that the processing of phoneme information in spoken words is modulated by reading experience in children (Schild, Röder, & Friedrich, 2011). Here we tested how information that is usually not encoded in the written signal in German, namely syllable stress, is processed by non-reading and reading children. In a unimodal auditory priming paradigm, spoken word onset syllables (primes) preceded spoken words (targets). We independently varied phoneme and stress priming in four conditions: (i) "phoneme-match, stress-match" (e.g., DO-DOse, Engl. can [capitals indicate a stressed syllable]); (ii) "phoneme-match, stress-mismatch" (e.g., do-DOse); (iii) "phoneme-mismatch, stress-match" (e.g., BA-DOse); (iiii) "phoneme-mismatch, stress-mismatch" (e.g., ba-Dose). Lexical decisions and Event-Related

Potentials (ERPs) for the targets were obtained from 22 non-reading preschoolers, 11 reading preschoolers and 24 beginning readers. For the decision latencies, we observed an interaction of phoneme and stress priming. Behavioral responses were fastest for the "phoneme-match, stress-match"- condition, indicating that both types of information are integrated to prepare the lexical decision. In the ERPs, we obtained independent effects for stress priming and phoneme priming. In line with previous research, phoneme priming elicit a left-lateralized ERP effect between 300 and 400 ms. In the same time window, stress priming elicited a centro-posterior ERP effect. This is further evidence for independent processing of word stress and phonemes. Behavioral and ERP results were comparable across all groups. This reveals that modulated spoken language processing due to reading does not generalize to information that is not coded in the written signal, such as syllable stress.

B8 ONLINE LEXICAL INFLUENCES DRIVE PHONOTACTIC EFFECTS

David Gow[1,2,3]; [1]Massachusetts General Hospital, [2]Salem State University, [3]Athinoula A. Martinos Center for Biomedical Imaging

Phonotactic constraints on word formation play a central role in phonology and have been implicated in an ever-growing set of language acquisition and spoken language processing phenomena. The mechanisms that produce sensitivity to phonotactic legality and frequency have not been widely investigated, but are often assumed to reflect either frequency-weighted bottom-up activation or response bias. We present two experiments that employ Kalman filter-based Granger causality analysis of source space reconstructions of neural activity based on MRI-constrained MEG/EEG to produce phonotactic effects. The first experiment explores the neural interactions that produce a novel regressive phonotactic bias in the categorization of ambiguous fricatives (/s/ - /ʃ/) in /_rV/ versus /_lV/ contexts. The second experiment examines the basis of probabilistic phonotactic frequency effects on auditory lexical decision in a set of words and nonwords in which phonotactic frequency and phonological neighborhood size are varied orthogonally. The results of both experiments show that activation of the superior temporal region is influenced by activation of brain regions associated with lexical representation and processing as a function of phonotactic frequency or legality. These results are consistent with the claim that phonotactic effects on speech perception are the result of "gang effects" in which partially activated lexical items that share a phonotactic sequence provide top-down influence on acoustic-phonetic processing. Moreover, they have implications for understanding both the nature of diverse frequency effects in language and the process that leads to the development of phonological laws and constraints through iterative learning over the course of language evolution.

B9 DOMAIN-DEPENDENT AND DOMAIN-INDEPENDENT SENSITIVITY TO STATISTICAL STRUCTURE FOR AUDITORY INPUTS IN LATERAL TEMPORAL CORTEX

Uri Hasson[1], Pascale Tremblay[2]; [1]University of Trento, [2]Université Laval

Speech units are temporally organized according to complex language-specific constraints, such as syllable transition probabilities (TP). Sensitivity to TP is thought to bootstrap word acquisition, as syllables with high TP tend to form words whereas those with lower TPs mark word boundaries. Little is known about the neurocognitive processes underlying statistical information processing (SIP). In particular, it is unknown if SIP for auditory inputs is mediated via domain-independent or domain-dependent mechanisms. McNealy et al. (2006) suggested that SIP for speech sounds is mediated by the supratemporal cortex (STC). However, it is unknown whether this function generalizes to non-speech auditory sounds. In an fMRI study (4T, TR=2.2) 20 participants passively listened to rapidly presented (3.3Hz) speech (syllables) and non-speech (bird chirps) auditory series while performing an unrelated visual task. The series were random, semi-predictable, or highly predictable depending on their elements' TP-structure. Sensitivity to TP was assessed in bilateral regions-of-interest covering the entire STC. Findings: posterior aspects of STC were sensitive to TP in both speech and non-speech series, without differentiation. In contrast, distinct sensitivity profiles to TP in speech/non-speech were found in the transverse temporal gyrus, with more distributed activation for non-speech than speech. Finally, behavioral data indicated that highly predictable series were associated with perceptual grouping – a lower number of perceived elements -- for non-speech inputs. These findings suggest a tight linking between SIP and segmentation processes in supratemporal cortex, with reduced speech-specific compared to bird-sound SIP patterns explainable by the easier segmentation of speech compared to birds.

B10 ELECTRO-CORTICOGRAPHIC SIGNATURES OF AUDITORY NAMING

Kiefer Forseth[1,2], Chris Conner[1], Nitin Tandon[1]; [1]UT Houston Health Science Center, [2]Rice University

Introduction: Electrocorticography (ECoG) recorded from chronically implanted, subdural electrodes (SDEs) affords the ability to measure evoked potentials arising from task-related activity. Methods: Electrocortiography (ECoG) data were collected at 1000 Hz while the patients performed an auditory naming task and auditory scramble control (88, 42 non-interspersed randomized trials). ECoG data were time-stamped using TTL pulses at stimulus onset and offset. Verbal responses were evaluated and time-stamped by a trained observer from video recordings. Power responses in the mid-gamma (60-120 Hz) range were compared to a 500 ms pre-stimulus baseline interval. Individual trials were time locked to stimulus onset, stimulus offset, or articulation to identify significant primary auditory, semantic decoding, and motor responses, respectively.

Electrodes (n=1127) from all patients were mapped to a common space and highlighted by their significance in one of the three timeframes. Results: There is a sequential progression of activation ($p<0.01$) from primary auditory concentrated in STG and MTG (200 ms to end of stimulus, 1.77% of electrodes), to semantic decoding in Broca's area and the midfrontal gyrus (end of stimulus for 200 ms, 0.62%), and finally motor response (articulation for 150 ms, 1.6%). The temporal and spatial characteristics of this auditory process are common to all patient analyzed (n=9). Conclusions: The cortical network responsible for auditory processing is strongly localized and follows a predictable time series of high frequency activation. This suggests a robust directed transfer of information. Further analysis will evaluate the functional connectivity suggested by these results.

B11 NEURAL RESPONSE TO LANGUAGE AND MUSIC IS LARGELY NON-OVERLAPPING

John Payne[1], Corianne Rogalsky[1], Greg Hickok[1]; [1]University of California, Irvine

Music and language share a number of features; both have rules dictating their use, exist primarily in the auditory domain, and are uniquely human. Whether music and language recruit the same brain systems is currently a matter of debate. In contrast to previous work, which highlighted similarities in the neural response to structural features, Rogalsky et al. (2011) found little overlap between language and music in regions thought to support structural processing. One potential criticism of Rogalsky et al.'s study was that the musical stimuli were too simple. The present study, therefore, used more complex musical stimuli with a fuller harmonic structure and included a condition with musical violations. As in Rogalsky et al., language stimuli comprised jabberwocky or scrambled versions of the same sentences. Musical stimuli were comprised of short piano chord progressions, with or without intermittent large key signature violations. All stimuli strongly activated auditory areas. A conjunction analysis involving sentences and non-violation musical stimuli replicated Rogalsky et al.: no overlap in Broca's area or the anterior temporal lobe, due to the fact that music stimuli did not activate these regions at all. The response to musical violation stimuli did include Broca's area, however, this activation was in a region distinct from that activated during sentence processing. These findings suggest largely distinct higher-order networks involved in musical and linguistic processing.

B12 SPECTRO-TEMPORAL CORRELATES OF RAPID LEXICAL ACCESS DURING AUDITORY LEXICAL DECISION

Jonathan Brennan[1], David Embick[2], Timothy P. L. Roberts[1]; [1]The Children's Hospital of Philadelphia, [2]The University of Pennsylvania

Lexical access during speech comprehension comprises numerous computations, including lexical activation, competition, and selection. The spatio-temporal profile of these processes involves neural activity in peri-auditory cortices engaged at least as early as 200ms after stimulation. Their oscillatory dynamics are less well understood, although reports link alpha de-synchronization with aspects lexical processing. We examined whether these oscillations co-vary with the speed of lexical access, as would be predicted if they index lexical activation. 15 subjects participated in an auditory semantic priming protocol during MEG recording. Monosyllabic high-frequency concrete nouns were presented in pairs with lexicality judgments registered after the second word. 83 related prime-target pairs were constructed using the USF free association norms. Pairings were re-shuffled to create unrelated pairs; pseudo-words were target items modified by one phoneme. Conditions were thus matched in terms of bottom-up input. Left auditory cortex was identified by fitting a dipole to the auditory M100 response per-subject. SAM beamforming was used to estimate spectro-temporal power at this location. Conditions were compared from 0-1sec after target onset between 5-35Hz. We found a significant reduction in alpha de-synchronization for related ($M\Delta pwr = -1.13\%$) compared to unrelated ($M\Delta pwr = -2.82\%$) targets beginning around 250ms, $p < .05$, consistent with a facilitation for lexical activation in priming. This is an extremely rapid effect; the average word duration was 459ms and average button press 950/986ms (related/unrelated). These findings are consistent with work showing lexical sensitivity in alpha-band activity, which our data suggest is influenced by the speed of lexical access.

B13 THE CRITICAL STATUS OF WORD-INITIAL SYLLABLE IN THE ON-LINE PROCESSING OF SPEECH: A MMN STUDY

Stéphane Pota[1,2,3], Elsa Spinelli[1,2,4], Léo Varnet[3], Michel Hoen[3], Fanny Meunier[3]; [1]Université Pierre-Mendès-France, [2]Laboratoire de Psychologie et NeuroCognition, CNRS, [3]Lyon Neurosciences Research Center, CNRS, INSERM, [4]Institut Universitaire de France

Speech signal is a continuous acoustic stream without explicit boundary between its components. As a consequence, listeners must perform the correct segmentation of this stream in order to recognize words. This segmentation process is usually realized quite easily, despite the complexity of speech acoustic signal. There are some fine-grained acoustic information that are likely to be used during word segmentation, as for example, in English, the word-initial accented syllable used to identify word-initial boundaries. But speech signal is also highly variable, across and within speakers. As a result, we ought to know whether these fine acoustic cues are robust enough, in a context of multiple productions, to be relevant for the speech perception system. For this purpose, we focused on the electrophysiological correlates of the subphonemic details perception, i.e. the segmentation cues, in intra-speaker variability conditions at syllabic and word scales. Homophone sequences were used, such as l'amie 'the friend' vs. la mie 'the crumb', both [lami], French spoken nominal utterances phonemically ambiguous. The

cortical marker of interest was the Mismatch Negativity (MMN), obtained in a modified version of the oddball paradigm, in which each stimulus, standard as deviant, came from different natural productions of the same speaker. The principal result of this study was that speech perception system is sensitive to acoustic cues situated within the initial syllable of phonemically identical sequences. However variations were observed depending of the linguistic status of the segment (in our example /a/ belonging to the article or to the noun).

Discourse, Combinatorial Semantics

B14 IT'S MY TURN: AN FMRI-STUDY ON TURN-TAKING DURING DYADIC ONLINE COMMUNICATION

Juliane Klann[1], Walter Huber[1]; [1]Clinical and Cognitive Neuroscience, Clinic of Neurology, University Hospital, RWTH Aachen University, Germany

Objectives: Turn-taking is seen as a basic mechanism of the human ability to communicate and participate in dialogues. In recent studies it is assumed to be part of a neurofunctional network that controls social cogntition and interaction (Hari &Kujala 2009). But so far, the neural substrates remain unclear, since studies, that investigate dyadic communication directly and online, are still missing. Aims: To uncover the neural substrate of communicative Turn-Taking in ongoing dyadic conversation. Methods: 12 single males (aged 20-40 years) were scanned while they were interviewed about their life history from a person outside the MR-scanner. In order to control for effects of mere talking without communicative impact, a monologue condition was conducted prior to the interview. Statistical parametric data analyses are executed with SPM8. A time-locked event-related as well as connectivity analyses were done in order to classify areas that responded specifically to communicative behaviour (interview condition) in contrast to mere speach starts (control condition) and to find out more about the interaction of these regions. Results: Analyses reveal activations within the "social-interaction network" as proposed by Hari & Kujala (2009). In contrast to starting to talk, taking a turn during dyadic communication relies especially on the medial temporo-parietal junction, that in former classical brain imaging studies were associated with context integration, inferences, updating old with new information, ToM, human awareness and episodic memory retrieval. Conclusions: The study gives new evidence for communicative functions being represented within a more general cognitive network for social interaction and action perception.

B15 INDIVIDUAL DIFFERENCES IN LOGICAL ABILITY PREDICT ERP RESPONSES TO UNDERINFORMATIVE SENTENCES

Stephen Politzer-Ahles[1], Xiaoming Jiang[2], Robert Fiorentino[1], Xiaolin Zhou[2]; [1]University of Kansas, [2]Peking University

Quantifiers like "some" provide an ideal test case for elucidating the neurocognitive foundations of meaning composition. In sentences like "Some of the students are hard-working", "some" contains two possible meanings: "at least one" (the inherent, semantic meaning) and "not all" (the pragmatic meaning, generated through an enrichment process). Previous event-related potential research in Mandarin (Politzer-Ahles et al., 2011, NLC) suggests that a sustained negativity occurs when pragmatic meaning inconsistent with a context must be suppressed. The present study further investigates this effect by examining the role of individual pragmatic and logical abilities in its generation. We presented 24 participants with Mandarin sentences using one of two quantifiers ("some" or "all") such that the sentences were either correct, pragmatically inconsistent with a context given by a preceding picture ("some" after a picture in which all the characters are doing the same activity), or semantically inconsistent with the context ("all" after picture in which not all the characters are doing the same activity). Participants also provided offline truth-value and naturalness judgments of pragmatically infelicitous "some" sentences, to measure individual differences in participants' abilities to suppress the pragmatic meaning (which is required for truth-value but not naturalness judgments). Repeated measures ANOVAs revealed that pragmatic violations elicited a posterior sustained negativity only for participants who were poor at suppressing the pragmatic meaning, and not for the other participants. These results provide support for a characterization of the sustained negativity as reflecting effortful inhibition of a pragmatically enriched reading in favor of a semantic reading.

B16 A NEURAL SIMILARITY SPACE BASED ON BELIEFS

Anna Leshinskaya[1], Juan Manuel Contreras[1], Alfonso Caramazza[1,2], Jason P. Mitchell[1]; [1]Harvard University, [2]University of Trento

The representation of a stimulus property (such as shape) can be thought of as a space in which the distance between any two objects (e.g., apples and bananas) reflects how these objects differ along the stimulus property. In this view, the nature of what is represented (by a brain region) is recoverable by knowing what stimulus property governs the distances between responses to objects. While this approach has been fruitfully applied to neural representations of visual properties, the aim was to identify representations of more abstract properties: people's beliefs. In a functional magnetic resonance imaging scanner, subjects viewed names of social groups (e.g., Atheists). Belief content was varied continuously

along two independent dimensions: "Spiritualism" (from Economists to Zen Meditators) and "Political Orientation" (from Dictators to Poets). Independent ratings for these stimuli on each dimension were used to create two semantic similarity models. Subjects viewed these stimuli in a one-back similarity judgment task, where they focused on either Spiritualism or Political Orientation. Using a multi-voxel-pattern-analysis searchlight approach, we looked for regions of the brain where the similarity model for the attended dimension fit the neural response. A significant fit was found in portions of posterior cingulate/precuneus and medial prefrontal cortex, which are close to or overlapping with areas activated during mental state reasoning tasks. The present findings suggest that these regions 1) represent semantic content about beliefs; 2) can represent content not based on sensory attributes; and, 3) for these reasons, form important parts of the neural substrate of semantic knowledge.

B17 NEURAL DIFFERENCES FOR HAPPY AND SAD MOODS IN PROCESSING CONSISTENCY IN DISCOURSE COMPREHENSION

Giovanna Egidi[1], Alfonso Caramazza[1,2]; [1]Center for Mind/Brain Sciences (CIMeC) - University of Trento, [2]Cognitive Neuropsychology Laboratory - Harvard University

This research examines the neural bases of integration of consistent information in discourse comprehension when listeners are in a pre-existing happy or sad mood. Behavioral and EEG evidence has shown that consistency processing in discourse comprehension is highly dependent on comprehenders' mood: Whether a sentence is understood as consistent with prior context does not depend solely on the features of the text, but also on the affective state comprehenders bring to linguistic processing. To evaluate how these effects are mediated by the language regions, we conducted an fMRI experiment. Fourteen participants were first induced to experience a happy mood and fourteen a sad mood. They then listened to short narratives that ended with a consistent or an inconsistent ending. A whole brain analysis corrected for family-wise error revealed an interaction in two right hemisphere clusters: the posterior part of MTG, and a cluster including the cerebellar culmen, dentate, and the middle portion of PHG. In both clusters the two moods elicited equal activation for consistent endings. With respect to these endings, happy mood showed stronger activation for inconsistent endings, and sad mood weaker activation. We suggest that this pattern of results reflects different mood-dependent processes. While happy mood promotes a more standard inconsistency detection process, sad mood increases sensitivity to the occurrence of more frequent irregularities and extraordinary contingencies. These results have an important implication for language theory: They show that consistency depends, at least partially, on the mood-dependent process employed during integration.

B18 FEEL BETWEEN THE LINES: IMPLIED EMOTION FROM COMBINATORIAL SEMANTICS

Vicky Tzuyin Lai[1], Roel Willems[2], Peter Hagoort[3]; [1]Max Planck Institute for Psycholinguistics, Nijmegen, [2]Donders Institute for Brain, Cognition and Behaviour, [3]Max Planck Institute for Psycholinguistics, Nijmegen; Donders Institute for Brain, Cognition and Behaviour

How do people understand emotion during reading? In single-word studies, emotion words (weep) showed increased activation in the motor system, emotional network, and language areas [1], suggesting sensorimotor involvement in emotional language comprehension. However, not all emotion is understood through word associations, and some emotion can be inferred/implied. In "The boy fell asleep and never woke up again", no word is negative by association, yet the sentence feels negative. Combinatorial theories of language (e.g., Semantic Unification Theory, [2]) would predict activation of emotional network from combinatorial processes in the left inferior frontal gyrus (LIFG). In contrast, association-based theories would predict activation of motor system. Subjects (N=16) silently read negative and neutral sentences (120, pretested and randomized) that contained no emotional words (neutral: The secretary walked over and picked up the papers), while being scanned. Catch trials of nonsense sentences were inserted (25%). In the analysis, negative> neutral contrast showed activation in amygdala and medial frontal cortex (whole brain, $p<.05$, corrected) and LIFG in particular Inferior Frontal Pars Orbitalis (BA47) (region-of-interest analysis). No activation was observed in the premotor or motor systems. These findings support combinatorial language theories, and not theories assuming the necessity of motor system in understanding emotion. In addition, the activation in the medial frontal cortex suggests a future direction linking (emotional) inference and mentalizing [3]. [1] Moseley, R., Carota, F., Hauk, O., Mohr, B., & Pulvermüller, F. (2011). [2] Hagoort, P. (2005). [3] Frith, C. D., & Frith, U. (2006).

B19 WHAT ARE YOU DOING WHILE I AM SPEAKING TO YOU? THE ALLOCATION OF COGNITIVE RESOURCES DURING IRONY PROCESSING

Nicola Spotorno[1], Anne Cheylus[1], Jean-Baptiste Van Der Henst[1], Ira Noveck[1,2]; [1]Laboratory l2c2, cnrs, Université Lyon 1, France, [2]Centre de Recherche Français à Jérusalem (crfj), Israel

Introduction Understanding verbal irony (e.g. imagine seeing a boring movie before hearing, "That film was really exciting!") requires going beyond the linguistic code and accessing the speaker's intentions through mentalizing processes (ToM). Prior work substantiated a role for ToM with such utterances through fMRI; here, we use ERP and Time Frequency (TF) analyses to investigate the allocation of cognitive resources of ironic sentence-processing. Method Twenty healthy adults read 120 7-sentence-long stories whose sixth line contained our Targets. The Ironic condition's negative context (e.g., a disappointing film)

rendered Target-line ironic while the Literal condition's positive context (e.g., a good film) rendered the Target-line non-ironic. Decoy stories -- whose negative events lead to non-ironic utterances – were designed to avoid associating negative events with irony. Results Using ELAN software, ERP analyses for the Ironic>Literal contrast revealed a P600 effect. Meanwhile, for the same contrast, TF analyses reveal a) a frontal increase of theta-power (4-7Hz) between 200 and 450 msec, b) a right-frontal increase of alpha-power (8-12Hz) between 400-700 msec. , c) a decrease of alpha-power in the left-parietal regions between 570-700 msec and; d) an increase of low-gamma-power (30-35Hz) in the frontal-central-parietal regions between 300-600 msec. Conclusion Increase in theta-power is interpreted as an index of acquiring relevant information and the specular distribution of alpha-power as a reflection of deep processing required of Ironic stimuli which recruit information from linguistic and ToM-related sources. One can speculate that the gamma-power increase mirrors the integration process across a broad range of available information.

Gesture, Prosody, Social and Emotional Processes

B20 SOCIAL COORDINATION LIMITATIONS IMPACT DISCOURSE

Corey McMillan[1], Katya Rascovsky[1], Robin Clark[2], Murray Grossman[1]; [1]University of Pennsylvania, Department of Neurology, [2]University of Pennsylvania, Department of Linguistics

During discourse two speakers must "coordinate" with one another to optimize communicative clarity. Behavioral-variant frontotemporal dementia (bvFTD) is characterized by executive and social limitations with relative sparing of language. This study investigates the neural mechanisms of coordination during discourse in bvFTD. 11 bvFTD patients and 11 healthy seniors (HS) were presented with two-scene stories containing a target animal character that moves from one position to another. We manipulated two factors in a counterbalanced design. In half of the scenes the target animal was embedded in a set of unique animals ("no-competitors") or in a set containing the same animal type differing by a single visual feature ("competitor"). In half of the trials participants described the scene to a "colorblind" partner or a "normal" partner. Participants were instructed to describe the scene with sufficient adjectives ("the pig"; "the large pig") so a partner could understand which animal was moving. Responses were coded for accuracy of adjective production. We observed a Group X Competitors interaction [$F(1,20)=11.73;p<0.005$]: bvFTD patients were less accurate than HS in the competitor condition and a regression analysis related this impairment to grey matter density in dorsal inferior frontal cortex (dIFC). We also observed a Group X Partner interaction [$F(1,20)=6.70;p<0.05$]: bvFTD patients were least accurate when coordinating with a colorblind partner. A regression analysis related this limitation to ventromedial prefrontal cortex (VMPFC) density. These findings suggest that coordinating with a conversational partner may be in part supported an executive mechanism in dIFC and a theory-of-mind mechanism in VMPFC.

B21 THE ROLE OF THE RIGHT DORSAL PATHWAY IN PROSODY AND MELODY PROCESSING

Daniela Sammler[1,2], Katrin Cunitz[1], Sarah M. E. Gierhan[1,3], Alfred Anwander[1], Jens Adermann[4], Jürgen Meixensberger[4], Angela D. Friederici[1,3]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Institute of Neuroscience and Psychology, University of Glasgow, Glasgow, UK, [3]Berlin School of Mind and Brain, Humboldt University, Berlin, Germany, [4]University Hospital Leipzig, Department of Neurosurgery, Leipzig, Germany

A growing number of studies focus on the functional roles of white matter fibre bundles such as the arcuate (AF) and superior longitudinal fascicle (SLF) connecting fronto-temporal "language-areas". While the roles of the left-hemispheric pathways gain increasing clarity, the roles of the homologue right-hemispheric tracts have received less attention, although the right hemisphere is known to substantially contribute to aspects of prosody processing in language. First publications showing a correlation between better pitch discrimination and greater right AF/SLF tract volume suggest that the right AF/SLF might be of greater relevance for the processing of speech and music – particularly pitch-related information – than previously believed. The present case study lends support for this hypothesis, showing that deficits in prosody and melody perception recover after resection and treatment of a tumour and the surrounding oedema that exerted pressure on the right dorsal fibre tracts. One patient with a right parietal meningioma was tested with a battery of language, music and neuropsychological tests 2 weeks before and 4 months after tumour resection. Compared to 10 healthy controls, the patient's performance in detecting prosodic mismatches in sentences and interval manipulations in melodies significantly improved between pre- and post-surgical test sessions. Conversely, performance in syntactic language comprehension and word list discrimination was always unimpaired, underlining the pitch-relatedness of the deficit. These data suggest a functional role of the right AF/SLF in pitch perception in speech and music and open a new avenue of research on intrahemispheric topographical connectivity in the right hemisphere.

B22 IS LANGUAGE IMPORTANT FOR PERCEIVING EMOTIONS? : EMOTIONAL DEFICITS IN SCHIZOPHRENIA

Chun-Wei Hsu[1], Tai-Li Chou[1,2,3]; [1]Department of Psychology, National Taiwan University, Taiwan, [2]Neurobiology and Cognitive Science Center, National Taiwan University, Taiwan, [3]Graduate Institute of Brain and Mind Sciences, National Taiwan University, Taiwan

Language is a common tool that we humans use to perceive and express emotions. Moreover, we use language to connect our internal feelings with emotional

information and a person's emotional experience becomes attached to a word's meaning. However, the underlying mechanism involved in the interaction between emotional experience and semantic processing is not well understood. Functional magnetic resonance imaging (fMRI) was used to investigate the neural mechanism of emotional deficits in 12 healthy controls and 12 patients with schizophrenia in a semantic association task. The patients were diagnosed as emotional deficits using blunted affect, emotional withdrawal, and social withdrawal in the Positive and Negative Syndrome Scale (PANSS). The two groups were matched in age, gender, IQ, and handedness. Participants were asked to judge if two Chinese words were related in meaning. Brain activations for semantically-related pairs between groups were compared. Compared with control group, the patient group showed greater activation in right inferior frontal gyrus (IFG, BA 45). Moreover, there was a positive correlation between right IFG activations and the scores of emotional withdrawal in the PANSS in patients. These results suggest that in order to perform semantic unification to perceive and express emotions, the right IFG activation may be associated with compensating the insufficient process in the left IFG. The patients with emotional deficits may have a weaker ability to unify word meaning. Our findings provide psychopathological evidence of the relationship between emotion and language.

B23 REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION TO RIGHT ANTERIOR TEMPORAL LOBE IMPROVES SEMANTIC PROCESSING

Laura Skipper[1], Lauren Richmond[1], Roy Hamilton[2], Ingrid Olson[1]; [1]Temple University, Philadelphia, PA, USA, [2]University of Pennsylvania, Philadelphia, PA, USA

Recent studies have shown that transcranial magnetic stimulation (TMS) over the anterior temporal lobes (ATLs) slows semantic processing in lexical tasks, and that this effect is more prominent for abstract words than concrete words (Pobric, LambonRalph & Jefferies, 2009). However, neuroimaging studies have repeatedly shown the ATL to be sensitive to social words, regardless of concreteness (Ross & Olson, 2010; Zahn, Moll, Krueger, Huey, Garrido & Grafman, 2007). To further investigate the role of the ATL in processing abstract versus concrete, social vs nonsocial semantic information, participants completed a semantic task that involved choosing a word most closely related to the probe word as quickly and accurately as possible. Word pairs varied on two dimensions: imageability (concrete, abstract) and social content (social, nonsocial). To investigate the extent to which TMS might disrupt processing across one or both of these modalities, 1 Hz repetitive TMS was applied to participants' right and left ATLs (10 mm from the temporal pole) for 20 minutes at 100% of motor threshold before the onset of the task. This was compared to a baseline condition in which no TMS was applied. Participants also completed a nonsemantic number task to control for the possibility that TMS to the ATLs disrupted some non-specific aspect of decision making or motor response. Stimulation of the right ATL led to significant slowing of reaction time only in abstract nonsocial trials. These results suggest that multiple semantic features – including social content and imageability – may be represented in this region.

B24 GESTURE RELATED ACTIVITY PRECEDES THE UTTERANCE OF WORDS IN A COVERT FASHION: ELECTROPHYSIOLOGICAL EVIDENCE FROM THE LATERALIZED READINESS POTENTIAL.

Thomas Gunter[1], J.E. Douglas Weinbrenner[1], Mareen Berndt[1]; [1]Max-Planck Institute for Human Cognitive and Brain Sciences

Gesture and speech form an intertwined communicative system. Gesture production models typically assume that gesture and speech sprout from the same idea unit after which both channels follow parallel processing streams leading to a cross-modal output. The present experiment explores the tightness of this intertwining by looking at effects of abstract pointing. In abstract pointing a physically empty location is assigned a meaning by virtue of being the target of a pointing gesture. For instance, when talking about animals, a speaker could refer to 'cat' using a left pointing gesture and to 'dog' by a right one. Then, by observing a pointing either to a left or right position, all interlocutors may be able to infer which animal is referred to by the speaker. While EEG and EMG were recorded, participants were presented with an interview on 72 dualistic topics. By answering several topic-related questions, the interviewee established abstract space (e.g. left: cats, right: dogs). The gestures were not essential to follow the conversation. At the end of each topic, participants were asked to respond orally to a question ('Which animal does bark?'). Approximately 300 ms preceding the utterance, the ERPs showed a lateralization of the motor cortex associated with the expected abstract pointing of the answer. This lateralized readiness potential (LRP) was present without any detectable EMG activity of either hand or arm. These data suggest a tight intertwining between gesture and speech during language production: abstract pointing is prepared even when behaviorally nothing is visible.

B25 USING RHYTHM IN L2 TO FACILITATE SYNTACTIC AMBIGUITY RESOLUTION: WHEN IS IT TOO LATE TO LEARN IT?

Maria Paula Roncaglia-Denissen[1], Maren Schmidt-Kassow[2], Angela Heine[3], Sonja A. Kotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Goethe University, Frankfurt/Main, Germany, [3]Freie Universität Berlin, Germany

In the present event-related potential (ERP) study we investigated the role of age of acquisition (AoA) in encoding rhythmic properties in the second language (L2). Syntactically ambiguous sentences embedded in rhythmically regular and irregular contexts were auditorily presented to German monolingual controls, Turkish early and late L2 learners of German. Turkish and German

share the syntactic preference for subject-first sentences, whereas their rhythmic properties are rather distinct; i.e. while Turkish is syllable-timed with a metric preference for the iambic foot, German is stress-timed and relies on the trochee. Thus, to use rhythmic regularity as a segmentation cue, Turkish learners of German have to master L2 rhythmic properties that are different from their first language. Higher accuracy rates were found for subject-first sentences in German controls and in Turkish early learners of German. No such difference for argument position was found in Turkish late learners. ERP results reveal a facilitation effect of rhythmic regularity for object-first sentence in German monolingual controls and Turkish early learners of German, as the P600 mean amplitude for rhythmically regular sentences was reduced in comparison to their rhythmically irregular counterparts. No reduction of the P600 mean amplitude was found for object-first sentences in Turkish late learners of German. These results suggest that there may be a sensitive period to acquire and use rhythmic properties in a L2. Broader implication of these findings for learning L2 rhythmic properties and using them as a segmentation cue for speech processing will be discussed.

Language Development, Plasticity, Multilingualism

B26 NATIVE AND NON-NATIVE PHONEMIC DISCRIMINATION CAPACITIES IN YOUNG ADULTS: RELATIONSHIPS TO STATISTICAL LEARNING OF SPEECH

Yu Jin[1], Anna Basora[1], Nuria Sebastian-Galles[1]; [1]Universitat Pompeu Fabra

Previous studies (Tsao et al. 2004; Kuhl et al. 2008) in infants using behavioral and electrophysiological measures showed that sensitivities to speech sound in the infants were correlated with their early language acquisition performance. Kuhl (2010) argued that implicit learning process commits the brain's neural circuitry to the properties of native language speech. Native mismatch negativity (MMNs) should be able to predict future language development. Current research aims to investigate the relationship between phoneme discrimination abilities and language learning ability in young adults. Participants' phonetic discrimination capacities were measured by their native (Spanish) and non-native (Finnish) MMNs, while participants listened to standard and deviant phonemes (oddball paradigm). Participants' language learning abilities were tested while participants learned an artificial language. Following the previous study (De Diego Balaguer et al. 2007), electrophysiological components (N4 and P2) were used to evaluate different language acquisition abilities (word learning and rule extraction). Participants' MMNs in response to native and non-native phonetic contrasts were compared with their corresponding electrophysiological responses (N4 and P2) throughout the learning process. No correlations between native/non-native MMNs and N4/P2 components was found. Contrary to previous results from infants during early language acquisition period, phoneme discrimination capacities to native or non-native phonetic contrast do not predict language learning abilities in young adults. Early language acquisition processes may differ with language learning in adults. Various factors (e.g. cognitive or social factors) may also attribute to such contrary result.

B27 TRACKING NEURAL PROCESSING OF WORD STRESS AND PHONEMES IN THE FIRST YEAR OF LIFE

Angelika Becker[1], Ulrike Schild[1], Claudia K. Friedrich[1]; [1]University of Hamburg

Word prosody helps infants to acquire their maternal language quite after birth. Indeed, perceptual narrowing and language-specific learning for word prosody has been shown in infants younger than six months old. Only later, from six month onwards, infants appear to figure out the typical phonemes of the maternal language. Here we tested whether neural processing of prosody and phonemes undergoes fundamental changes between three and nine months after birth. We presented stressed syllables and unstressed syllables as primes in an auditory word onset priming paradigm. Each prime was followed by an initially stressed disyllabic spoken German word (target). Targets were chosen from an early words screening inventory. Half of the primes shared the initial phonemes with their targets (e.g. pup – Puppe [Engl. doll]). Half of the primes did not share the targets' phonemes (e.g. fe – Puppe). EEG – Data of 30 3-month-olds, 30 6-month-olds and 30 9-month-olds from German speaking environments were analyzed. In the 3-month-olds, ERPs predominantly reflected prosody overlap between prime and target. In the 6-month-olds, ERPs predominantly reflected phoneme overlap between prime and target. In the 9-month-olds, ERPs in early time windows reflected phoneme overlap (100 to 200ms) and prosody overlap (300 to 400ms) as well as a later interaction of both effects (650 to 1000ms). Taken together, language processing in 3-month-olds appears to focus on word prosody, whereas language processing in 6-month-olds appears to focus on phonemes. 9-month-old infants are already able to integrate both types of information.

B28 TITLE: THREE-MONTH OLD INFANTS ALREADY SHOW ADULT-LIKE ACTIVATION

Claudia Teickner[1], Angelika Becker[1], Claudia K. Friedrich[1]; [1]University of Hamburg

Recent electrophysiological studies demonstrated total and partial word-form activation on a neuronal level in adults (Friedrich, Schild & Röder, 2008; Schild, Röder & Friedrich, 2012). Here we investigated word form activation in three-month-old infants. We recorded event-related potentials (ERPs) in unimodal auditory word onset-priming. Infants listened to initial syllables of German words (primes) which were followed by complete German words (targets). Words were chosen from an early words screening inventory (German version of the

McArthur Communicative Development Inventories). In an identity condition, the primes were the onsets of the target words (e.g., Ma – Mama). In a variation condition, the primes differed from the targets only in the initial place of articulation (e.g., Tan – Kanne). In a control condition there was no overlap between prime and target (e.g., Fin – Papa). We tested 21 three-month-old infants (10 female) from German speaking parents. Starting 250 ms after target word onset, ERPs differentiated the identical and the control condition. Starting at 950 ms after target word onset, ERPs also differentiated the variation condition and the control condition. Our results indicate that the activation of early phonological representations in three-month olds is sensitive to variation in a single phonetic feature, namely place of articulation.

B29 NEURAL CORRELATES OF VOWEL ENCODING AND DISCRIMINATION IN MONOLINGUAL AND BILINGUAL CHILDREN

Carol Tessel[1], Nancy Vidal[1], Jennifer Gerometta[1], Yan Yu[2], Valerie Shafer[1]; [1]The Graduate Center - CUNY, [2]William Paterson University

The current study examined the neural correlates of encoding and discrimination of a vowel contrast found in English, but not Spanish in a sample of 35 monolingual English (ML) and 29 bilingual Spanish/English (BL) children between four and seven years of age. A study of younger children (6 months to three years of age) using the same vowels revealed that BL-exposed children showed a different trajectory of vowel discrimination development. Event-related potential (ERP) were recorded from 65 electrode sites to [E] (standard) vs. [I] (deviant) in an oddball paradigm. In general, obligatory components (P1, Na, Ta) shifted earlier in latency with increasing age for both language groups. However, Na latency was later and more negative for BL children compared to monolingual controls. The emergence of the subsequent Ta positive peak in the monolingual children may account for the latency and amplitude changes in the Na. The mismatch negativity (MMN) shifted earlier in latency with increasing age in both groups of children. However, BL-exposed children showed later MMN than age-match groups until 7 years of age. These results suggest that less experience with English leads to less robust encoding and discrimination of the acoustic-phonetic patterns necessary to processing English vowels. However, by 7 years of age, children with bilingual exposure have had sufficient English language experience, possibly as a result of two-to-three years of experience in schools where English is the language of instruction.

B30 AGE OF SECOND LANGUAGE ACQUISITION AFFECTS CORTICAL THICKNESS IN THE LEFT DORSOLATERAL PREFRONTAL CORTEX

Jonathan Berken[1,2], Kelvin Mok[1], Jen-Kai Chen[1], Vincent L. Gracco[2], Shari Baum[2], Denise Klein[1,2]; [1]Cognitive Neuroscience Unit, Montréal Neurological Institute, McGill University, [2]Centre for Research on Brain, Language, and Music, McGill University

The age of second language acquisition has long been thought to influence the organization of linguistic networks in the brain. Previous literature demonstrates a correlation between age of second language acquisition and patterns of gray matter density using voxel-based morphometry methods. Here, we take advantage of the bilingual environment of Québec to address the effects of age of acquisition on brain structure in right-handed simultaneous and sequential bilinguals matched for age, intelligence, and proficiency in their two languages. We used a cortical thickness measure, a high-resolution application of anatomical magnetic resonance imaging, and observed a negative correlation between thickness of the left dorsolateral prefrontal cortex (LDLPFC) and age of acquisition; that is, earlier learning of the second language resulted in a thicker LDLPFC. These results, generated by group contrast and regression analyses, support data obtained through functional neuroimaging and lesion studies that implicate the dorsolateral prefrontal cortex as an important locus of cognitive control and language switching and suggests that early bilingualism may play a specialized role in the development of this brain region.

B31 NEURAL CHANGES IN READING INDUCED BY TRAINING EXECUTIVE FUNCTIONS

Pedro M. Paz-Alonso[1], Maria R. Rueda[2], Sonia Guerra[2], Myriam Oliver[1], Manuel Carreiras[1]; [1]BCBL, Basque Center on Cognition, Brain and Language, [2]Department of Experimental Psychology, University of Granda

Cognitive psychologists have begun to devise effective methods for training cognitive abilities. Recent evidence suggests that some of the core ingredients of cognition are susceptible to substantial practice-related improvements. Nevertheless, little is yet known about the neural changes supporting these improvements and to what extent the strengthening of executive functions transfers to other domains, such as reading. The present fMRI study was aimed at investigating the neural changes in cognitive control and reading abilities induced by training executive functions. A total of 56 participants aged 8-9 years took part in the study. Before undergoing training, participants' higher cognitive functions and reading abilities were assessed behaviorally and with functional MRI. Then, participants either received 8 sessions of computer-based games of increasing difficulty intended to train attention and executive control abilities (Experimental Group) or received an equally long control intervention playing the lower levels of difficulty of the same games (Control Group). After training, participants' cognitive functions

were again assessed behaviorally and in the scanner. Similar to prior evidence, our results revealed that the experimental intervention improved participants' fluid reasoning and working memory, but it did not influence participants' crystallized intelligence. Training modulated the involvement of fronto-parietal networks in cognitive control, as well as critical regions within the reading network including the left inferior frontal gyrus and the ventral occipitotemporal cortex. Interventions intended to train executive functions might not only produce benefits in the specific functions being trained, but also yield transfer effects in untrained functions, such as fluid reasoning and reading.

B32 A COMPREHENSIVE NEUROANATOMICAL META-ANALYSIS OF SECOND LANGUAGE FUNCTIONAL IMAGING STUDIES

Kaitlyn M. Tagarelli[1], Sarah Grey[1], Michael T. Ullman[1], Peter E. Turkeltaub[1]; [1]Georgetown University

Numerous functional neuroimaging studies have examined the neuroanatomical bases of second language (L2) learning and processing, and how these compare with first language (L1). However, inferring clear patterns from these studies has proven difficult. Although a number of qualitative reviews have been published, the lack of quantitative statistics in such reviews precludes reliable determination of the true patterns of neural activity, limiting confidence in their conclusions. Moreover, such reviews cannot easily address important study features that can substantially affect outcomes, such as sample size, sensitivity/specificity, and focus on specific brain structures. These limitations can also make finer dissection of the data difficult, such as the effect of factors like age of acquisition, proficiency, and language domain (e.g., lexical vs. grammatical). Here we attempt to address these limitations with a comprehensive neuroanatomical meta-analysis of L2 functional neuroimaging studies. Analyses were performed with Activation Likelihood Estimation (ALE), a probabilistic method for quantifying spatial reproducibility in neuroimaging studies. Eighty-one fMRI and PET studies of L2 were identified, 33 of which focused on lexical or grammatical processing and qualified for ALE analysis (e.g., examined the whole brain and reported stereotactic coordinates). Preliminary analyses revealed differential activation patterns for L2 and L1, both for lexical and grammatical processing, in structures including the anterior insula, inferior frontal cortex, and caudate nucleus. Implications of the results will be discussed as they pertain to our understanding of the similarities and differences between L1 and L2 neurocognition, the factors that influence these patterns, and theories that may explain them.

B33 THE IDLE BRAIN PREDICTS LEARNING: THE CASE OF PHONETIC TRAINING

Ana Sanjuán[1,3], Noelia Ventura-Campos[1], Julio González[1], Mª Ángeles Palomar-García[1], Aina Rodríguez-Pujadas[1], Núria Sebastián-Gallés[2], Gustavo Deco[2], César Ávila[1]; [1]Universitat Jaume I,Castellon,Spain, [2]Universitat Pompeu Fabra,Barcelona,Spain, [3]Wellcome Trust Centre for Neuroimaging,London,UK

Introduction We combined task-related fMRI and resting-state fMRI (rs-fMRI) before and after training with a Hindi non-native contrast. We hypothesized that this training session would result in changes in functional connectivity (FC) during rs-fMRI. Methods Nineteen (Experiment A) and twenty-eight (Experiment B) right-handed participants completed fMRI session before and after A) 2-week training and B) single day of training respectively. Brain activation changes obtained from the comparison of fMRI task on Experiment A were used as ROIs for rs-fMRI. We used REST toolkit to calculate FC obtaining the z-values for each subject. Furthermore, we performed ICA to obtain the FC networks. A paired t-test was computed to evaluate changes in FC. We also performed correlation analysis between the z-values and the values of the identification test. Results We replicated previous results showing that learning recruited, between others, the left insula-frontal operculum (LFO/aI) and the left superior parietal lobe. Crucially, resting-state FC between these areas at pre-training predicted learning outcomes after distributed and intensive training. Furthermore, this FC was reduced at post-training, and this change could also account for learning. ICA showed that the mechanism underlying this reduction of FC was mainly a change in the activity of the LFO/aI to the salience network. Conclusion Rs-FC may contribute to predict learning capacities of the brain, and to understand how learning modify the brain functioning. The discovery of this correspondence between initial rs-FC in task-related areas and learning post-training opens new avenues for finding predictors of learning capacities in the brain.

B34 LEARNING TO READ IRREGULAR WORDS DOES NOT DEPEND ON DISTINCT NEURAL SYSTEMS FROM LEARNING TO READ REGULAR WORDS

Jo S H Taylor[1,2], Kathleen Rastle[3], Matthew H Davis[1]; [1]MRC Cognition and Brain Sciences, Cambridge, [2]Newnham College, University of Cambridge, [3]Royal Holloway, University of London

Cognitive models of reading contain separable mechanisms representing spelling-sound rules, necessary for pseudoword reading (TEW, YANG), and item-specific knowledge, necessary for irregular word reading (SEW, YACHT). However, whereas item-specific knowledge is lexical (whole-word forms) in the Dual Route Cascaded model (Coltheart et al., 2001), it is semantic in the triangle model (Plaut et al., 1996). Neuroimaging contrasts are often confounded by difficulty, familiarity, and word meaning and, as such, have not discriminated between these possibilities. This fMRI experiment used an artificial

language to avoid these confounds and delineate the neural systems supporting irregular and regular word learning. Twenty-two adults learned to read 24 new words written in novel symbols, whilst in an MRI scanner. Some words were regular - all symbols had one pronunciation, some words were irregular - vowel symbols were pronounced differently in different words. Regular symbols occurred in 8 (high frequency) or 4 items (low frequency). Learning involved interleaved training (see word-hear pronunciation) and testing (read words aloud) phases, and was followed by generalization to untrained words. Participants learned the trained words (regular high/low frequency-83%, irregular-73% correct) and generalized their knowledge to untrained words (70% correct). Activity in left occipitotemporal (visual-form processing) and parietal (spelling-sound processing) cortices was greater during irregular than regular word learning. However, this was also true for regular words containing low relative to high frequency symbols. Learning to read irregular words does not depend on distinct neural mechanisms from learning to read regular words when confounds of difficulty, familiarity, and meaning are removed.

B35 NEURAL ACTIVATION TO A LOST FIRST LANGUAGE: INTERNATIONALLY ADOPTED CHILDREN FROM CHINA

Lara Pierce[1], Denise Klein[2], Jen-Kai Chen[2], Fred Genesee[1]; [1]McGill University, [2]Montreal Neurological Institute

Internationally-adopted (IA) children rapidly lose their birth language post-adoption when their adopted family's language differs (Nicoladis & Grabois, 2002). At this point neural traces may be lost (Pallier et al., 2003); or may persist, influencing L2-acquisition (Hyltenstam et al., 2009). To investigate this, 3 groups of 10-16-year-olds were scanned using BOLD fMRI: (1) Monolingual French-speaking IA children from China, adopted by age two (n = 6); 2) L1-Chinese Bilinguals who began learning French by age two (n = 6) and; 3) monolingual French-speaking children (n = 8). Participants responded same/different to 3-syllable Chinese pseudo-sentences that were identical or differed with respect to tone. Because tonal information is phonemic in Chinese but not French, activation similar to Bilinguals would indicate residual L1-traces, while activation similar to Monolinguals would indicate that no L1-traces remain. As expected (Klein et al., 2001), Bilinguals showed predominantly left hemisphere activation to tonal contrasts, particularly in left-temporal auditory regions, and the left-inferior frontal area. In contrast, Monolinguals showed bilateral temporal lobe activation that was stronger in the right, with no left-frontal activity. Like Monolinguals, IA children showed bilateral temporal activation; however, like Bilinguals, activation was stronger in the left. Also like Bilinguals, IA children showed left-frontal activation, although more weakly. Finally, both IA and Bilingual children, but not Monolinguals, showed basal ganglia activation (implicated in phonological processing; Tettamanti et al., 2005). These findings suggest that traces of IA children's L1, acquired early in life, may persist to some degree despite complete termination of exposure to that language.

Language Disorders

B37 BLURRING OF LEXICAL MAPPING DUE TO ANTERIOR TEMPORAL ATROPHY

Robert Hurley[1], Ken Paller[1], Emily Rogalski[1], Marsel Mesulam[1]; [1]Northwestern University

Primary progressive aphasia is a neurodegenerative syndrome that causes a gradual atrophy of the left hemisphere language network, leading to impairments of object naming (anomia) and word comprehension. In 33 human subjects with PPA, object naming and word comprehension were explored with N400 event-related potentials elicited by picture-word or picture-picture matching tasks. In patients who were unable to either verbalize or recognize the names of objects, nouns of the same category (but not those of other object categories) could not be identified as mismatches. This blurring of intra- but not inter-category differentiation of word meaning was correlated with anterior temporal atrophy, predominantly in the left hemisphere, especially along the superior temporal gyrus. Although not part of the classic language network, this area appears critical for proceeding from generic to specific levels of word comprehension and object naming. N400 abnormalities emerged for lexical (picture-word) but not non-verbal (picture-picture) associations, supporting a dual-route rather than amodal organization of object concepts.

B38 WHITE MATTER DISRUPTION AND LANGUAGE PROCESSING IN FLUENT AND NONFLUENT VARIANTS OF PRIMARY PROGRESSIVE APHASIA

Karine Marcotte[1], Naida Graham[1], Sandra E. Black[1,2,3,4], David F. Tang-Wai[3,5], Tiffany W. Chow[4], Morris Freedman[3,4], Jed A. Meltzer[3,4], Carol Leonard[6], Rochon Elizabeth[1,3]; [1]Toronto Rehabilitation Institute, Toronto, Canada, [2]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada, [3]University of Toronto, Toronto, Ontario, Canada, [4]Rotman Research Institute - Baycrest Centre, Toronto, Ontario, Canada, [5]University Health Network Memory Clinic, Toronto, Ontario, Canada, [6]University of Ottawa, Ottawa, Ontario, Canada

The literature suggests that white matter (WM) changes may distinguish the different variants of primary progressive aphasia (PPA), given that WM is also part of the language network. To date, little is known about WM disruption and how this relates to language abilities. We undertook a structural MRI study to investigate this relationship. We used diffusion tensor imaging in 42 individuals: 12 non-fluent PPA (nfPPA), 12 fluent PPA (fPPA) and 18 age-matched controls. Probabilistic tractography (FSL) was used to identify the ILF, SLF and uncinate bilaterally. We compared the tracts' mean fractional anisotropy (FA) as well as mean, axial and radial diffusivities with a univariate ANCOVA, using sex, age and intracranial volume (ICV) as covariates. For both

groups of patients, partial correlations were performed using ICV as covariate. NfPPA patients showed diffusivity abnormalities specifically in the left SLF whereas no changes were found in FA. Conversely, fPPA patients showed widespread abnormalities; mean, axial and radial diffusivities were significantly greater in all tracts as compared to controls whereas FA changes were observed in the ILF bilaterally and the right uncinate. Bilateral diffusivity damage in the ILF and uncinate predicted naming deficits after ICV was taken into account, whereas FA abnormalities predicted naming only in the right ILF and uncinate. These findings suggest that both FA and diffusivity are important to reflect differences in the white matter pathology in nfPPA and fPPA. Furthermore, probabilistic tractography provides evidence that structural compromise to multiple tracts is associated with naming impairments in patients with PPA.

B39 CONTEXTUAL PREDICTION IN SCHIZOPHRENIA: MULTIMODAL IMAGING EVIDENCE FROM A SEMANTIC PRIMING PARADIGM

Ellen Lau[1,2,3], Kirsten Weber[1,2], Nate Delaney-Busch[1,2], Candida Ustine[1,2], Kristina Fanucci[1,2], Matti Hamalainen[1], Gina Kuperberg[1,2]; [1]Martinos Center, Massachusetts General Hospital, [2]Tufts University, [3]University of Maryland

Language processing deficits in schizophrenia are often related to a generalized deficit in the use of relevant contextual information to process incoming input, perhaps due to abnormalities in prefrontal function (Barch & Ceaser 2012, Boudewyn et al. 2012; Kuperberg 2010). One mechanism through which context can be used to facilitate language comprehension is by generating predictions about upcoming input (Federmeier, 2007). In the current study, we examine contextual prediction in patients with schizophrenia and demographically-matched controls using a relatedness proportion semantic priming paradigm, and a multimodal neuroimaging approach (within-subjects MEG-EEG and fMRI). Previous work has demonstrated that increasing the proportion of related pairs results in increased use of the prime to predict the target (Neely, 1991), leading to a reduced N400 (Lau, Holcomb & Kuperberg, 2011). Here, the overall proportion of related pairs was varied across two different blocks (10% vs. 50%), using visual presentation with a long SOA (600ms). In contrast to previous studies (Condray et al. 1999; 2003), we used a semantic category probe task to encourage semantic processing. Initial ERP results (12 patients, 17 controls) show a significant N400 priming effect in controls in the high but not the low proportion condition, consistent with increased contextual prediction. Patients demonstrated a similar qualitative pattern, suggesting that they were able to use predictive strategies to some degree. Subsequent analyses of fMRI and MEG data will determine whether the same regions drive these effects in both populations, as well as similarities or differences captured by electrophysiological vs. hemodynamic measures.

B40 PREDICTIONS FROM THE IMPLICIT PROCEDURAL DEFICIT IMPAIRMENTS IN SLI: A CASE STUDY OF NEUROANATOMICAL CORRELATES OF IMPLICIT LEARNING DEFICITS IN A CHILD WITH SLI AND TWO BIOLOGICAL SIBLINGS.

Yoonho Chung[1], Timothy T Brown[1], Matthew Erhart[1], Anders M Dale[1], Terry L Jernigan[1], Julia L Evans[1,2]; [1]University of California, San Diego, [2]University of Texas, Dallas

Children with SLI appear to have domain general implicit learning deficits (Tomblin et al., 2005; Evans et al., 2009) and differences as compared to controls in the basal ganglia and frontal regions proposed to support implicit learning (Jernigan et al., 1991, Badcock et al., 2012). One of the weaknesses of group comparison studies is that information about individual differences is lost by averaging data for the clinical population, which may mask relevant heterogeneity. In order to characterize individual differences in the neural correlates of SLI, we obtained volumetric MRI and diffusion weighted imaging data on one subject with SLI and his two unaffected siblings and compared these individuals with distributions for typically developing subjects obtained from the Pediatric Imaging, Neurocognition, and Genetics (PING) study (http://ping.chd.ucsd.edu). For statistical analysis, we descriptively characterized the brain morphometry of our subjects of interest relative to the distribution and developmental trajectory of 948 subjects across a broad age range. Studentized residuals and Z scores were computed for each hypothesized region of interest (ROI) after controlling for age, gender, and head size. Consistent with our predictions, unlike the siblings, we observed hippocampal volume within normal limits, but relatively smaller caudate with rightward caudate asymmetry ($t = 2.07$) and low FA in corticostriatal white matter tracts ($t = -2.87$) for the child with SLI as compared to the normative database. This unique approach allows for detailed analysis of individual differences in brain morphometry in children with SLI, providing valuable insights into possible neural heterogeneity of SLI.

B41 INVESTIGATION OF REAL-TIME LEXICAL SEMANTIC PROCESSING IN A CHILD WITH SPECIFIC LANGUAGE IMPAIRMENTS USING ANATOMICALLY CONSTRAINED MAGNETO-ENCEPHALOGRAPHY (AMEG)

Julia L. Evans[1,2], Timothy T. Brown[2], Matthew Erhart[2], Yoonho Chung[2], Eric Halgren[2]; [1]University of Texas Dallas, [2]UCSD

This project examines N400m activity in a single child with Specific Language Impairment (SLI) with documented procedural learning deficits, compared to his biological siblings and adult normative data using aMEG. Indirect evidence suggests that procedural learning deficits impact lexical semantic acquisition and use in children with SLI (Evans et al., 2011; 2012; Mainela Arnold & Evans, 2012) yet little is known about the direct impact of these deficits on real-time lexical processing in SLI. Magneto-

and electro- encephalography (M/EEG) studies show qualitative differences in N400-like event-related activity in SLI as compared to normal groups; but group research designs do not facilitate investigation of individual differences – possibility the key to developing effective interventions. Further, EEG signals cannot be precisely localized to their cerebral sources because of inherent biophysical limitations; electric potentials are smeared, distorted, and deflected as they pass through different tissue types; and while MEG allows good localization precision, it depends on assumptions made about the complexity of the source(s). Anatomically constrained magneto-encephalography (aMEG) is a novel tool that integrates millisecond-wise neurophysiological data with individual cortical surface anatomy, providing noise-normalized, dynamic statistical parametric maps (dSPMs) of brain activity. Using a new technique to compare brain-wide single subject data to reference distributions of normal brain activity for the same paradigm, we observed similar behavior performance but qualitatively different lexico-semantic networks for the child with SLI. (Research supported by: NIDCD R01DC00068 (PI, Evans); Kavli Institute for Brain and Mind Innovative Research Award (Brown, Halgren) NINDS R01 NS018741-23A1 (Halgren))

B42 LANGUAGE DETERIORATION IN BILINGUAL SPEAKERS WITH ALZHEIMER'S DISEASE: A FOLLOW-UP STUDY

Marco Calabria[1], Paula Marne[1], Mireia Hernández[1,2], Montserrat Juncadella[3], Jordi Gascón-Bayarri[3], Isabel Sala[4], Albert Lleó[4], Jordi Ortiz-Gil[5], Lidia Ugas[5], Rafael Blesa[4], Ramon Reñé[3], Albert Costa[1,6]; [1]Departament de Tecnologies de la Informació i les Comunicacions, Universitat Pompeu Fabra, Barcelona, Spain., [2]Cognitive Neuropsychology Laboratory, Department of Psychology, Harvard University, Cambridge, MA, USA, [3]Hospital Universitari de Bellvitge, L'Hospitalet de Llobregat, Barcelona, Spain, [4]Hospital de la Santa Creu i Sant Pau, Barcelona, Spain, [5]Hospital General de Granollers, Barcelona, Spain, [6]Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain

In the context of bilingual research little is known about the effects of neurodegenerative disorders on the processing of the two languages of a bilingual. Recently, in a cross-sectional study, we have shown that in early and high-proficient bilinguals with Mild Cognitive impairment (MCI) and Alzheimer's disease (AD) the lexico-semantic processes are similarly affected by cognitive decline in the two languages (Costa et al., Neuropsychologia, 2012, 50 (5), 740-53). In the present longitudinal study, we want to extent this finding by looking at the pattern of language deterioration over time of the same population of Catalan-Spanish bilingual patients. The initial population of 73 patients (MCI n=24, Mild AD n=23, Moderate AD, n=24) was followed up at six and twelve months. All participants were tested in three tasks of language processing, such as picture naming, word translation and word comprehension, both in first (L1) and second (L2) language. The final group at one year was made up of 44 patients: 13 MCI, 16 Mild AD and 15 Moderate AD. The two AD groups performed significantly worse when compared with MCI patients one year later, especially for those items supposed to be more demanding to retrieve, such as low frequency words and no-cognates. However, the language deterioration over time was parallel for both languages, as previously reported in the cross-sectional study. These results are consistent with the hypothesis that the two languages of high-proficient bilinguals are represented by a common neural substrate and they share lexico-semantic processing.

B43 INSIGHTS INTO ACUTE APHASIA AND RECOVERY FROM DIASCHISIS THROUGH QUANTIFICATION OF WHITE MATTER TRACT DAMAGE

Argye Hillis[1], Muwei Li[1], Samson Jarso[1], Andreia Faria[1]; [1]Johns Hopkins University School of Medicine

Introduction: We hypothesized that, in acute stroke, percent damage to specific white matter tracts (quantified with tractography) would predict: (1) performance on particular language tasks and (2) activation of cortical regions during language tasks. For example, damage to tract connecting left thalamus to precentral gyrus (PrCG) would have a high correlation with error rate in speech production tasks (eg, naming) and predict absence of normal activation of left PrCG in fMRI tasks of naming. Methods. Eight patients had language testing and Trail Making Test and MRI with DTI and fMRI of naming within 4 days of stroke and at 2-6 months. We calculated Pearson correlations between percent damage to each affected white matter tract and naming and repetition errors, number of seconds on Trail Making Part B. We examined fMRI scans for activation ($p<.05$, corrected) in ROIs activated in controls in naming. Results. Percent damage to any given white matter tract was not correlated with error rate in naming or repetition, but percent damage to combined white matter tracts was strongly correlated ($r2=0.96$; $p=.009$) with performance on Trail Making. Damage to specific tracts predicted absence of activation in corresponding cortical ROIs. For example, >50% damage to left thalamus-PrCG tract was associated with absence of activation in left PrCG but increased activation in right PrCG at Day 3 post-stroke; with return of normal activation in left PrCG at month 2. Conclusion: Quantified white matter tract damage predicting reduced activation in cortical ROIs acutely but not subacutely may explain recovery from diaschisis.

B44 DELAYED LEXICAL ACCESS IN BROCA'S APHASIA

Jungwon Choy[1]; [1]University of Kansas

This study tested lexical access during comprehension in Broca's aphasia using eye tracking to examine whether lexical access is delayed in Broca's aphasia. Additionally, factors such as word frequency, phonological neighborhood density and word context were manipulated to examine their effect on aphasic lexical access. Methods Eight individuals with Broca's aphasia (ages: 37-74; WAB

AQs: 56.4-86.2), and nine unimpaired age-matched control participants (ages: 35-75) were tested. All participants were native speakers of English, and demonstrated good visual and hearing acuity. There was no reported history of neurological or psychological disorders. Eye movements were recorded while participants looked at a computer screen with four objects. Latency of eye movements to target items was analyzed for three conditions, a) non-linguistic (i.e., pure eye movement), b) words in isolation, c) words within sentence context. The target items were a) words with high and low frequency, b) words with high and low phonological neighborhood density. Results Pure eye movement latencies were similar for both groups. In comparison, aphasic latencies were longer than controls for words, both in isolation (Z= 2.676, p =.007) and in sentence context (Z= 3.477, p= .001). The delay in latency for was numerically larger for words in isolation compared to words in sentence context but the context effect was not statistically significant. There was a significant difference in latency between high and low phonological neighborhood frequency (Z = 2.054, p = .04) but not between high and low word frequency.

B45 DYSLEXIA, GENDER AND HEREDITY

Turid Helland[1]; [1]University of Bergen

It has for long been accepted that the gender ratio of dyslexia is about three to four boys to one girl, and that dyslexia runs in families. However, most dyslexia studies are on clinically referred groups, and more boys than girls tend to be referred to clinical assessment. In population based studies the gender ration seems to be more equally distributed. The present study addressed both gender and heredity distribution in dyslexia. Parents of a population based group of 105 preschool children (52 boys and 53 girls) from a diversity of randomly selected places in Norway answered a questionnaire on language problems and/or dyslexia in close biological family. 13 of the children (5 boys, 8 girls) were identified as dyslexic when they were eleven years old. There was no statistical difference between the genders as to literacy scores (non-word decoding, real word decoding, single word spelling, text reading and comprehension) or IQ-scores. For all boys (100%) language related problems and/or dyslexia in close biological family were reported, while this was the case for only three (37.5%) of the girls. For comparison, language related problems and/or dyslexia in close biological family was reported in 20 (43%) of the boys and 14 (31%) of the girls who did not develop dyslexia. These results point to that 1) an equal number of girls and boys develop dyslexia; 2) heredity may play a larger role in boys than in girls. Despite small numbers, the results point to the need for more research.

Lexical Semantics

B46 MULTIPLE ROUTES FOR COMPOUND WORD PROCESSING IN THE BRAIN: ERP EVIDENCE

Lucy J MacGregor[1], Yury Shtyrov[1]; [1]MRC Cognition and Brain Sciences Unit

Are compound words (e.g., homework) represented as unitary lexical units, or as individual constituents that are processed via a combinatorial mechanism (home+work)? Two factors that may influence representation and processing are lexical frequency and transparency of meaning. We investigated the neurocognitive processing of compounds using high density EEG and a passive-listening mismatch negativity (MMN) design. We drew upon an established dissociation of MMN activation patterns: 1) a larger MMN for meaningful words relative to meaningless pseudowords and for higher compared to lower frequency words, reflecting stronger memory representations (lexical MMN), 2) a smaller MMN for congruous relative to incongruous word combinations reflecting priming (syntactic MMN). We presented participants with spoken compound words (e.g., homework) as infrequent 'deviant' stimuli in the context of monomorphemic 'standard' stimuli (e.g., home). Compounds were either transparent (e.g., homework) or opaque (e.g., framework), or meaningless pseudo-compounds (e.g., houndwork). Whole-form compound frequency was systematically varied. To rule out acoustic confounds and possible effects of constituent frequency, the second constituent (work) was identical across all stimuli, whilst acoustic and psycholinguistic features of the first constituents were tightly controlled. MMN (~150ms) amplitude varied with compound frequency and meaning, supporting an account in which compound processing can take different routes. We argue that transparent compounds are processed via a dual-route mechanism invoking combinatorial processing in addition to whole-form lexical access. By contrast, opaque compounds are more likely to be processed as a whole form rather than syntactically parsed and this is particularly the case for high frequency opaque compounds.

B47 TMS TO PARS TRIANGULARIS AFFECTS THE SEMANTIC PROCESSING OF SENTENCES

Sylvia Vitello[1], Joseph T. Devlin[1], Jennifer M. Rodd[1]; [1]UCL

Although widely associated with speech production and syntax, recent decades increasingly highlight the importance of Broca's area for comprehension and semantic processing. We used transcranial magnetic stimulation (TMS) to examine the role of pars triangularis in sentence comprehension, specifically focusing on the resolution of semantic ambiguities. An initial fMRI experiment confirmed increased ambiguity-related activation in this region. In the TMS study, participants listened to sentences and decided whether a subsequent visual probe word was related in meaning. Ambiguous sentences, which contained a word with multiple meanings (e.g., 'jam')

that was disambiguated by the sentence-final word (e.g., 'the man said that the jam was on the other motorway'), were compared to well-matched unambiguous sentences. Probes were related or unrelated to each sentence type, and, for ambiguous sentences, half the unrelated probes corresponded to the contextually-inappropriate meaning of the ambiguous word. Four TMS pulses were delivered at sentence offset, prior to the probe, to ensure that TMS specifically targeted disambiguation processes evoked by the sentence-final word (and not the relatedness probe decision). Participants received TMS to pars triangularis and vertex (control) in separate blocks. Results showed that TMS to pars triangularis significantly slowed-down responses to two probe types: those related to ambiguous sentences and those unrelated to unambiguous sentences. Probes related to unambiguous sentences showed a similar trend. These results suggest that disrupting pars triangularis impairs semantic processing of sentences, rendering them more ambiguous. Understanding which processes are disrupted and why all probe conditions were not affected by TMS requires further investigation.

B48 DOPAMINERGIC MODULATION OF SENTENCE BASED AMBIGUITY PROCESSING

David Copland[1], Katie McMahon[1], Greig de Zubicaray[1]; [1]The University of Queensland

The influence of dopamine on the language processing and its neural mechanisms is not clear but may relate in part to broader proposals regarding the role of dopamine in cognitive control and context processing. The present study employed a double blind placebo controlled crossover design with healthy individuals ingesting levodopa 45 minutes prior to an event-related fMRI study investigating the potential influence of levodopa on context integration and meaning suppression, and hypothesised that context based meaning suppression would be more efficient on Levodopa compared to placebo through modulation of fronto-striatal circuitry. Critical trials involved presentation of a sentence containing a lexical ambiguity (e.g. spade in "he dug with the spade"), after which subjects were asked to verify whether a probe word (an unrelated word or a word related to the alternative meaning of the ambiguity such as ACE) was related to the overall meaning of the sentence. As hypothesised, there was a significant drug by condition interaction for behavioural RTs, with a significant interference effect on placebo which was not observed on Levodopa suggesting increased efficiency in suppressing representations based on integrated contextual information. Imaging analysis conducted in SPM5 indicated a significant drug by condition interaction involving modulated activity in the inferior temporal lobe and the striatum for interference versus unrelated conditions on levodopa versus placebo. These findings support the view that dopamine enhances meaning selection and suppression based on contextual integration through subcortical and temporal mechanisms.

B49 EFFECTS OF SEMANTIC CATEGORY ON TEMPORAL AND SPATIAL DYNAMICS OF BRAIN ACTIVATION DURING INTERNALLY GUIDED WORD GENERATION

Irina Simanova[1,2], Marcel van Gereven[2], Robert Oostenveld[2], Peter Hagoort[1,2]; [1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, Nijmegen, The Netherlands, [2]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands

A large number of neuroimaging studies have reported distinct brain activations for different categories of objects, when object names or pictures are presented to participants. Only few fMRI studies have investigated semantic effects during internally guided word generation. In this study we set out to explore such effects with MEG, taking an advantage of both spatial and temporal resolution of this method. Participants (N = 12) were asked to produce single words of different semantic categories (animals, everyday objects, countries). Participants were presented with the semantic category cue and the initial letter cue. They were asked to report with a button-press if they had generated a word that fulfills the requirements indicated by the cues. They produced the word overtly after a short maintenance period. Time-frequency MEG analysis revealed effects of the word generation task in theta (4-8 Hz) and gamma (65-75 Hz) bands. The power of gamma activity increased over left temporal channels at 1500 – 1100 and 300 ms prior to the button press. Robust increase of theta power was found over anterior temporal channels starting at 1700 ms prior to the button press. Topography of theta was modulated by the semantic category. The results agree with previous studies, suggesting that gamma possibly reflects aspects of lexical access related to timing and control (Meeuwissen et al, 2011), whereas theta plays a functional role in semantic retrieval (Bastiaansen et al., 2008). We are planning to extend these results by investigating the effects of semantic category at the source level.

B50 SUSTAINED MEANING ACTIVATION FOR POLYSEMOUS BUT NOT HOMONYMOUS WORDS: EVIDENCE FROM EEG

Ekaterini Klepousniotou[1], Lucy J MacGregor[2], Jenny Lines[3]; [1]University of Leeds, [2]MRC Cognition and Brain Sciences Unit, Cambridge, [3]University of Stirling

The present study explored the theoretical assumption that lexical ambiguity is not a homogeneous phenomenon, but is divided into homonymy, where words that share a lexical form have unrelated meanings, and polysemy, where the meanings are related. Are homonyms and polysemes represented and processed differently in the brain? We investigated the time-course of meaning activation of different types of ambiguous words using a 64-channel EEG system. Homonyms and polysemes were each further subdivided into two: balanced homonyms (e.g., "panel") and unbalanced homonyms (e.g., "pen"); metaphorical polysemes (e.g., "lip") and metonymic polysemes (e.g., "rabbit"). These four types of ambiguous words were presented as primes in a visual single-

word priming delayed lexical decision task employing a long ISI (750 ms). Targets were related to dominant or subordinate meanings of the primes, or were unrelated. Additional ambiguous primes and pseudoword targets were included as foils. ERPs formed relative to the target onset indicated that the theoretical distinction between homonymy and polysemy was reflected in the N400. For homonyms (both balanced and unbalanced), no effects survived at this long ISI indicating that both meanings had already decayed. On the other hand, for polysemes (both metaphorical and metonymic), activation was observed for both dominant and subordinate senses. The observed processing differences between homonymy and polysemy point toward differential mental representations for the two types of ambiguity. We argue that the polysemous senses act collaboratively to strengthen the representation, facilitating maintenance even at very long ISIs, while the competitive nature of homonymous meanings leads to decay.

B51 DISSECTING THE SEMANTIC NETWORK: FMRI EVIDENCE FOR OPPOSING CONTEXT EFFECTS IN REGIONS INVOLVED IN REPRESENTATION VS. CONTROL

Paul Hoffman[1], Richard J. Binney[1,2], Matthew A. Lambon Ralph[1]; [1]University of Manchester, [2]UCSF Memory & Aging Center

Effective verbal comprehension requires representations of word meanings and executive processes that regulate access to this knowledge in a context-appropriate manner. Neuropsychological studies indicate that these two elements depend on different brain regions and can be impaired independently. We investigated the neural basis of these functions using distortion-corrected fMRI. 19 healthy subjects were scanned while completing a synonym-judgement comprehension task with concrete and abstract words. Each judgement was preceded by a sentence cue that manipulated the executive control demands of the semantic judgement. On some trials, the cue was irrelevant to the judgement, placing maximum demands on executive control processes. On others, the cue placed the target word in a specific linguistic context, reducing the executive demands of selecting the context-appropriate meaning. A network of regions were involved in the task, including inferior frontal gyrus, inferior parietal cortex, posterior temporal regions and superior and ventral areas within the anterior temporal lobe. Further analysis revealed a triple dissociation within this semantic network. (1) inferior prefrontal cortex was most active when irrelevant cues were provided, indicating involvement in executive regulation of meaning and suppression of irrelevant information, (2) superior anterior temporal lobe was most active when cues were contextually relevant, suggesting a role in integrating word meaning with preceding context, (3) ventral anterior temporal lobe was strongly active for both types of cue, consistent with its role in context-invariant representations of meaning. These differing responses to contextual constraints align with neuropsychological and TMS data and indicate functional specialisation within the semantic network.

B52 CHARTING THE EFFECTS OF TMS WITH FMRI: CHANGES IN CORTICAL RECRUITMENT AND EFFECTIVE CONNECTIVITY WITHIN THE SEMANTIC CONTROL NETWORK

Beth Jefferies[1], Carin Whitney[1], Mark Hymers[1], Andre Gouws[1]; [1]University of York, UK

Semantic memory comprises everything we know about words and objects. In any given task or context, not every aspect of our knowledge is retrieved: relevant features are selected, while others are inhibited. Control processes are therefore vital for successful semantic cognition, yet their neural basis is not well-understood. Research has focused almost exclusively on the contribution of left inferior frontal gyrus (LIFG) and has not explored interactions between widely distributed brain regions. In this study, we temporarily disrupted processing within LIFG via repetitive brain stimulation (TMS) and used fMRI to explore compensatory changes within the semantic network. An increased response was seen in a second component of the network, left posterior middle temporal gyrus (pMTG) following LIFG stimulation. No such increase was observed following (i) stimulation of a control site (occipital pole) and (ii) in a baseline scan performed in the absence of TMS. These changes were restricted to situations where the demands on the semantic control network were high. Our results reveal that LIFG and pMTG both contribute to semantic control via a flexible, distributed cortical network and demonstrate the power of studies that combine TMS and fMRI to investigate effective connectivity within large-scale distributed functional systems.

B53 FROM LEXICAL ACCESS TO ARTICULATION: DIFFERENCES BETWEEN NOUNS AND VERBS

Christopher Conner[1], Gang Chen[2], Thomas Pieters[1], Nitin Tandon[1]; [1]Vivian Smith Dept Neurosurgery, UT Houston, [2]Scientific and Statistical Computing Core, National Institute of Mental Health, NIH/HHS

Storage of semantic information across grammatical classes has been an area of intense interest. Prior work using lesion studies and neuroimaging has yielded conflicting results regarding differences between nouns and verbs. Dissociations between these distinct classes requires high spatial and temporal precision in a larger group of subjects. We studied 19 patients scheduled for left hemispheric subdural electrode implants. Patients performed three language tasks – naming visual stimuli of nouns and verbs, and identifying scrambled images. Electro□corticography (ECoG) was collected during the tasks, filtered from 60-120Hz (gamma band) and normalized relative to baseline. In all three conditions, early (100-200ms) gamma activation was prominent over V1-4, while late processing (>700ms) was noted in M1 mouth and primary auditory cortices. During lexical access (150-350ms), differences

between noun and verb generation were primarily noted over ventral occipito-temporal cortex (nouns) and lateral parieto-occipital cortex (verbs). A scrambled naming specific response during this interval was also present over dorso-lateral prefrontal cortex (DLPFC). Activity over anterior Broca's area was greatest during verb naming and least for scrambled images, however, there was no difference over posterior Broca's area. While vastly similar, there were distinct differences between noun and verb activation along the dorsal and ventral visual processing streams. This suggests semantic knowledge for each grammatical category is stored separately, and that cognitive control regions (DLPFC) can supersede lexical access during task performance. Importantly, after diverging from 150-350ms, each task equally activated pars opercularis and M1 mouth, suggesting that these regions represent the final common pathway for articulation.

B54 BEHAVIORAL PRIMING BUT NO N400 IN A CATEGORICAL LIST CONTEXT

Joseph Dien[1], Linzi Gibson[2], Patrick O'Connor[3], James H. Neely[3]; [1]University of Maryland, College Park, [2]Washburn University, [3]State University of New York, Albany

The N400 has been a widely studied measure of semantic processing for over thirty years (Kutas and Hillyard, 1980) and yet there remains disagreement about the nature of the process it reflects. The dominant view is that it reflects semantic access (Federmeier & Laszlo, 2009; Lau, Phillips, & Poeppel, 2008). Some of the chief evidence is that it seems to be influenced by the same manipulations that produce behavioral semantic priming effects, both automatic and controlled. There is evidence that there are differend kinds of semantic priming that in turn reflect different aspects of the semantic network, especially a distinction between associative relations and semantic feature relations including categorical (Hutchison, 2003; Lucas, 2000). The claim that the N400 reflects semantic access broadly defined would require that it respond to priming of both types of relations. In a high-density 128-channel ERP replication and extension of the Becker (1980) behavioral study, 59 participants participated in a lexical decision experiment where a critical set of both associative (LAUGH-cry) and categorical (FABRIC-silk) priming pairs were embedded in either associative dominant lists or category dominant lists to manipulate expectancy sets. While both lists produced behavioral priming in both types of critical stimulus pairs, only the associative dominant list produced N400 effects. We therefore suggest that the N400 reflects not semantic access but rather reflects a post-semantic process of semantic updating (Franklin, Dien, Neely, Huber, & Waterson, 2007), much as the P300 reflects a post-decisional process of context updating (Donchin & Coles, 1988).

B55 PLACE AND FACE NAMING DISSOCIATION MEASURED WITH ELECTROCORTICOGRAPHY

Cihan Kadipasaoglu[1], Christopher Conner[1], Thomas Pieters[1], Nitin Tandon[1]; [1]Vivian Smith Dept Neurosurgery, UT Houston

The ventral and lateral occipito-temporal cortex, known as the 'ventral stream', activates in a category specific manner during visual object recognition. Studies of the ventral stream have focused predominantly on the specificity of neural responses to three major categories: faces, places, and common objects. The regional selectivity for each of these categories has been studied using fMRI, but data from electrophysiology is sparse due to the location. Thirteen patients diagnosed with temporal lobe epilepsy were scheduled for implantation of subdural electrodes and pre-operative fMRI. Subjects were presented images of faces and places during fMRI and electro-corticography (ECoG) data collection. ECoG data were filtered between 60-120Hz and normalized relative to pre-stimulus baseline, while fMRI were compared to scrambled image recognition. After primary visual processing (>100ms), right hemisphere electrodes showed greater gamma power during face naming relative to places, while left hemisphere SDEs had the opposite response. Further, left hemisphere SDEs over parahippocampal place area (PPA) and fusiform face area (FFA) were strongly activated for places and faces, respectively. Anterior inferior temporal cortex was not significantly activated for either task. The population level results of ECoG data were consistent with fMRI data, suggesting that prior findings using neuroimaging reflect these categorical differences. The temporal resolution and signal-to-noise ratio afforded by SDEs is greater than that of neuroimaging, however, the results of both studies were largely similar. Our results demonstrate that different cortical networks process faces and places in similar time window prior to speech planning and articulation.

Motor Control, Speech Production, Sensorimotor Integration

B56 AN ARTIFICIAL NEURAL NETWORK (ANN) MODEL OF SENSORIMOTOR DEVELOPMENT FOR SPEECH

Grant Walker[1], Feng Rong[1], Gregory Hickok[1]; [1]University of California, Irvine

We instantiated some key assumptions of the hierarchical state feedback control theory of speech (Hickok, 2012) in an ANN learning model. Two such assumptions are: i) overt (slightly delayed) feedback is used to train an internal model, and ii) forward predicted consequences of motor commands are represented in auditory cortex as an inhibition of the anticipated signal. We tested whether our ANN could develop anticipatory inhibition in simulations of spontaneous production and coordinated repetition of syllables. The network has three layers (15 units each): motor, auditory, and sensorimotor translation. Simultaneous activation of 3 units within motor or

auditory layers represented a CVC syllable. Training used supervised learning with weight updates after each example. Examples had 2 phases: motor planning and auditory analysis. For spontaneous production, a random motor syllable was activated, then overt feedback activated the corresponding auditory syllable. For repetition, a random auditory syllable received input that spread to the corresponding motor targets, then auditory units received a copy of motor activations. In both paradigms, baseline targets (0.15) were applied to motor and auditory layers in phase 2. Both training types converged on solutions. By minimizing deviations from baseline in the analysis phase, the models learned to predict the incoming stimulus and inhibit responses. Regardless of the training paradigm, testing spontaneous production generated an inhibitory response in auditory units during motor planning and an excitatory "echo" in motor units during auditory analysis. The model supports the developmental viability of the proposed mechanisms, encouraging further investigation.

B57 ARE YOU A TALENTED MIMIC? A NEURO-ACOUSTIC STUDY OF SPEECH SOUND IMITATION ABILITY

Susanne Reiterer[1,2], Xiaochen Hu[2,3,4], Sumathi T.A.[5], Nandini C Singh[5]; [1]University of Vienna, Centre for Language Learning and Teaching Research (FDZ), Vienna, Austria, [2]University Clinic Tübingen, Germany, [3]University of Tübingen, Hertie Institute for Clinical Brain Research, Tübingen, Germany, [4]University of Bonn, Clinic for Psychiatry and Psychotherapy (KBFZ), Bonn, Germany, [5]National Brain Research Centre (NBRC), Manesar, India

There has been an increasing interest in individual differences in language skill acquisition particularly in the second language. We investigated individual differences in speech imitation ability in late bilinguals using a neuro-acoustic approach. 138 German-English late bilinguals matched on various behavioral measures were tested for "speech imitation ability" in a foreign and unknown language, Hindi, and were rated for imitation ability, using an internet rating database of native Hindi speakers into "talent" and "non-talent" groups. Cortical activations and speech recordings were then obtained from nine participants from each group as they spoke sentences in three conditions: (A) German, (B) English and (C) German with fake English accent. Acoustic features of the two groups were studied by comparing the articulation space across the two groups. Articulation space was constructed of probability distributions of various spectro-temporal amplitude modulations of the speech envelope which encode information about different articulatory features. When compared to the "talent" group, the non-talent group displayed cortical activations that were significantly higher and more widespread (corrected at $p<0.05$). BOLD analysis showed peak activation differences in the left supramarginal gyrus and postcentral areas. On the other hand, the talent group showed significantly larger articulation space in all three conditions. The articulation space correlated positively with imitation ability ($r=0.7$, $p<0.01$) behaviorally and within the left supramarginal gyrus in terms of BOLD. We suggest that an expanded articulation space for high ability individuals allows access to a larger repertoire of sounds, thereby providing skilled imitators greater flexibility in pronunciation and language learning.

B58 LATERALITY EFFECTS OF NEUROSTIMULATION UPON NEW LANGUAGE LEARNING

Anna Woollams[1], Emma Wells[1], Isobel McMillan[1]; [1]Neuroscience and Aphasia Research Unit, School of Psychological Sciences, University of Manchester

Current neuroanatomical models of speech processing propose that while comprehension relies on bilateral temporal regions, production is lateralised to left frontal regions, consistent with the speech production difficulties seen in Broca's aphasia. Such patients show a phonological anomia, and face the challenge of relearning the labels of familiar objects. Transcranial Direct Current Stimulation (tDCS) has recently been used improve performance in patients with language deficits due to frontal lesions. It should therefore be possible to facilitate/inhibit the acquisition of new labels for familiar objects amongst normal healthy adults by applying anodal/cathodal tDCS to Broca's area, but stimulation of its right homologue should not significantly influence performance. We tested twelve participants on a novel label learning task, with stimulation order (anodal, cathodal, sham) counterbalanced across sessions, and performance assessed immediately and after one week. Participants receiving stimulation of Broca's area showed an immediate benefit from anodal stimulation and a cost for cathodal stimulation ($ts(6)>1.74$, $ps<.07$, one-tailed). Interestingly, the anodal benefit was stronger a week later, and the cathodal cost had reversed to deliver a benefit comparable to that seen for anodal stimulation ($ts(6)>2.11$, $ps<.045$), with generalisation to different views of objects in both cases ($ts(6)>2.20$, $ps<.040$). In contrast, for participants who received stimulation of the right homologue area, no effects were reliable either immediately or after a week ($ts(6)>1.11$, $ps>.318$). These results demonstrate strong lateralisation of speech production for newly acquired labels in healthy adults, as predicted by neuroanatomical models of speech processing.

B59 THE FUNCTIONAL NEUROANATOMY OF LEARNING TO ARTICULATE NON-NATIVE WORDS

Anna J Simmonds[1], Robert Leech[1], Paul Iverson[2], Richard J S Wise[1]; [1]Imperial College London, UK, [2]University College London, UK

The motor-sensory control of speech involves posterior frontal and temporo-parietal cortices. These generate and integrate signal associated with the intended motor speech goal and the one achieved. Previous work has shown that both anterior and posterior regions are more active during non-native, relative to native, speech production, even in proficient bilinguals. In this prospective training study, using fMRI, we explored changes in local activity and functional connectivity as monolingual subjects underwent

a brief period of training in the production of non-native words. The emphasis was on correct articulation, with no training on word meaning. Online speech production was recorded and subsequently rated by native speakers. Non-native, relative to native, repetition resulted in increased activity in widespread bilateral cortical and subcortical regions. The interaction between language (native and non-native) and session (pre- and post-training) was observed mostly in motor cortex and in bilateral anterior basal ganglia. Before training, during anticipatory listening there was greater temporal-parietal-frontal activity for native than non-native words, a difference that reversed after training. An independent component analysis of the fMRI data was then performed. Assessing the whole-brain connectivity of a temporo-parietal component that was centered on the planum temporale, connectivity changed from a distribution along the lengths of both superior temporal gyri (STG) to one between bilateral posterior STG and bilateral inferior frontal gyri. Improvement scores correlated with the BOLD signal difference in the basal ganglia, auditory and somatosensory cortices. This is the first demonstration of the role of anterior striatum in learning novel articulatory gestures.

B60 GABAERGIC NEUROTRANSMISSION DURING SPEECH PRODUCTION

Kristina Simonyan[1], Arash Fazl[1], Peter Herscovitch[2]; [1]Mount Sinai School of Medicine, [2]Clinical Center, National Institutes of Health

The role of gamma-aminobutyric acid (GABA) in regulation of neuronal excitability during a wide range of behaviors is well recognized. However, GABAergic influences on central speech control are poorly understood. We investigated the GABAergic function associated with speech production by mapping the correlations between central GABA-A receptors and functional brain activity. Twenty healthy volunteers (mean 53.2 years, 12F/8M) underwent PET with the radioligand [11C]flumazenil (FMZ) and fMRI during sentence production and resting state using standard acquisition protocols. Data were analyzed according to standard procedures followed by computation of whole-brain voxelwise Spearman correlation coefficients between speech-induced BOLD signal, resting-state low frequency fluctuations and FMZ binding ($p < 0.025$). Significant positive relationships between BOLD signal (both speech-related and resting-state) and FMZ binding were found in the parietal operculum, supplementary motor area, precuneus, and superior temporal gyrus. Negative correlations were observed in the inferior frontal gyrus, posterior cingulate cortex and cerebellum. In addition, significant positive relationships between speech-induced BOLD signal change and FMZ binding were observed in the laryngeal/orofacial sensorimotor cortex, supramarginal and angular gyri, inferior parietal lobule, basal ganglia and cerebellum. Negative correlations were found in the superior parietal lobule, middle temporal gyrus and anterior cingulate cortex. Our data provide the first direct evidence of the interactions between the GABAergic transmission and neural activity controlling speech production in healthy humans. Our results suggest that, within the speech system, GABAergic modulation of brain activity may be exerted at the different stages of speech and language control, from auditory perception to motor production.

Orthographic Processing, Writing, Spelling

B61 PHYSIOLOGY OF EARLY VISUAL PROCESSING IN READING

John Hogan[1], Adrian Toll[1], Joseph T. Devlin[1]; [1]Cognitive, Perceptual & Brain Science, UCL

Reading involves successfully recognizing complex visual patterns (i.e. written words) and linking them with their corresponding sound and meaning. It may be surprising, then, that the contributions of the early visual fields to reading have received relatively little attention. We combined fMRI with retinotopic and eccentricity mapping to functionally identify early visual fields in a set of volunteers who subsequently each performed an additional five hours of reading experiments in the scanner. By varying the type of stimuli (high frequency words, low frequency words, pseudowords, and consonant strings) while carefully matching their low-level physical and orthographic properties, we systematically investigated top-down influences of visual familiarity on visual fields. In addition, these factors were fully crossed with task (covert reading, lexical decision, semantic decision, phonological decision, and one-back). Across both task and stimulus type, reading consistently produced activation in foveal areas of V1 and V2, region V4v and a region of occipito-temporal sulcus (OTS) anterior and lateral to area V4v. Familiarity and task effects were seen in V4v and OTS regions but not in earlier visual areas. Familiarity produced an inverted U-shaped activation curve across most tasks, although a notably different pattern was observed in the one-back task. The results highlight the influence of non-visual factors that shape activation in visual fields during reading, suggesting that the receptive fields of neurons in mid-level visual areas such as V4v and OTS are not stimulus-bound but instead respond based on the specific processing demands of task at hand.

B62 ORTHOGRAPHIC TRANSPARENCY SHAPES PRE-ORTHOGRAPHIC VISUAL PROCESSING: EVIDENCE FROM BILINGUALISM

Marie Lallier[1], Manuel Carreiras[1,2], Marie-Josèphe Tainturier[3,4], Guillaume Thierry[3,4]; [1]Basque Center on Cognition, Brain and Language, [2]Ikerbasque, Basque Foundation for Science, [3]School of Psychology, Bangor University, [4]ESRC Centre for Bilingualism Research

Grapheme-to-phoneme mapping regularity is thought to determine the grain size of orthographic information extracted whilst reading. Here we tested whether learning to read in two languages differing in their orthographic transparency yields different grain size / visual attention strategies as compared to monolingual reading. Sixteen

English monolingual and 16 early simultaneous Welsh-English bilingual participants undergoing event-related brain potentials (ERP) recordings were asked to report whether or not a target letter displayed at fixation was present in either a nonword or an English word presented immediately before. In word prime trials, behavioural performance and ERPs were overall unaffected by target letter position in the prime, suggesting similarly efficient reading in the two participant groups. By contrast, in the case of nonword primes, behavioural performance worsened and ERP amplitudes decreased with the position of the target letter in the prime, and significantly more so in bilinguals than monolinguals. This shows that bilinguals who learnt to read simultaneously in an opaque and a transparent orthography struggle to encode nonword information presented to the right of fixation to a greater extent than monolinguals and resort to a smaller decoding grain size. Overall, the present study suggests that grain size and visual attention strategies underlying letter-string encoding are constrained by orthographic transparency.

B63 LEARNING NEW WRITTEN WORDS: EVIDENCE FROM MASKED FORM PRIMING *Samantha McCormick[1], Kathy Rastle[1]; [1]Royal Holloway University of London*

People acquire most of their vocabulary during childhood, but continue to learn new words throughout their lives. Our studies examined the acquisition of orthographic representations in laboratory conditions. Participants learned novel words that were orthographic neighbours of existing words (beshop, a neighbour of BISHOP) in a two-hour training session. During training participants were exposed to pairings of novel pictures with spoken and written novel words. The words were trained to a pre-set criterion. These recently acquired words were then used as related primes in a masked priming study (e.g., beshop-BISHOP) conducted immediately after training or following a one week interval. Results showed that trained words inhibited recognition of their base words, but only when testing was conducted one week after training, showing competitive effects between existing representations and the newly-learned words. By contrast, immediately after training, trained words facilitated recognition of their base words. The results support the notion that words acquired in adulthood can become integrated with existing lexical entries but that this requires offline memory consolidation as suggested by complementary learning systems accounts of memory (e.g. McClelland, McNaughton, & O'Reilly, 1995).

B64 NEURAL CORRELATES OF READING EXPERTISE IN EARLY AND INTERMEDIATE VISUAL CORTEX: A CROSS-CULTURAL FMRI STUDY WITH FRENCH AND CHINESE READERS. *Marcin Szwed[1,2], Emilie Qiao[3], Antoinette Jobert[2], Stanislas Dehaene[2], Laurent Cohen[3]; [1]Jagiellonian University, Krakow, Poland, [2]INSERM-CEA Cognitive Neuroimaging Unit, Gif sur Yvette, France, [3]CR-ICM Research Center, and Salpétrière Hospital, Paris, France*

Introduction: Which levels of the visual system are modified through acquisition of literacy? The visual system is hierarchical: simple feature analysis is done in early areas which then converge on high-level areas responding to complex stimuli e.g. faces. Several studies have shown that reading skills are linked to changes in high-level visual system (Visual Word Form Area). Here we investigated whether reading also relies on perceptual learning within earlier visual areas (perceptual learning is a form of implicit learning that involves improvement in sensory discrimination by repeated exposure to stimuli). Methods: in an fMRI study with French and Chinese adults, we matched French and Chinese written words and line-drawings of objects for their low-level visual features, and designed control images by scrambling procedures that keep local features intact. Results: Greater responses to words relative to controls, but not to objects relative to controls were found not only in high level visual areas, but also in early and intermediate visual areas V1-V8. Moreover, these responses to words were found only in French reading French (peak in areas V1/V2), and Chinese reading Chinese (peak in areas V4/V8). No enhanced V1-V8 responses were found for Chinese stimuli in French subjects or for French stimuli in Chinese subjects, even though Chinese subjects could partially recognize French words (67% accuracy). Conclusion: Early and intermediate visual activations reflect fast and parallel detection of character shapes, the hallmark of mature, expert reading. The impact of literacy on the brain is thus more widespread than previously thought.

B65 WHY IS IT HARD TO READ ARABIC? *Zohar Eviatar[1]; [1]University of Haifa*

Previous research has shown that reading in Arabic is slower than reading in other languages, even among skilled native Arabic speakers. In addition, the process of reading acquisition by beginning readers is slower than in other languages. We present three possible sources of these phenomena from both a psycholinguistic and a neuropsychological perspective. We examine the effects of diglossia (the fact that children learn to read a language in which they are not fluent), and the visual characteristics of Arabic orthography on reading acquisition, and suggest that the particular combination of grapheme-phoneme relations and visual characteristics of Arabic orthography result in a specific reading strategy among skilled readers that involves the cerebral hemispheres differently in Arabic than in Hebrew or English.

B66 DEVELOPING AN ALPHASYLLABARY WRITING SYSTEM FOR ENGLISH: IMPLICATIONS FOR DECODING AND THE VWFA

Elizabeth Hirshorn[1,2,3], Alaina Wrencher[1], John Cordier[1], Michelle Moore[4], Julie Fiez[1,3,4,5]; [1]University of Pittsburgh, Learning Research and Development Center, [2]Pittsburgh Science of Learning Center, [3]Center for the Neural Basis of Cognition, [4]Communication Sciences & Disorders Department, [5]Psychology Department

In previous research, we found that a patient with acquired alexia was significantly better at learning a reduced orthography in which 15 faces were paired with syllables, compared to one involving face-phoneme pairs. This suggests that reliance upon the VWFA might be reduced through the use of syllabic mappings between orthography and phonology. The current study reports the development of a complete alphasyllabary for English. The 'face' graphs represent CV or VC syllables, with consistent information in the face identity and expression. Over 2 weeks, participants were taught the visual/sound mappings of 382 graphs, with accuracy exceeding 90%. Each day they were trained on decoding words using previously learned syllables, using a small set of rules for how to manipulate the sounds to reach the real English word (e.g., fih-shuh= fish). Decoding accuracy consistently exceeded 85% correct. Participants then read stories using the alphasyllabary. Results showed comparable fluency in the alphasyllabary compared to a phoneme-based system that used 35 graphs. With more than 10 times the graphs to learn and retrieve, this suggests that increased memory demands associated with the alphasyllabary may be offset by decreased demands on phonological decoding. These results serve as proof of concept that 1) we can represent all of English using fewer than 400 syllable-based graphs and few decoding rules, 2) the resulting alphasyllabary can be learned and used to read text. Future work will investigate whether syllabic mappings between orthography and phonology are of value for individuals with decoding difficulty or compromised VWFA functionality.

B67 NEURAL SUBSTRATES OF CONSISTENCY AND FAMILIARITY EFFECTS ON JAPANESE KANJI WORDS READING: AN FMRI STUDY.

Ayumi Seki[1], Daisuke Tanaka[1], Hitoshi Uchiyama[2]; [1]Tottori University, [2]International University of Health and Welfare

The left middle frontal gyrus has been reported as the neural substrate for phonological processing of the logographic characters. A recent study reported the contiguous regions are relevant for phonological selection for Japanese logograms, kanji. However, it is not clear that these regions are specifically relevant to the phonological processing. Using the same set of two-character kanji-words, which controlled for familiarity and consistency, we conducted the phonological judgment task and the semantic judgment task. Twenty-two native Japanese college students (10 male and 12 female) participated in the study. The response time showed that familiarity and consistency effects and the familiarity-by-consistency interaction in the phonological task, and the familiarity effect in the semantic task. During the phonological task, the left middle and inferior frontal gyri (IFG/MFG), the left superior parietal lobule (SPL), and the left inferior temporal gyrus (ITG) showed greater activation for unfamiliar than familiar words. The left IFG/MFG and the left inferior parietal lobule (IPL) were activated more strongly for inconsistent than consistent words. During the semantic task, the extensive areas in the IFG/MFG (greater in the left) and the left SPL showed the familiarity effect. These regions mostly overlapped with the regions that showed the consistency effect at the low-familiarity words. The results suggest that the left dominant IFG/MFG and the left SPL are related to the non-specific task demand, such as selecting from multiple representations. The left IPL is specifically relevant to the phonological processing and the left ITG is to the semantic retrieval.

B68 MORPHOLOGICAL SEGMENTATION AND ORTHOGRAPHIC TRANSPARENCY IN TYPICAL AND DYSLEXIC HEBREW READERS

Tali Bitan[1], Yael Weiss[2], Tami Katzir[2]; [1]Dept. of Communication Sciences and disorders, University of Haifa, [2]Dept. of Learning Disabilities, The E.J. Safra Brain Research center for Learning Disabilities, University of Haifa

The plasticity of the nervous system implies that neuronal pathways involved in reading processes of skilled and unskilled readers could depend on unique characteristics of the given language and its orthography. We asked whether reliance on morphological parsing during reading may compensate for missing phonological information in Hebrew readers. The Hebrew script has two levels of orthographic transparency (pointed/unpointed), and a rich Semitic morphology, thus providing a unique opportunity to examine this interaction in a within language design. Three groups of typical Hebrew readers (21 adults, 42 2nd graders and 48 5th graders) and one group of (20) adult poor readers participated in the behavioral study. 18 typical adult readers participated in the fMRI study. Participants read aloud 248 frequent Hebrew nouns manipulating the following variables: morphological complexity (mono-morphemic vs. bi-morphemic (root+ pattern) nouns); phonological transparency (pointed vs. unpointed; with vs. without a vowel letter); and word length (3 vs. 4 consonants). Behavioral results show greater reliance on morphological decomposition in unskilled compared to skilled readers. However, skilled readers showed enhanced activation for pointed words in right fusiform gyrus (less-familiar orthography), and in left pars-opercularis and inferior parietal lobule, indicating enhanced orthography-to-phonology mapping and phonological segmentation. For pointed words greater activation was found in bi-morphemic compared to mono-morphemic words in left middle & superior temporal gyri indicating enhanced semantic and phonological processing. Altogether our results suggest that all readers rely (to

different degrees) on morphological decomposition when it is available, but not necessarily to compensate for missing phonological information.

B69 WORD RECOGNITION DURING PARAFOVEAL PREPROCESSING INVOLVES SERIAL LEFT-TO-RIGHT PROCESSING. EVIDENCE FROM AN INFORMATION LOCATION MANIPULATION IN A BOUNDARY PARADIGM WITH PARTIAL DEGRADATION OF WORDS.

Benjamin Gagl[1], Stefan Hawelka[1], Fabio Richlan[1], Mario Braun[1], Florian Hutzler[1]; [1]University of Salzburg

Early orthographic processing of adults is typically described as either fast serial letter-by-letter processing or whole word processing. In natural reading, orthographic processing of the upcoming word already starts in parafoveal vision. The present study investigates the nature of orthographic processing during parafoveal preprocessing. We presented in sentences embedded five letter target words that differed in the location of critical word information (unique trigram at the word beginning and frequent trigram at word end or vice versa). Additionally, parafoveal visibility was manipulated in an invisible boundary paradigm (full, no or partial degradation). The sentence stimuli were presented on a high refresh-rate CRT screen (200 Hz) and eye movements were recorded by Eye-link CL eye-tracker (2000 Hz). Eye movement results showed an effect of information location, which is indicative for serial processing, when the preview of the whole word was limited. Furthermore, when only the critical letters of a word were parafovealy presented, only unique beginnings were accompanied by a preprocessing benefit. In contrast, critical word ends showed no preprocessing benefit in comparison to the rather uninformative beginning letters of the same words. This pattern of results indicates a serial letter-by-letter process during parafoveal preprocessing.

Poster Session C

Saturday, October 27, 9:30 am – 11:30 am, Ground Floor Foyer and 1st Floor

Auditory Perception, Speech Perception, Audiovisual Integration

C1 ONLINE AND OFFLINE EFFECTS OF GRADIENT PROSODIC BOUNDARY SIZES ON AMBIGUOUS SENTENCE PROCESSING: AN ERP STUDY.

Efrat Pauker[1,2], Karsten Steinhauer[1,2]; [1]McGill University, [2]CRBLM

Recent theories have been debating about the influence multiple boundaries have on ambiguous sentence processing; the most influential of which assume that prosody-syntax mapping is driven by either (a) the global pattern and relative size between boundaries [1,3,5], or (b) by local, strong boundaries only [8,9]. While making strong claims, these theories lack conclusive evidence [4,6] as they were tested mostly behaviorally and were based on syntactic structures in which boundary placement was optional, and therefore could only modulate, but not drive, parsing decisions. Methodologically, these theories also assume purely categorical boundary sizes [2], while more recent studies suggest gradient quantitative boundary sizes may be sufficient to explain parsing decisions [7]. In this study, we employed an innovative paradigm to contrast the predictions of the opposing theoretical accounts, both electrophysiologically and behaviorally, and test whether boundaries can yield a gradient effect. In two behavioral and one ERP experiments, participants listened to highly controlled digitally-manipulated sentences that differed only in terms of their prosodic boundary sizes and made acceptability judgments on a 7-point-scale. We found (a) a gradient pattern of acceptability and EEG components that closely mirrored the parametric manipulation of the boundaries; (b) even small boundaries affected parsing decisions, and were difficult to override with later, stronger boundaries; (c) lastly, we found discrepancy between online and offline performance, revealing prosody has an immediate influence of processing difficulty, while offline, all syntactic elements are combined to understand the sentences. Data support gradient boundary processing within a global context.

C2 DOES SEMANTIC CONTEXT FACILITATE PERCEPTUAL CLARITY?

Carine Signoret[1], Ingrid Johnsrude[1,2], Elisabeth Classon[1], Mary Rudner[1]; [1]Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University, Sweden, [2]Department of Psychology, Queen's University, Canada

Giving people an opportunity to hear an unintelligible noise-vocoded (NV) sentence after they know its identity produces pop-out, a clearer percept of the NV sentence (Davis, Johnsrude, Hervais-Adelman, Taylor, & McGettigan, 2005), which can be measured using a magnitude-estimation procedure (Wild, Davis, & Johnsrude, 2012). Pop-out appears to occur when the auditory system is able to match input with top-down predictions that can be used to perceptually organize/'explain' that input. Semantically coherent sentences (e.g. "his new clothes were from France") are more predictable than matched anomalous sentences (e.g. "his great streets were from Smith"), raising the possibility that semantic information may also give rise to popout. In the present study we investigated how the magnitude of the pop-out effect produced by prior knowledge in the form of identical text cues (100% predictable) compared to that produced by semantic coherence. Twenty normal-hearing native Swedish-speaking participants listened to Swedish NV (1, 3, 6 and 12 bands) and clear sentences, and rated the clarity on a 7-point Likert scale. The sentences were semantically coherent or anomalous. Each spoken word was preceded (200 ms) by either its text equivalent or a consonant string of matched length. We observed the expected main effects of speech quality and text cues on

clarity ratings (Wild et al., 2012). Semantically coherent sentences were rated as clearer than anomalous sentences, even when both types of sentences were preceded by identical text cues, suggesting that the effect of semantic context on perceptual clarity is not entirely due to greater predictability.

C3 MODALITY-SPECIFICITY IS EVIDENT IN THE MICRO-ORGANIZATION OF "AMODAL" CONCEPTUAL-ACCESS AREAS

Feng Rong[1], Jiang Xu[2], Karen Emmorey[3], Allen Braun[2], Gregory Hickok[1]; [1]Center for Language Science, UC Irvine, [2]Language Section, NIDCD, NIH, [3]Speech, Language & Hearing Sciences, SDSU

It has been argued that accessing meaning from symbols, including speech and non-linguistic gestures, relies on an amodal network including a left posterior temporal region. Specifically, a recent fMRI study (Xu, et al. 2009) found that the same left posterior temporal lobe region activated during the processing of meaningful symbolic hand gestures and spoken glosses of those same gestures, relative to their respective controls. However, standard univariate analyses of fMRI activation patterns, as was used in the previous study, may not be sensitive to the micro-organization of a region. In this study we reanalyzed the same dataset using an ROI-based multivariate pattern classification method to assess the modality sensitivity in the posterior temporal lobe ROI. If this region is truly amodal, the pattern classifier should not be able to distinguish the gesture from the speech conditions within the pattern of activation in the ROI. We found instead that this ROI significantly classified the meaningful speech versus the gesture conditions (accuracy = 0.83, d'=3.25, $p < 0.001$), as well as the meaningless speech vs. gesture control conditions (accuracy = 0.76, d'=3.04, $p < 0.005$), suggesting relatively low-level sensitivity to modality-specific information. Moreover, mapping of the prediction weights onto the voxels within the ROI demonstrated a gradient of preference among modalities, where the gesture preferring voxels were distributed more medial and posterior, and the speech preferring voxels were distributed more lateral and anterior. This region is not modality independent, at least broadly, but contains sub-regions that are sensitive to each individual modality.

C4 PREDICTIONS IN SPEECH COMPREHENSION: FMRI EVIDENCE ON THE METER-SEMANTIC INTERFACE

Kathrin Rothermich[1], Sonja Kotz[2]; [1]1International Laboratory for Brain, Music and Sound Research (BRAMS), Université de Montréal, Canada, [2]Research Group "Subcortical Contributions to Comprehension", Department of Neuropsychology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

When listening to speech we not only form predictions about what is coming next, but also when something is coming. For example, metric stress may be utilized to predict the next salient speech event (i.e. the next stressed syllable) and in turn facilitate speech comprehension. However, speech comprehension can also be facilitated by the semantic context, that is, which content word is likely to appear next. In the current fMRI experiment we investigated (1) the brain networks that underlie metric and semantic predictions, (2) how semantic processing is influenced by a metrically regular or irregular sentence context and (3) if task demands influence both processes. The results are three-fold: First, different brain networks respond to metric and semantic prediction errors, with metrically unfulfilled predictions yielding activation in a bilateral fronto-striatal network, whereas semantically unfulfilled predictions lead to activation in fronto-temporal areas. Second, metrically regular context facilitates speech comprehension in this left-fronto-temporal language network. Third, attention directed to metric or semantic predictions in speech activate different parts of the left inferior frontal gyrus (IFG). The current results strongly suggest that speech comprehension relies on different forms of prediction, and extend known speech comprehension networks by revealing the importance of sensorimotor areas.

C5 VISUAL INFORMATION AND TALKER FAMILIARITY IN SPEECH PROCESSING

MICHAEL GROSVALD[1], Howard Nusbaum[2], Steven Small[1]; [1]Department of Neurology, University of California at Irvine, [2]Department of Psychology, University of Chicago

Previous work has shown that familiarity with a talker improves the perception of that talker's speech under difficult listening conditions (e.g. Nygaard & Pisoni 1998). Imaging studies have also found relationships between intelligibility and activation in left IFG, inferior parietal (IP) and superior temporal (ST) regions (e.g. Obleser & Kotz 2010). In this fMRI study, we investigate the hypothesis that visual information aiding talker familiarization will modulate activation in these regions. Before and after a training phase, participants heard two talkers each saying 50 phonetically-balanced (PB) words, acoustically degraded using noise vocoding (Shannon et al 1995). Training provided clear-speech exposure to one of the talkers saying 300 PB words; half of participants saw audiovisual (AV) training stimuli, while the others were given audio (A) stimuli with a still image of the talker's face. We used rapid-sparse scanning (alternating 1.5s functional acquisition and 1.5s for stimuli) for optimal sound presentation. Behavioral pre- and post-testing were conducted outside the scanner. Activation was seen consistently in occipital and ST regions. However, group differences in left IFG, IP and ST regions were apparent during training, presumably because only AV stimuli showed linguistically useful visual information (the talker's moving face). After training, AV-trained participants listening to degraded speech from the familiar talker showed greater activation in these regions than A-trained participants. Moreover, AV participants' behavioral scores improved more after training than A participants'

scores. These results show clearly the importance of visual information in talker familiarity, and offer new insights into the underlying neural processes.

C6 EEG OSCILLATION DYNAMICS DURING SPEECH AND NON-SPEECH SOUND PERCEPTION

Yu Jin[1], Núria Sebastián Gallés[1]; [1]Universitat Pompeu Fabra

An increasing number of studies have been examining electroencephalography (EEG) data using time-frequency analysis and suggesting that neural oscillations and their synchronization represent important mechanisms for interneuronal communication in various brain regions. Previous study (Diaz et al. 2008) showed that individual variability in L2 phonetic mastery stems from differences in speech-specific capabilities, rather than psychoacoustic abilities. We hypothesized that individual behavioral differences may reflect different neural dynamics in either perceptual or memory aspects of speech sounds. EEG data was recorded in participants while perceiving speech and non-speech sound in an oddball paradigm. Participants were classified as good and poor perceivers according to their phoneme discrimination abilities. EEG power spectrum and coherence patterns were measured for different frequency bands. The results showed an increase of theta oscillation power in the native phoneme condition for midline channels. In particular, for good and poor perceiver groups, there is a reverse pattern in this frequency range: an increase for good perceivers and a decrease for poor perceivers. Also different patterns of positive channel couplings for good and poor perceivers were found for the low-frequency range. Contrary to speech sound, there was no difference between two groups in perceiving non-speech sounds. The dominance of dynamic patterns in the low frequency range may reflect an early automatic access of memory trace for speech sound in the brain. The difference between good and poor perceivers correlates with their behavioral measures and may suggest an individual variation of activating brain circuits at early perceptual level.

C7 OSCILLATORY FUNCTIONAL CONNECTIVITY IN SPEECH COMPREHENSION AND OTHER NATURALISTIC TASKS

Antti Jalava[1], Timo Saarinen[1], Jan Kujala[1], Claire Stevenson[1], Riitta Salmelin[1]; [1]Aalto University

Functional networks connecting brain regions have been suggested as key mediators for cognition and behavior. Accordingly, there is a great interest in characterization of inter-regional functional connectivity of the human brain. This characterization has mainly been based on hemodynamic measures and, in particular, on data collected at rest, without any active task. Yet, electrophysiological oscillations have been proposed as a key mechanism of inter-regional coupling with direct linkage to neuronal information processing and communication. In the present study, we investigated the critical question of whether the patterns of cortico-cortical oscillatory coupling change in a systematic way when subjects perform different types of naturalistic tasks. The tasks, selected to represent basic human behaviors, included a linguistic task, speech comprehension, and two non-linguistic tasks, object manipulation and picture comparison. Each naturalistic task had an easy and a more demanding variant; we also included low-level conditions, monotonous auditory and visual stimulation and repetitive finger movement. Cortical activity was recorded with magnetoencephalography (MEG), and Dynamic Imaging of Coherent Sources (DICS) was used to map sensor-level oscillatory coherence to cortico-cortical functional connectivity. We found task-specific patterns of oscillatory (6-20 Hz) connectivity, most prominently in the active naturalistic tasks (rather than low-level conditions), in good agreement with previous general understanding of functional organization and lateralization for these type of tasks. These results thus empirically demonstrate that oscillatory coherence can reveal networks that support naturalistic performance. They highlight the importance of oscillations for understanding brain function and for exploring the human connectome.

C8 PERCEPTION OF CONTINUOUS ACOUSTIC CUES IN SPEECH REVEALED BY THE AUDITORY N1 AND P3 ERP COMPONENTS

Joseph Toscano[1], Bob McMurray[2]; [1]University of Illinois at Urbana-Champaign, [2]University of Iowa

Many models of speech perception posit that listeners perceive speech sounds categorically (i.e., that the units of speech perception are phoneme categories), and behavioral and electrophysiological evidence has supported this. However, previous results may reflect responses that include both initial encoding of the stimulus and categorization. Thus, it is unclear whether early processing is based on continuous acoustic features or categorical phonological features. Recently, we presented an ERP approach for separating effects of perceptual encoding from later categorization responses (Toscano, McMurray, Dennhardt, & Luck, 2010, Psychological Science). We measured the auditory N1 and P3 components in response to speech sounds varying in voice-onset time (VOT) and found that the N1 reflects the acoustic properties of the stimulus (VOT differences) rather than discrete categories (/b/ vs. /p/). The later-occurring P3 component, in contrast, reflects both acoustic and category-level differences. Here, we extend these results to see whether these components serve as an index of encoding and categorization for other cues and phonological contrasts. We found that effects of continuous acoustic differences on N1 amplitude can be observed for some distinctions but are difficult to observe for others. Differences in P3 amplitude reflecting both acoustic and phonological information were observed for a variety of stimulus types. Overall, the results suggest that this approach allows us to separate effects of encoding and categorization for certain perceptually-relevant speech distinctions. More importantly, in

contrast to many classic models, they suggest that speech perception is based on differences in continuous acoustic cues rather than discrete categories.

C9 AUDITORY MASKED PRIMING AND LEXICAL PROCESSING IN PEOPLE WITH DIFFERING FAMILIAL HANDEDNESS

Julia Fisher[1], Roeland Hancock[1], Thomas G. Bever[1]; [1]University of Arizona

Prior research claims that in early sentence processing right-handers with familial left-handedness (FS+) focus on lexical/semantic information, while right-handers without it (FS-) focus on syntax [1]. To determine whether this difference exists in isolated word recognition, we contrasted FS+ and FS- lexical decision using Kouider and Dupoux's [2] auditory masked priming paradigm (AMPP). AMPP presents subjects with masked primes followed by unmasked targets. Masking is achieved through overlaid noise and prime compression. Using AMPP with synthetic English, Davis et al. [3] found repetition priming for only low neighborhood density (ND) words. We used the factor ND in our AMPP study with naturally-spoken English, and further explored AMPP by allowing a small variation in prime-target delay. Priming occurred for both high and low ND words, suggesting that AMPP's ND sensitivity is modulated by other stimulus properties. For example, natural speech phonetic transitions may counteract inhibitory effects of high ND. Familial handedness results suggest faster lexical decision for FS+ compared to FS- women. This lends some support to previous findings from studies of lexical access in sentence contexts, but raises new questions about the interaction of familial sinistrality with gender. [1]Townsend, D.J., C. Carrithers, and T.G. Bever. 2001. Familial Handedness and Access to Words, Meaning, and Syntax during Sentence Comprehension. Brain and Language. 78. 308-331. [2]Kouider, Sid and Emmanuel Dupoux. 2005. Subliminal Speech Priming. Psychological Science. 16. 617-625. [3]Davis, Chris, Jeesun Kim, and Angelo Barbaro. 2010. Masked speech priming: Neighborhood size matters (L). Journal of the Acoustical Society of America. 127. 2110-2113.

C10 WITHIN-SUBJECT ALPHA POWER IS NEGATIVELY CORRELATED WITH SUBJECTIVE INTELLIGIBILITY - A STUDY OF DEGRADED WORD COMPREHENSION IN MEG

Carolyn McGettigan[1,2,3], Sonja A. Kotz[2], Burkhard Maess[2], Sophie K. Scott[1], Jonas Obleser[2]; [1]UCL Institute of Cognitive Neuroscience, London, UK, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [3]Department of Psychology, Royal Holloway University of London, Egham, UK

Previous work has taken advantage of between-subject variability in speech perception performance to explore the neural correlates of comprehension and perceptual learning (Eisner et al., 2010; Obleser & Kotz, 2011; McGettigan et al., 2012). The current study investigated neural signatures of within-subject variability, using a word comprehension task in MEG. Nineteen adult speakers of German listened to bisyllabic nouns that were degraded by noise-vocoding. For each participant, a pilot task estimated a single level of degradation (4, 5 or 6 noise-vocoded channels) that would yield mid-range (40-70%) word recognition performance. In the MEG run, the participant heard individual words at this level, and was asked to rate each item's intelligibility on a scale from 1-4 (1 = totally unintelligible, 4 = completely intelligible). Testing for channel-frequency-time clusters in a contrast of noise-vocoded > control words revealed a marginally significant enhancement of theta power over bilateral temporal sensors around 300-800ms after stimulus onset, and a later significant alpha suppression with a left-dominant posterior distribution, around 600ms. Within-condition, a left-dominant, mid-to-posterior decrease in alpha power around 1 second after stimulus onset was associated with increasing intelligibility ratings for the noise-vocoded items (1,2 < 3,4). A posterior-central alpha suppression, at a similar latency, was also sensitive to subjective intelligibility differences across control items (1 < 2). We show similar alpha power modulations related to increasing subjective intelligibility within both the noise-vocoded and control conditions, suggesting that the observed alpha modulations reflect higher-order aspects of the attempts to extract linguistic percepts from acoustic signals.

C11 SINEWAVE SPEECH AND NON-SPEECH CAN REVEAL DISTINCT SPEECH-MODE AND SPEECH-INTELLIGIBILITY EFFECTS IN THE CORTICAL SPEECH PERCEPTION NETWORK.

Pradheep Shanmugalingam[1], Carolyn McGettigan[1], Zarinah Agnew[1], Stuart Rosen[1], Sophie K Scott[1]; [1]UCL

Most people do not hear SinewaveSpeech(SWsp) as linguistically meaningful unless informed of its speech-derived status. We exploited this effect with fMRI, comparing neural responses to identical SWsp sentences before and after informing participants of their potential intelligibility (a perfect acoustically-controlled comparison). We also included similar, but unintelligible, SinewaveNonspeech 'sentences' (SWnon) containing formant and amplitude information from different sentences. To match attention between naïve and informed blocks, participants performed a vigilance task (detecting infrequent guitar sounds). Preliminary results: Questioning between blocks revealed 6 of 9 participants were unaware of the sounds' speech-derived status throughout NaiveBlock (13 out of 18 in the recently expanded dataset); this was followed by a training task, before starting the InformedBlock. Our effects of interest are 'speech mode listening' compared with naïve listening (InformedBlock>NaïveBlock), the effect of speech intelligibility (SWsp>SWnon), and the interaction of these effects. Speech-mode effects occurred bilaterally in posterior-to-mid portions of superior temporal sulcus (STS) and middle temporal gyrus (MTG). Both clusters included superior temporal gyrus posteriorly, the left more than twice as large as the right ($p<0.001$ FWE cluster-level correction). The intelligibility effect ran bilaterally from posterior STS to anterior STS/MTG ($p<0.001$ FWE).

Interactions occurred in posterior left STS, and left insula ($p < 0.001$ uncorrected voxel threshold) – activation profiles showed SWsp and SWnon as equivalent in NaiveBlock, but SWsp greater than SWnon in InformedBlock, and all Informed sounds greater than Naive sounds. This interaction pattern, under a novel design with two levels of acoustic control, describes a network specialised for intelligible speech.

C12 THE DISTRIBUTION OF CORTICAL SURFACE AREA DEDICATED TO AUDITORY TEMPORAL RECEPTIVE FIELDS IS SYMMETRIC BETWEEN HEMISPHERES IN HUMAN AUDITORY CORE AND BELT

Jonathan Venezia[1], Brian Barton[1], Kourosh Saberi[1], Alyssa Brewer[1], Gregory Hickok[1]; [1]University of California, Irvine

The Asymmetric Sampling in Time (AST) theory proposes that auditory-cortical representations are elaborated on different timescales in left and right hemispheres. Specifically, AST posits that, (1) there are distinct neuronal ensembles that sample from time windows spanning roughly 25-50ms (50-20Hz) and 150-300ms (6.67-3.33Hz), and (2) these neuronal ensembles are distributed differentially across hemispheres. Thus, one measure that should dissociate between hemispheres is auditory-cortical magnification of Temporal Receptive Fields (TRFs). In the present fMRI study, we investigate magnification differences by mapping auditory cortex along two dimensions, frequency (tonotopy) and time (periodotopy). A modified version of the standard procedure in visual field mapping, the Traveling Wave (TW) method, was applied. Amplitude-modulated Gaussian noise of two types, narrowband and broadband, was varied across a range of center frequencies (400-6400Hz) and modulation rates (2-256Hz), respectively. Corresponding tonotopic and periodotopic gradients were measured. The orthogonal representation of these gradients in cortex allowed precise delineation of 11 auditory field maps (AFMs) in auditory core and belt. Collapsing across AFMs, we measured cortical surface area dedicated to the range of TRFs represented in our broadband stimuli. Equally spaced bins were constructed around preferred modulation rate (i.e., TRF) and mean cortical surface area (mm2) within each bin was tabulated. Two results were of note: (1) significant cortical magnification was observed for certain TRFs, with a unimodal distribution centered at 5-11Hz (range: 3-43Hz), and (2) significant differences in magnification between hemispheres were not observed. Together, these results do not support AST at the level of auditory core and belt.

Language Development, Plasticity, Multilingualism

C13 NEURAL SUBSTRATES UNDERLYING THE PRIMACY EFFECT IN STATISTICAL LEARNING

Elisabeth A. Karuza[1], Ping Li[2], Daniel J. Weiss[2], Richard N. Aslin[1]; [1]University of Rochester, USA, [2]Pennsylvania State University, USA

When adult learners were presented with consecutive miniature artificial languages differing in structure, they successfully computed statistical regularities and formed word-level representations only for the first language (L1), and not the underlying structure of the second language (L2). This primacy effect was overcome when a strong contextual cue to the shift from L1 to L2 was present (i.e., participants learned both languages) [1]. The present study seeks to uncover the neural substrates mediating the detection of a change in language structure, as well as the nature of the neural mechanism that computes the statistics of L1, maintains its structural representation, yet fails to trigger the acquisition of L2 in the absence of a strong contextual cue. Materials and design were adapted from [2] and made fMRI-compatible. The exposure phase consisted of 34s blocks of either language interleaved with periods of silence. L1 was presented during the first half of exposure, and L2 during the second. In the cued condition, L1 and L2 were paired with images of visually distinct "aliens", indicating that the languages were spoken by different creatures. The uncued condition was identical except that a single alien was paired with both languages. Behavioral results replicate previous findings. Participants in the cued condition discriminated statistically regular items (words) from irregular items (partwords) in both languages. In the uncued condition, they discriminated only words and partwords from L1. Ongoing fMRI analyses suggest differences in activation in the processing of L1 and L2 dependent on the presence/absence of a cue.

C14 WHEN LANGUAGE SHAPES NUMERICAL PROCESSES.

Elena Salillas[1], Manuel Carreiras[1,2]; [1]BCBL. Basque Center on Cognition, Brain and Language, [2]IKERBASQUE. Basque foundation for Science

Modulation of basic numerical effects by language would suggest that purely abstract number representations are penetrable. In two experiments, here we show that core quantity processing reflected by the distance effect and retrieval processes such as the problem size effect are modulated by linguistic variables in bilinguals. Specifically, the language of learning math (LLmath) moderates the ERPs indexes of these effects in balanced, Basque-Spanish fluent bilinguals. In Experiment 1, participants solved addition problems of three number words presented in LLmath or in the other language. The N1 component to the third number showed a strong gradation depending on the four problem sizes, but only for numbers in the other language. When presented in LLmath, only the biggest size differed from other problem sizes. In accord with previous

evidence, prominent gradations depending on size are shown by low math achievers. Thus results suggest the importance of the linguistic format for solution retrieval. In Experiment 2, participants compared Arabic digits related through base-10 or base-20 system. Basque and not Spanish retains both base-20 and base-10 in the way of naming numbers. Only bilinguals with LLmath Basque showed a N1-P2 distance effects for digits pairs related through base-20. Participants whose LLmath was Spanish showed a later P2p distance effect for these pairs, with different scalp distribution. Results show that both retrieval during calculation and access to magnitude depend on LLmath. Therefore language, and specifically LLmath, has a crucial role in the way that different levels of number representations evolve through education.

C15 "VISUAL" CORTEX IS INCORPORATED INTO THE LANGUAGE NETWORK OF CONGENITALLY BLIND ADULTS: EVIDENCE FROM RESTING STATE CORRELATIONS.

Marina Bedny[1], Ben Deen[1], Rebecca Saxe[1]; [1]Massachusetts Institute of Technology

Language processing depends on a left-lateralized network of brain regions in the prefrontal and temporoparietal cortices. This neurobiological signature of language is highly consistent across individuals, languages and cultures. Congenitally blind individuals exemplify a striking exception to this consistency. In addition to classic language areas, blind individuals activate "visual" areas of the occipital cortex during language tasks. These data raise the possibility that "visual" circuits, take on language functions as a result of early blindness. We provide further evidence for this hypothesis from resting state correlations in BOLD fMRI signal. Twelve congenitally blind adults and twenty-one sighted adults took part in an fMRI study. During a resting state scan, participants were asked to relax and remain awake. Sighted participants wore a light-exclusion blindfold for the duration of the scan. Language-selective seed regions were defined in individual subjects based on a separate task-based fMRI scan. (During the task-based scan, participants performed an auditory language comprehension task.) We found that in blind people, left-lateralized pericalcarine, fusiform and lateral occipital areas had increased correlations with language-selective prefrontal regions. Correlations between prefrontal and occipital areas were significantly positive in blind individuals, and non-significant or negative in sighted people. Developmental blindness alters the function of fronto-occipital connections. Occipital areas of blind individuals also had greater within hemisphere than between hemisphere correlations. These findings support the hypothesis that left-lateralized occipital areas are incorporated into the language network in people who are blind.

C16 EVENT-RELATED SPECTRAL POWER TO SPOKEN WORDS IN AN L2 RETRIEVAL PRACTICE PARADIGM

Doug Davidson[1], Alejandro Pérez[1], Ainhoa Bastarrika[1]; [1]Basque Center on Cognition, Brain, and Language

Although there is good evidence that band-specific changes in spectral power are related to successful lexical-memory performance, few studies have examined oscillatory activity in adult second language learners. This study used a paired-associate memory task for spoken words to test memory for translation pairs using MEG. Native Spanish (L1, n=16) subjects without knowledge of Basque (L2) listened to eight adjective pairs during an encoding phase, followed by a retrieval phase in which participants recalled the translation in response to a probe. For the MEG preprocessing, head movement compensation was performed, single trial epochs consisting of 2.0 s before and after word onset were selected, ICA artifact rejection was applied, and a continuous wavelet analysis was performed using a fixed 0.5 s Hanning taper for all frequencies. The relative power change for all words compared to a -1.0:-0.5 s baseline showed a bilateral theta-band power increase, and a left-posterior alpha-band decrease. The L1 and L2 words showed no power differences, but in the retrieval phase there was a greater reduction in alpha-band power on posterior sensors for later-remembered words compared to later-forgotten words. The results show a strong modulation of theta- and alpha-band oscillatory power to spoken words. The alpha-band reduction during the retrieval phase was the strongest correlate of successful memory formation, supporting other suggestions in the literature that alpha-band oscillatory activity has an important role in memory retrieval.

C17 CROSS-LANGUAGE ERP MASKED ASSOCIATIVE PRIMING EFFECTS: EVIDENCE FROM BALANCED BILINGUALS.

Maria Dimitropoulou[1], Jon Andoni Duñabeitia[1], Itziar Laka[2], Manuel Carreiras[1,2,3,4]; [1]Basque Center on Cognition, Brain and Language (BCBL), [2]University of the Basque Country, [3]IKERBASQUE, Basque foundation for Science, [4]Departamento de Filología Vasca, University of the Basque Country UPV/EHU

Previous behavioural studies have shown that semantic associates from a bilingual's two languages can automatically activate each other. However, the electrophysiological correlates of these cross-language masked associative/semantic priming effects have not been yet identified. The present ERP study examined these effects and compared them to within-language associative/semantic priming effects with a group of balanced Basque-Spanish bilinguals. Participants were presented with Spanish non-cognate targets that were preceded by i) another Spanish semantically related word, ii) a Spanish unrelated word, iii) a Basque semantically related word, or iv) a Basque unrelated word. Results revealed significant effects in the N400 time-window for semantically related primes that critically, did not differ as a matter of prime language. We also found a significant code-switching

cost at both the N250 and the N400 time-windows when primes were in the non-target language as compared to when they belonged to the target language. The symmetric pattern of masked semantic/associative priming effects obtained within and across languages fully replicates the behavioural effects previously obtained with native-like bilinguals. This set of findings indicates that for bilinguals who have acquired both languages simultaneously, have reached a comparable level of proficiency and are being equally exposed to them, even though at an early orthographic level of processing the language membership of each word is automatically computed, the lexico-semantic links connecting words of the same or of both languages are functionally indistinguishable.

C18 THE IMPORTANCE OF PASSIVE LISTENING FOR THE ACQUISITION OF FOREIGN WORDS IN ADULT LEARNERS: EVIDENCE FROM EVENT-RELATED BRAIN POTENTIALS

Micol Vignotto[1,2], Tobias Hartmüller[2], Maria Richter[1,2], Hellmuth Obrig[1,2], Sonja Rossi[1,2]; [1]University of Leipzig, Medical Faculty, Germany, [2]Max Planck Institute for Human Cognitive and Brain Sciences Leipzig, Germany

When listening to an unknown language we try to segment the acoustic speech stream into single units in order to identify the beginning and the end of words. Phonotactic regularities aid this segmentation and thus are crucial for word learning. Phonotactics describes the legal and illegal combinations in a given language. For example `br` is a legal onset in English whereas `bz` is not. In the present study we aim at investigating the impact of passive exposure to legal (i.e., native) and illegal (i.e., non-native) phonotactic regularities by means of event-related brain potentials. A Passive Listening Training and an implicit Categorization Training in which the attention was directed away from the phonotactic rules were conducted. On each of three consecutive learning days a pretest, training, and posttest were performed. ERP results of the Passive Listening Training show a decrease of the N400 component for trained illegal pseudowords from the posttest of day 1 to the succeeding learning time points. A similar decrease of the N400 was also observable during training. No modulation was present during this training for untrained illegal pseudowords and trained and untrained legal phonotactic rules. Also during the implicit Categorization Training no N400 changes occurred, neither for legal nor for illegal pseudowords. These findings suggest very fast brain plasticity effects through passive exposure to the foreign stimuli reflecting a better sorting out of illegal phonotactic rules as nonwords. Further, the results indicate that at least a minimum of attention is needed to acquire such regularities.

C19 BRAIN PLASTICITY WHILE ASSOCIATING A NEW NAME TO A FAMILIAR OR UNFAMILIAR OBJECT: AN EEG LANGUAGE LEARNING STUDY

Sonja Rossi[1,2], Rüdiger Wolf[2], Paula Hillebrand[2], Hellmuth Obrig[1,2]; [1]University of Leipzig, Medical Faculty, Germany, [2]Max Planck Institute for Human Cognitive and Brain Sciences Leipzig, Germany

The present project investigates the impact of different semantic trainings on the acquisition of phonotactic regularities in adults. Phonotactics governs the possible combination of different phonemes in a specific language (for example `br` is a legal onset in English whereas `bz` is not) and is thus relevant for word learning. In the present study we investigate the neuronal changes during exposure to phonotactically legal (i.e., native) and illegal (i.e., non-native) pseudowords embedded in different kinds of semantic contexts. The first training consisted in the acoustic presentation of these pseudowords together with pictures of real objects reflecting a classical L2 acquisition scenario where the object representation is already established but the new name has to be learned. The second training combined the pseudowords with pseudoobjects, thus simulating in adults an L1 acquisition scenario as it occurs in early infancy. For both training groups a pretest, training, and posttest were administered on three consecutive days. ERP results for the Real Objects Training show a fast increase of the N400 to illegal pseudowords after the first training session suggesting that illegal nonwords approximate a lexical status. Legal pseudowords, however, show a decrease with increasing exposure to the stimuli indicating familiarization effects. The Pseudoobject Training, however, showed only a decrease in N400 amplitude for illegal pseudowords suggesting an improved ability to sort them out as nonwords with increasing exposure. These findings indicate very fast neuronal changes through learning emphasizing the importance of both familiarization and integration into the lexicon for successful word learning.

C20 BRAIN PLASTICITY IN 6-MONTH-OLD INFANTS: THE IMPACT OF A SEMANTIC TRAINING ON THE PROCESSING OF PHONOTACTIC REGULARITIES DURING WORD LEARNING

Maria Richter[1,2], Micol Vignotto[1,2], Hellmuth Obrig[1,2], Sonja Rossi[1,2]; [1]University of Leipzig, Medical Faculty, Day Clinic for Cognitive Neurology, Leipzig, Germany, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Department of Neurology, Leipzig, Germany

Within the first year of life infants acquire knowledge about the phonetic, prosodic, and phonotactic (i.e., the combination of phonemes in a given language) organization of their native language. Already 6-month-old infants can differentiate between native (i.e., legal) and non-native (i.e., illegal) phonotactics. The present study investigates how brain activity responses to native and non-native phonotactic regularities are modulated through training in infants of this age. We therefore acoustically presented phonotactically legal and illegal

pseudowords embedded in a semantic training in which the pseudowords were combined with pictures of real objects to create an associative learning setting to 6-month-old infants. Following the principle of statistical learning, during training we repeatedly presented the same pseudoword in association with the same object and equally often with different objects. Each infant underwent a pretest, training, and posttest on three consecutive days. Pretest and posttest included trained and untrained pseudowords. Learning effects were monitored by means of event-related brain potentials. Preliminary results revealed a familiarization effect for phonotactically legal and illegal trained pseudowords. The familiarization was indexed by a decreasing frontally distributed negativity, a precursor of the N400, displayed from day 1 to day 3. This effect was not present for untrained words. These findings suggest that more acoustically oriented perceptual mechanisms guide word learning at this early age even within a semantic learning context rather than pure associative learning. Probably, more lexically oriented brain mechanisms aiding the development of concrete semantic representations between an object and a word establish later during language acquisition.

C21 CAN YOU GUESS WHAT I'M GONNA SAY? WORD ANTICIPATION IN MONOLINGUALS AND BILINGUALS DURING SENTENCE READING.

Alice Foucart[1], Clara Martin[2,3], Eva Moreno[4], Albert Costa[1,5]; [1]Universitat Pompeu Fabra, Barcelona, Spain, [2]Basque Center on Cognition, Brain and Language, Donostia-San Sebastian, Spain, [3]IKERBASQUE, Basque Foundation for Science, Bilbao, Spain, [4]Instituto Pluridisciplinar Universidad Complutense de Madrid, [5]Institució Catalana de Recerca i Estudis Avançats

The present study investigates whether monolinguals and bilinguals anticipate words and their features in a similar manner during sentence reading. Previous event-related brain potential (ERP) studies have shown that when readers come across a word that is expected from the sentence context the amplitude of the N400 effect is more reduced than when the word is unexpected (DeLong, Urbach & Kutas, 2005; Wicha, Moreno & Kutas, 2004). In addition, anticipation effects were also observed on the article preceding the (un-)expected word. In the present study we presented Spanish monolinguals, Spanish-Catalan early bilinguals and French-Spanish late bilinguals with sentences containing nouns that either fit in the sentence context or did not (but always fit semantically). Sentences were manipulated so that the gender of the expected and unexpected nouns differed. Participants' brain activity was recorded as they read sentences silently. Results revealed a significant N400 effect on both the noun and the article for monolinguals and early bilinguals. In contrast, an N400 effect was found only on the noun for the late bilinguals. At first sight, it seems that late bilinguals do not anticipate words; however, when looking further at the data, late bilinguals tend to show a similar pattern as the monolinguals for cognate words. We conclude that monolinguals (and early bilinguals) anticipate words and their features to build up sentence meaning in real time. Moreover, the results suggest that late bilinguals might be able to anticipate words and their features like monolinguals when words are 'more easily available' (i.e., cognates).

C22 TO PEEK AND TO PEER: "VISUAL" VERB MEANINGS ARE LARGELY UNAFFECTED BY CONGENITAL BLINDNESS

Rebecca Saxe[1], Jorie Koster-Hale[1], William Johnston[2], Lindsay Yazzolino[1], Marina Bedny[1]; [1]Massachusetts Institute of Technology, [2]Northeastern University

Congenitally blind adults learn about the world through touch, audition, and language, but not through vision. What consequences does this atypical sensory experience have for blind adults' concepts of actions and events, especially for features related to vision? Congenitally blind (n=24), late blind, age-matched sighted (n=22) judged semantic similarity (1 to 7) of verbs describing: perceptual experiences (visual e.g. to glance, tactile e.g. to touch, amodal e.g. to investigate, n=60), perceptible qualities (visual e.g. to flash and auditory e.g. to buzz, n=30), and manners of motion (e.g. to roll). The similarity ratings for all verb categories, including "visual" verbs, were remarkably similar across blind and sighted participants (all r>.85), as similar as among sighted participants. Within group homogeneity was also similar across groups. By contrast, neither blind nor sighted people's ratings were well correlated with similarity matrices obtained from Latent Semantic Analysis (LSA), suggesting neither group relied heavily on word associations. Cluster analyses on similarity matrices produces nearly identical clusters across groups. For example, for both congenitally blind and sighted participants, "visual" verbs emerged a cluster distinct from other sensory modalities (touch and audition) and distinct from amodal verbs. Within a sensory modality, participants rated verbs based on coarse spatiotemporal properties (e.g. intensity, temporal frequency). These data suggest that congenitally blind individuals acquire typical meaning for visual and non-visual verbs and that first-person sensory experience is not necessary for typical word-meaning acquisition.

Language Disorders

C23 THE RESPONSE OF ANTERIOR CINGULATE CORTEX TO APHASIA REHABILITATION

Sonia Brownsett[1], Jane Warren[1,2], Fatemeh Geranmayeh[1], Howard David[3], Wise Richard[1]; [1]Imperial College London, [2]University College London, [3]University of Newcastle-upon-Tyne

This study investigated the effects of a rehabilitation programme, using clear speech, on 14 patients with chronic aphasia following stroke, using fMRI before and after rehabilitation. The patients' lesions spared rostral and superior frontal regions. A comparison was made between the patients' data and that from a group of 16 control subjects who underwent training on 3-channel

noise-vocoded speech. In a 2*2 ANOVA (session by group) there was a main effect of session in right auditory cortex (left auditory cortex was infarcted in most of the patients). This corresponded to a large improvement in the ability to accurately perceive noise-vocoded speech in controls, and a small but significant improvement in the patients to perceive clear speech. The main effect of group showed widespread greater activity in the patients. The interaction was confined to the rostral ACC, with activity declining as the control subjects' gained greater proficiency but being maintained in the patients. We demonstrate the role of rostral ACC in cognitive control when speech comprehension is difficult. We move away from the notion that lesion size, location or perilesional cortical integrity alone determines rehabilitation outcomes. It is known that ACC activity is required to maintain performance as an individual ages and that lesions of the ACC markedly reduce the response to environmental stimuli. As most stroke patients are aged >60 years, the implication of this is that age-related decline in rostral ACC function may influence a patient's response to aphasia rehabilitation.

C24 ATYPICAL SIMPLE TONE DISCRIMINATION AND PROCESSING IN CHILDREN WITH DEVELOPMENTAL LANGUAGE IMPAIRMENT

Sergey Kornilov[1,2,3,4], Nicole Landi[2,3], Natalia Rakhlin[2], Elena Grigorenko[2,3,4,5], James Magnuson[1,3]; [1]University of Connecticut, [2]Yale University, [3]Haskins Laboratories, [4]Moscow State University, [5]Columbia University

The etiology of developmental language impairment (LI) is largely unknown, although evidence for non-language deficits in LI is mounting (e.g., reports of atypical neural responses to rapidly presented tones suggest specific impairment in rapid auditory processing that underlies phonological impairment). We investigated neurocognitive correlates of LI in 23 children with LI and 16 typically-developing children (TD; matched on age and nonverbal intelligence) using an auditory oddball ERP paradigm. All children passed a hearing screening. A standardized narrative instrument assessed phonetic/prosodic development, syntactic complexity, MLU, grammatical and semantic/pragmatic error rates, and vocabulary. We assessed verbal memory with digit span. Children discriminated frequent standard (2000Hz, p = .85) and infrequent target (1000Hz, p = .15) tones presented at a long SOI (2000ms). EEG was recorded using 64 active electrodes. Waveform analyses identified significant midline differences in latency and/or amplitude for early and late sound processing, discrimination and classification components: slower auditory N1, less positive P2, more negative N2 and less positive P3b (all ps < .05) for LI compared to TD. Topographic ANOVA and microstate segmentation analysis revealed significant group differences in topography from 250-350ms. Neither phonological ability nor nonverbal intelligence correlated with neural measures. However, P2 amplitude correlated with verbal memory (r = .32), N2 with grammatical errors (r = -.33) and vocabulary (r = .41), and P3b with syntactic complexity (r = .34, all ps < .05). Our results indicate the presence of domain-general, multi-stage auditory processing deficits in children with LI that are not limited to high-demand rapid processing.

C25 DELAYED AUDITORY FEEDBACK AS A PATHOPHYSIOLOGICAL MODEL OF PROGRESSIVE APHASIA

Jason Warren[1], Sonya Makhmood[1], Phillip Fletcher[1]; [1]Dementia Research Centre, UCL Institute of Neurology, UCL, United Kingdom

Delayed auditory feedback (DAF) has been used as a therapy in developmental and acquired stuttering and induces speech output deficits in healthy individuals, suggesting that DAF modulates dorsal language pathway functions. Dorsal language pathway dysfunction occurs in association with the neurodegenerative syndrome of progressive nonfluent aphasia (PNFA), however despite recent intense interest in the progressive aphasias our understanding of PNFA pathophysiology remains very limited. Here we used DAF as a model system to begin to address this issue. We compared speech while reading aloud (Grandfather Passage) and while describing a picture (Boston Cookie Theft) in a cohort of 20 healthy older control subjects under different conditions of DAF with raw speech parameters in a cohort of 26 patients with PNFA. Under DAF, healthy subjects' speech showed slowing of speech rates and increased error rates overlapping with the PNFA range. Our findings suggest that DAF may constitute a paradigm for modelling PNFA pathophysiology in the healthy brain and further imply that posterior dorsal pathway malfunction plays a key role in the development of the PNFA syndrome.

C27 DOES POSTERIOR TEMPOROPARIETAL CORTEX SUPPORT SEMANTIC CONTROL? A DIRECT COMPARISON OF SEMANTIC DEFICITS FOLLOWING TEMPOROPARIETAL, PREFRONTAL AND BILATERAL ANTERIOR TEMPORAL LOBE LESIONS.

Hannah Thompson[1], Krist Noonan[2], Paul Hoffman[3], Matthew Lambon Ralph[3], Elizabeth Jefferies[1]; [1]University of York, UK, [2]Royal United Hospital, Bath, UK, [3]University of Manchester, UK

Multimodal semantic memory deficits typically follow either (1) degradation of amodal semantic representations within the anterior temporal lobes, as in semantic dementia (SD) or (2) difficulty in controlling activation within the semantic system in line with current goals or context, as in semantic aphasia (SA). SA patients have damage to prefrontal, inferior parietal and/or posterior temporal regions suggesting that a distributed neural network underpins semantic control, yet the particular contribution of each of these regions remains unclear. Our aim was to directly compare for the first time SA patients with prefrontal damage (PF+) and those with temporoparietal damage (TP-only). Relative to SD patients, both TP-only and PF+ cases (1) showed greatly reduced item consistency when the task demands changed; (2) were more influenced

by the requirement for semantic control – in experimental manipulations of both controlled retrieval and selection/ inhibition of concepts; (3) exhibited attenuated effects of lexical frequency; and (4) showed evidence of poor semantic regulation in their verbal output – performing substantially worse when the task provided minimal constrains on internal semantic activation. Nevertheless, the PF+ cases showed a greater degree of impairment across several control-demanding tasks, such as auditory counting, and digit span. Whilst PF+ and TP-only cases show parallel effects of semantic control demands, PF+ display a significantly lower accuracy in semantic tasks, such as ambiguity resolution. These findings confirm that semantic control is instantiated across a network of prefrontal and temporoparietal cortical areas, with partially distinct roles for these regions in different aspects of semantic control.

C28 LANGUAGE IMPAIRMENTS IN CHILDREN WITH AD/HD AND IN CHILDREN WITH READING DISORDER

Wenche Andersen Helland[1,2], Turid Helland[3], Astri Lundervold[3], May-Britt Posserud[4], Mikael Heimann[5]; [1]Department of Psychiatry, Helse Fonna HF, Norway, [2]Statped Vest, Support System for Special Education, Norway, [3]Department of Biological and Medical Psychology, University of Bergen, Norway, [4]Uni Helse, RKBU Vest, Norway, [5]Department of Behavioural Science, Linköping University, Norway

Attention deficit hyperactivity disorder (AD/HD) and reading disorder (RD) are the two most prevalent neurodevelopmental disorders of childhood, and high rates of comorbidity have been reported for both disorders. This large scale population-based study aimed a) to investigate language impairments in children with symptoms of AD/HD, children with symptoms of RD, children with symptoms of both AD/HD and RD and a control group, b) to explore whether these groups could be differentiated from each other regarding different aspects of language. Method: A screening questionnaire was distributed to teachers and parents of the children. Out of a sample of 5672 children aged 7-9 years four groups were derived; children with RD (N=332); children with ADHD (N=169); children with AD/HD + RD (N=121) and a control group (N=5050). Results In the AD/HD +RD group 80.7 % of the children were identified with LI compared to 46.0 % of the RD group, 42.6 % of the AD/HD group and 5.7 % of the control group. All groups differed significantly on measures of phonology, expressive language and receptive language. Conclusions In sum these findings support findings from clinical samples pointing to a considerable rate of language impairments both in children with symptoms of AD/HD and in children with symptoms of RD. Furthermore, they underline the importance of assessing language abilities in children who show symptoms of AD/HD or RD in order to develop appropriate treatment plans and provide sufficient educational support.

C29 A DEFICIT IN NOVEL THOUGHT GENERATION: AN EXECUTIVE FUNCTION ACCOUNT FOR DYNAMIC APHASIA?

Gail Robinson[1], Donna Spooner[2]; [1]School of Psychology, The University of Queensland, Brisbane Australia, [2]Royal Brisbane and Women's Hospital, Brisbane Australia

Frontal dynamic aphasia is characterised by impaired propositional speech despite well-preserved nominal, repetition, reading and comprehension skills (Luria 1966, 1970). There are two main forms of dynamic aphasia, one specific to language and associated with left inferior frontal lesions and a second that encompasses both verbal and non-verbal generation and is associated with diffuse frontal lesions (e.g., Bormann 2008; Robinson 1998, 2005, 2006). The second form of dynamic aphasia has been accounted for by a fluent sequencing of novel thought deficit (i.e., a reduction in generating new ideas and a deficit in fluent sequencing of ideas). We report a patient that presented with the second form of dynamic aphasia in the context of PSP. A series of baseline cognitive and experimental tests (e.g., word/ sentence/ discourse production, non-verbal generation) were administered to the patient and matched controls. Word and sentence generation was well preserved. By contrast, discourse production was severely reduced (complex scene descriptions, topic discussions, procedural narrative) and both verbal and non-verbal fluency performance was impaired. The results were consistent with a deficit in generating novel ideas, similar to previous cases. However, unlike previous studies, discourse production was not characterised by a fluent sequencing deficit. This case further refines our understanding of the critical mechanisms involved in conceptual preparation processes for language generation. Moreover, as the fluency task performance resembles a pattern recently documented in patients with superior medial frontal lesions, the results are discussed in relation to an energization deficit (Robinson et al 2012).

C30 DIFFERENTIAL PATTERNS OF FUNCTIONAL OUTCOME IN FIRST EPISODE PATIENTS WITH SCHIZOPHRENIA AND BIPOLAR DISORDER

Clara Isabel González[1], Javier Peña[1], Judit Ciarrusta[1], Sarah Raffety[1], Natalia Ojeda[1]; [1]Faculty of Psychology, University of Deusto, Bilbao, Spain.

INTRO Previous studies have analyzed the level of functional outcome in patients with schizophrenia (FES) and bipolar disorder (BD). However, few studies have assessed if patients with first episode schizophrenia present a more severe impairment in functional outcome than patients with bipolar disorder. The aim of this study was to compare the functional outcome of both groups. METHODS 115 patients with FEP were recruited according to DSM-IV criteria and clinical interview. All subjects underwent a full clinical evaluation (i.e., PANSS, Mania, Depression and Insight) and a functional outcome with the WHO Disability Assessment Schedule (DAS-WHO). Premorbid functioning was evaluated with the Cannon – Spoor Premorbid Adjustment Scale. The final diagnosis was

obtained two years later. RESULTS We found statistically significant differences in clinical and sociodemografic variables: years of education (F=11.39, p<0.001), duration of untreated psychosis (DUP) (F=5.11, p<0.03), negative symptoms (F=18.71, p<0.001) and mania (F=9.83, p<0.01). The patients with first-episode schizophrenia showed higher levels of functional disability regarding DASWHO (F=6.87 p<0.01). These differences remained statistically significant even after controlling for years of education, duration of untreated psychosis (DUP), negative symptoms and mania. CONCLUSIONS The patients with PEP that finally have a schizophrenia diagnosis suffer from higher levels of functional disability comparing to patients that have bipolar disorder. Moreover, we suggest that these differences are not influenced by educational level, mania, negative symptoms, premorbid adjustment or DUP. We propose that additional variables, inherent to the schizophrenia disorder that may affect functional outcome in a more intense manner.

Phonology, Phonological Working Memory

C31 A TRACTOGRAPHY STUDY IN DYSLEXIA: NEUROANATOMIC CORRELATES OF PHONOLOGICAL AND ORTHOGRAPHIC PROCESSING

Maaike Vandermosten[1], Hanne Poelmans[1], Jolijn Vanderauwera[1], Stefan Sunaert[1], Jan Wouters[1], Pol Ghesquière[1]; [1]KU Leuven

Previous fMRI studies demonstrate that reading elicit a widespread left lateralised activation pattern and that dyslexics fail to produce this typical pattern. Given that these regions are distant, examination of its connections is vital to understand the cause of underactivation. In a first study, 20 dyslexic adults and 20 typical reading adults were scanned using Diffusion Tensor Imaging, and the bilateral superior longitudinal fasciculus (SLF) and the left inferior fronto-occipital fasciculus (IFOF) were delineated. Group comparisons showed a significantly reduced fractional anisotropy (FA) in the left SLF of adults with dyslexia, in particular in the segment that directly connects Wernicke's and Broca's areas. In contrast, no significant group differences in FA were found in the right SLF nor in the left IFOF. Correlational analyses (controlled for reading status) demonstrated a specific relation between performance on phonological processing and FA in the left SLF, and between orthographic processing and FA in the left IFOF (Vandermosten et al., 2012, Brain, 135). In order to unravel cause and consequence of a lifelong reading impairment, we started up a longitudinal DTI study which will examine the neural connections of reading-related areas in pre-reading children (last year of kindergarten) and in beginning readers (2th grade). We currently scanned 25 pre-reading children with a family risk for dyslexia and 25 pre-reading children with no family risk for dyslexia. Preliminary data on FA group differences in the left SLF will be presented as well as correlations with phonological and orthographic behavioural measures.

Language Disorders

C32 NEURAL CORRELATES OF AGRAMMATIC SPEECH IN AN OVERT PICTURE DESCRIPTION TASK

Eva Schoenberger[1], Stefan Heim[1,2], Elisabeth Meffert[1], Patricia da Costa Avelar[1], Walter Huber[1], Ferdinand Binkofski[1], Marion Grande[1]; [1]RWTH Aachen University, [2]Research Centre Juelich

Different approaches of functional brain imaging have improved our knowledge of the neural localisation of language functions and the functional recovery after a lesion. The neural correlates of aphasic symptoms, which can be observed best in spontaneous speech, are still largely unknown. Here, different aspects of agrammatic speech production were investigated with fMRI. A patient suffering from chronic stroke-induced agrammatic aphasia described overtly 9 pictures showing complex situations for 3 minutes each. 17 healthy control-speakers completed the same task but were instructed to use only 3 words per phrase in 5 of the pictures to reduce the morpho-syntactic complexity. Phrases were analysed for syntactic complexity, completeness and morphology. Event-related data analysis was conducted by defining every uttered phrase as an event with its onset-time and duration. Phrases with omissions, substitutions or inflectional errors of function words were accompanied by activations in the inferior and middle frontal gyrus, Rolandic operculum, middle and superior temporal and supramarginal gyrus. These activations showed primarily in the left hemisphere in the control-group. In the patient, activations in the left IFG and MFG were accompanied by strong activations in right homologue areas. Activations in the precentral gyrus, Rolandic operculum and supramarginal gyrus only showed in the right hemisphere. The right-hemispheric activations might be compensations for dysfunctional lesioned left fronto-parietal areas, resulting unsuccessfully in morphologic errors. In the control-group, an intentional supression of producing function words in order to produce 3-word-phrases might explain activations in areas engaged in morpho-syntactic encoding even when function words are omitted.

C33 IMPAIRED FIGURATIVE LANGUAGE PROCESSING IN PATIENTS WITH MILD TRAUMATIC BRAIN INJURY: AN FMRI AND DTI STUDY

Fan-pei Yang[1], Yu-Chen Chang[1], Kailyn Bradley[2], C. Wang[2], Brain Dorner[2], Daniel C. Krawczyk[2,3]; [1]National Tsing Hua University, [2]Center for Brain Health, University of Texas at Dallas, Dallas, TX, [3]Southwestern Medical Center, University of Texas Southwestern, Dallas, TX

Prior research has suggested that competence in figurative language processing after mild traumatic brain injury (mTBI) may be affected by general cognitive functions involving multiple brain regions (Wigg et al., 1988). Studies employing functional and structural neuroimaging

techniques to investigate abnormal cortical and subcortical involvement for language comprehension in TBI are scant. The present study investigates structural and functional deficits in language pathways and their associations with figurative language impairment in mTBI patients. Thirty-eight mTBI patients (aged 40 ± 13.51 year old, 11 female, 27 male) and 28 matched controls were scanned for diffusion images. Among the 66 subjects, 11 patients (aged 39 ± 10.51 year old, 3 females, 8 males) and 11 matched controls participated in an fMRI experiment, where they had to judge whether each sentence had a positive or negative meaning. We had three conditions: Literal sentences, conventional metaphors, and novel metaphors. Patients showed lower fractional anisotropy (FA) values and higher mean diffusivity (MD) values in almost all types of tracts. Decreases in fiber characteristics such as fiber count, volume and density suggested a large-scale white matter deterioration not restricted to language-related tracts. The regions of interest analysis of the fMRI experiment indicated that controls significantly activated more left inferior frontal gyrus (LIFG) for novel metaphor comprehension than TBI patients ($p < 0.05$). The structural and functional imaging results together suggest that frontal and global disconnectivity in TBI might both contribute to their deficits in figurative language comprehension.

Lexical Semantics

C34 THE COMPREHENSION OF EXOPHORIC REFERENCE: AN ERP STUDY

David Peeters[1,2,3], Asli Özyürek[1], Peter Hagoort[1,3]; [1]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, [2]International Max Planck Research School for Language Sciences, [3]Radboud University Nijmegen, Donders Institute for Brain, Cognition, and Behaviour

An important property of language is that it can be used exophorically, for instance in referring to entities in the extra-linguistic context of a conversation using demonstratives such as "this" and "that". Despite large-scale cross-linguistic descriptions of demonstrative systems, the mechanisms underlying the comprehension of such referential acts are poorly understood. Therefore, we investigated the neural mechanisms underlying demonstrative comprehension in situated contexts. Twenty-three participants were presented on a computer screen with pictures containing a speaker and two similar objects. One of the objects was close to the speaker, whereas the other was either distal from the speaker but optically close to the participant ("sagittal orientation"), or distal from both ("lateral orientation"). The speaker pointed to one object, and participants heard sentences spoken by the speaker containing a proximal ("this") or distal ("that") demonstrative, and a correct or incorrect noun-label (i.e., a semantic violation). EEG was recorded continuously and time-locked to the onset of demonstratives and nouns. Semantic violations on the noun-label yielded a significant, wide-spread N400 effect, regardless of the objects' orientation. Comparing the comprehension of proximal to distal demonstratives in the sagittal orientation yielded a similar N400 effect, both for the close and the far referent. Interestingly, no demonstrative effect was found when objects were oriented laterally. Our findings suggest a similar time-course for demonstrative and noun-label processing. However, the comprehension of demonstratives depends on the spatial orientation of potential referents, whereas noun-label comprehension does not. These findings reveal new insights about the mechanisms underlying everyday demonstrative comprehension.

C35 TEMPORAL GRADIENTS IN NARRATIVE PRODUCTION FOR EARLY VERSUS LATE ACQUIRED WORDS ACROSS THE LIFESPAN

Alison Paris[1], Kali Woodruff Carr[1], Samantha Morrill[1], Jamie Reilly[1]; [1]University of Florida

Ribot argued for a temporal gradient to memory consolidation; earlier acquired memories are less susceptible to disruption as a function of neurological damage. Moreover, consolidation can take place over many decades and is thought to involve shifting representation from medial temporal lobe structures to the temporal neocortex. It is unclear whether Ribot's predictions extend to language organization. Natural language is continually changing, and we must flexibly update our lexicons to reflect emergent cultural conventions. One possibility predicted by age-of-acquisition theories is that lexical representation is also temporally graded similar to a Ribot Effect in episodic memory. We examined narrative for words and people whose names emerged at specific points over the last six decades (e.g., slinky was invented in the 70s). Participants (N=40) included an equal number of younger (μ=20 yrs) and older adults (μ=64 yrs). Participants defined randomly, orthographically presented popular objects (e.g., slinky, smurf) (N=54) and famous people (e.g., Elvis Presley, Bill Clinton) (N=60). Stimuli represented decade blocks from 1950-2000s. Three independent raters coded narratives offline for accuracy, MLU, TTR, and mazes (e.g., fillers). Older (OAs) and younger (YAs) participants showed unique narrative characteristics for all measures. These differences were characterized by temporally graded divergence for recent (most similar) to remote (most divergent) words. Accuracy showed a crossover interaction; OAs described temporally remote items better than YAs whereas the reverse held for recent items. Lexical acquisition potentially represents a temporally graded phenomenon (a la Ribot). We address implications for theories of age-of-acquisition and the neurobiology of aging.

C36 EXPLICIT AND IMPLICIT METAPHORS: AN ERP STUDY

Gwenda L Schmidt-Snoek[1], J Davis VanderVeen[1], Amanda Layman[1], Erin Hildebrandt[1], Audrey Weil[1]; [1]Hope College

Previous metaphor research has primarily focused on metaphors that are nominal (noun-based) and explicit (stating a clear metaphorical comparison or mapping). We tested the hypothesis that comprehension of explicit

and implicit metaphors has different neural bases since implicit and explicit text comprehension also differs. Experimental stimuli consisted of a highly matched set of nominal explicit metaphors (The unexpected divorce was an earthquake) and nominal implicit metaphors (The relationship could not withstand the earthquake). Matched literal and anomalous sentences served as controls. Right-handed native English speakers (n=16) categorized visually presented sentences as literal, metaphorical, or anomalous. The N400 response to the last word of the sentence (laterally presented to the left or right) was calculated by averaging electroencephalographic (EEG) recordings at 64 scalp sites and based on the area under the curve from 350 to 500 ms post-stimulus. The N400 amplitude was larger for explicit than implicit metaphors, and larger for right visual field-left hemisphere presentation, with a sentence type x side of presentation interaction. The N400 difference between explicit and implicit metaphors was significant in the right visual field-left hemisphere, but not for left visual field-right hemisphere presentation. Although explicit metaphors are literally not true, it is not clear that this is the case for implicit metaphors. These findings bear on theories of metaphor comprehension that emphasize the literal falsity of metaphor. The obvious non-literal nature of explicit metaphors presents more of a challenge to the left hemisphere while the right hemisphere can process metaphor without regards to this distinction.

C37 THAT SMALL BUT SIGNIFICANT DIFFERENCE BETWEEN FUNCTIONAL AND PART-WHOLE ASSOCIATIONS

Juliane Muehlhaus[1,2], Stefan Heim[1,2,3], Ute Habel[1,2], Katharina Sass[1,2]; [1]RWTH Aachen University, [2]JARA - Translational Brain Medicine, [3]Research Centre Jülich

In the field of speech production research there are still controversies about the underlying organizational patterns and functional networks of semantic knowledge. Therefore, the pre-sent studies examined the influence of functional (e.g, car - garage) and part-whole associa-tions (e.g., bike - handlebars) on single word production. In one behavioral (Exp 1) and one fMRI experiment (Exp 2), two groups of subjects per-formed the same picture-word interference task. They had to name a picture while ignoring a written distractor word whose relationship to the target picture was part-whole or functional, or unrelated. In both experiments, part-whole and functional relations facilitated naming. Additionally, in Exp 1 the facilitation effect was stronger for part-whole compared to functional. In Exp 2, both relations induced activation in widespread left-hemispheric networks with common acti-vation in the mid-portion of left MTG. The comparison of both associative relations revealed distinct activations in left IFG, left posterior MTG, left SMG and posterior region of left rMFC as well as distinct deactivations in left cuneus and left AG. The findings of both experiments support different classification and organization within our semantic network for associative relations. We replicated a common selection process of as-sociations within the mid-portion of left MTG (Abel et al., 2009). The distinct activation patterns within the left IPC might represent an interaction between perception-related and se-mantic processes differently recruited by both types of associations. These distinct patterns seem to differentiate between part-whole and functional in a common facilitation network.

C38 CUMULATIVE SEMANTIC INTERFERENCE (SI) IS NOT LIKE THE SI EFFECT IN BLOCKED CYCLIC NAMING: PERFUSION FMRI EVIDENCE FOR DIFFERING MECHANISMS

Greig de Zubicaray[1], David Howard[2], Katie McMahon[3]; [1]School of Psychology, University of Queensland, [2]School of Education Communication and Language Sciences, Newcastle University, [3]Centre for Advanced Imaging, University of Queensland

Picture naming latencies increase monotonically when exemplars of the same category are named in sequence, irrespective of the lag introduced between items; an effect termed cumulative semantic interference (SI). Two accounts have been proposed: The first implements shared activation of semantic features, priming and lexical selection by competition (LSC) mechanisms (Howard et al., 2006), while the second implements a learning mechanism that makes incremental changes to the connection weights between semantic features and object names (Oppenheim et al., 2010). The latter account was also proposed to explain the SI effect in the blocked cyclic naming paradigm, in which blocks of categorically related and unrelated items are alternated repeatedly. We tested hypotheses from these rival accounts in a perfusion fMRI experiment (N = 24). A significant cumulative SI effect was replicated in the naming latencies, associated with linear increases in perfusion signal in left perirhinal cortex and middle-temporal gyrus, regions associated with processing/priming of visual semantic features and lexical selection, respectively. The results did not resemble those reported for blocked cyclic naming, where perfusion increases in the hippocampal formation and left posterior superior temporal gyrus were interpreted as supporting the incremental learning account (Hocking et al., 2009). We interpret the results as supporting an account in which shared activation of semantic features, priming and LSC mechanisms produce the cumulative SI effect.
References : Howard, D., et al. (2006). Cognition, 100, 464-482. Oppenheim, G., et al. (2010). Cognition, 114, 227-252. Hocking, J., et al. (2009). Journal of Cognitive Neuroscience, 21, 1571-1583.

C39 WHAT IS MEANING?: ANATOMICAL AND FUNCTIONAL CONNECTIVITY OF THE COMMON MEANING SYSTEM FOR LANGUAGE AND VISUAL IMAGES

Anne-Lise Jouen[1], Timothy M Ellmore[2], Carol Madden[1], Sullivan Hidot[1], Peter F Dominey[1], Jocelyne Ventre-Dominey[1]; [1]Stem-Cell and Brain Research Institute INSERM U846, Bron, France, [2]Department of Neurosurgery, University of Texas Medical School, Houston, Texas

Embodied theories argue that the conceptual system is implemented in distributed brain networks shared by perceptual and action. Such meaning representations are accessible by different perceptual routes, including language and vision. Last year (NLC 2011), we presented an fMRI-DTI study (N = 19) which revealed a network common to processing of pictures and sentences including inferior frontal gyrus, the retrosplenial complex, and medial temporal gyrus extending into the temporo-parietal junction and inferior parietal lobe. In the current research, a DTI analysis revealed a privileged network with two "hubs" BA11 and TPJ, linked to the retrosplenial complex (RSC), medial temporal gyrus, inferior frontal gyrus and the caudate nucleus. An ICA-based functional connectivity analysis on the fMRI data using NetBrainWork corroborated the existence of this common network and the two-hub topology. These functional and anatomical data help to define a "meaning" network that includes components of recently characterized systems for semantic memory, embodied simulation, and visuo-spatial scene representation into a coherent framework. We will consider the link between the frontal and parietal hubs to the notion of the convergence zone theory of meaning. The observed network displays substantial overlap with the "default mode" network, implicated as part of a core network of semantic representation, suggesting that the embodiment of understanding extends well beyond the sensorimotor system to include a system that contributes to autobiographical memory, scene analysis and theory of mind. This research is supported by the French ANR Comprendre and EU FP7 projects Organic and EFAA.

C40 MOTOR CORTEX ACTIVITY AFFECTS EARLY ACTION-WORD PROCESSING: MEG-EEG EVIDENCE FOR A CAUSAL LINK BETWEEN LANGUAGE AND ACTION SYSTEMS

Giovanna Mollo[1,2], Friedemann Pulvermüller[1,3], Olaf Hauk[1]; [1]Medical Research Council Cognition and Brain Sciences Unit, Cambridge, UK., [2]Department of Psychology, University of York, UK, [3]Brain Language Laboratory, Department of Philosophy, Freie Universität Berlin, Germany

Embodied theories of semantics claim that sensorimotor areas of the brain are essential for storing the meaning of words, but the crucial question of how activation in the sensorimotor system affects language performance is yet unanswered. Behavioral and metabolic neuroimaging studies cannot tell us whether action-language interactions occur at a semantic or post-semantic processing stage. We here used a motor-priming paradigm to demonstrate effects of motor cortex activity on language processing, exploiting the temporal and spatial resolution of combined EEG/MEG measurements. Participants performed a two-alternative forced choice task on word stimuli; they initiated experimental trials by pressing a button either with their index finger or foot. Stimuli included well-matched arm- and leg-related action-words. We hypothesized that if motor cortex is part of cell assemblies representing the words' semantics, the congruency between effector type for the button press should interact with word category in motor as well as non-motor brain areas. The ROI analysis on MNE source estimates showed that, 150 ms after word onset, significant congruency effects between effector- and word-type were present both in left hand motor and posterior superior temporal cortex. These results demonstrate that motor cortex activation affects non-motor language areas early-on, and indicate a causal link between the motor and language systems.

C41 CONTEXTUAL EFFECTS ON MOTOR ACTIVATION DURING "ACTION WORD" PROCESSING: GRIP FORCE STUDY OF VOLITION DENOTING SENTENCES

Pia Aravena[1], Viviane Deprez[1], Yves Paulignan[1], Anne Cheylus[1], Victor Frak[2], Tatjana Nazir[1]; [1]L2C2-Institut des Sciences Cognitives, CNRS/UCBL, Université Claude Bernard Lyon1, Lyon, France, [2]Faculté des sciences, Université du Québec à Montréal. Institut de Réadaptation Gingras-Lindsay de Montréal, Centre de Recherche Interdisciplinaire en Réadaptation du Montréal Métropolitain, Université de Montréal, Canada.

Although motor activation during action-word-processing has received considerable attention, the effects of the linguistic context have largely been overlooked. To assess how flexible and context dependent motor activation during language processing may be, we experimentally tested the impact of volition modality (want to do) on this activation: volition modality sets an action in a irrealis perspective, since to want to do X presupposes that X is not currently being done. Our experimental design relied on a novel experimental technique developed in our lab (Frak et al., 2010; Aravena et al., submitted), using a grip-force sensor (ATI mini-40) to measure online the effects of language processing on motor behaviour. Participants held the grip-force sensor with closed eyes throughout the experiment while listening to orally presented French action and non-action words in affirmative vs. volitive sentences. Relative to non-action words a significant enhancement of grip force was observed for action words in declarative sentences starting around 250ms after target word onset. In volitional contexts, however, the same action-words elicited a reduced grip-force amplitude. Our results clearly demonstrate that motor brain structures are not activated mandatorily during the processing of action words; motor activation is modulated by the linguistic context and more specifically, the manner in which the corresponding action concept is recruited. Consequences for models of embodied semantics are discussed. Our findings further confirm that our simple experimental

paradigm can advantageously be used for enlighten online studies of the crosstalk between language and the motor systems that are also ecological.

C42 EVENT-PARTICIPANT PRIMING IN SPANISH: A BEHAVIORAL, CORPUS AND ELECTROPHYSIOLOGICAL APPROACH

Camila Zugarramurdi[1], Alvaro Cabana[1,2], Leonel Gómez[2], Juan Valle-Lisboa[1,2]; [1]Fac. de Psicología, Universidad de la República, Uruguay, [2]Fac. de Ciencias, Universidad de la República, Uruguay

The notion of a static and passive lexicon has been questioned based on several converging approaches. Recently, some reports have pointed out that the amount of information stored in the lexicon can be huge and diverse, casting doubts on the idea of the lexical store being a relevant entity. In particular it has been shown that nouns that denote events are effective primes for the nouns that denote the typical participants of the corresponding events and nouns that denote objects. We replicated the experiments of Hare and coworkers (Cognition, 2009, vol 111, pg 151) using nouns in Spanish. A set of the nouns denoting events shows a clear effect of priming over participants, but there is another set that shows the reverse pattern. This difference resisted changes in the protocol aimed at reducing variance or at improving the training of participants. In order to better understand this difference we created an LSA space based on the Spanish version of Wikipedia. We measured the cosine distance between primes and targets in the space showing that in most cases where no priming was observed the distance between unrelated pairs was effectively smaller than the distance between related pairs of words. In order to analyze the Neurobiological basis of such robust difference, we started analyzing the Electroencephalographic response using an evoked potential protocol and a wavelet approach. A set of hypothesis about the organization of the lexicon is presented based on the relationship between behavioural, EEG, and LSA data.

Motor Control, Speech Production, Sensorimotor Integration

C43 CORTICOBULBAR EXCITABILITY DURING SPEECH PRODUCTION REFLECTS A LEFT-HEMISPHERIC SPECIALIZATION FOR A STATE FEEDBACK CONTROL MECHANISM IN FLUENT SPEAKERS BUT NOT IN ADULTS WHO STUTTER

Nicole Neef[1], Linh Hoang[1], Walter Paulus[1], Andreas Neef[1,2], Martin Sommer[1]; [1]Goettingen University, [2]MPI for Dynamics and Self-Organization

For decades theories of speech production postulate that selection and execution of speech units arise from facilitation of target units and inhibition of others. We present the first measurement of motor unit facilitation during speaking in real time. Excitability tuning of layer V pyramidal cell populations is quantified by MEP recordings from the tongue. Thirteen fluent speakers und thirteen adults who stutter were asked to build compound verbs with the verbal prefix "auf". Single-pulse transcranial magnetic stimulation was applied over the primary motor cortex during the transition phase between a fixed labiodental articulatory configuration and very subsequent articulatory configurations, at five different latencies after transition onset. Bilateral electromyography was recorded from the upper top of the tongue. Off-line, we extracted the MEP-amplitudes and normalized these amplitudes to the individual baseline excitability during the fixed configuration. Fluent speakers demonstrated a prominent left hemispheric increase of motor cortex excitability in the transition phase. On the contrary, the excitability of the right primary motor tongue representation remained unmodified. Interestingly, adults afflicted with stuttering revealed a lack of left-hemispheric facilitation. Our novel method provides the unique prospect to directly proof the hierarchical state feedback control model of speech production at the level of the primary motor cortex. Furthermore, our results indicate a left-hemispheric specialization of a proposed state feedback control mechanism in fluent speakers and a lack of hemispheric-specialization in stuttering. Such data can guide the much needed integration of psycholinguistic and motor control approaches to speech production at a neurobiological level.

C44 ICA OF MULTI-MODAL EEG DATA REVEALS SHARED NEURAL MECHANISMS FOR THE INTERPRETATION OF LINGUISTIC AND NON-LINGUISTIC STIMULI

Jona Sassenhagen[1], Franziska Kretzschmar[2], Matthias Schlesewsky[2], Ina Bornkessel-Schlesewsky[1]; [1]University of Marburg, [2]University of Mainz

Neurolinguistic EEG research often emphasizes the functional specificity of ERP components (e.g. "N400 indexes semantic processing"). However, this perspective neither takes into account how the mixing of multiple signals constitutes the EEG nor explains how language-related EEG modulations might fit into a more general framework of brain activity. Here, we used Independent Component Analysis (ICA) to examine possible shared sources in multi-modal processing. We analyzed the (64-channel) EEG of participants (n=30) performing an antonym processing task. Sentences (e.g., translated from original German, "The opposite of black is white/yellow/nice.") were presented auditorily, followed by a visual probe (task: sensicality judgement) and manual response. ICA revealed shared brain sources across all modalities (auditory linguistic, visual, motor). Time-frequency and single-trial analysis differentiated two types of sources: those sensitive to external stimuli, and those sensitive to internal events. 'External' sources (including generators in ACC) showed target-sensitive ERP effects to both critical words and probes. They further tracked the continuous speech signal prior to critical words, displaying quasi-oscillatory anticipatory behavior. 'Internal' sources (including IFG) showed neither oscillatory pre-stimulus nor probe-locked activity, but contributed to response-

and target word-related ERPs, presumably via inhibition/facilitation of internally generated motor impulses. These results provide a first indication of how sentence processing might be integrated into a general action-perception loop. Critical words are partially tracked by the same brain mechanisms that also process task-relevant non-linguistic input.

C45 LEFT PRECENTRAL ROLE IN READING HINDI/DEVANAGARI: SUPPORT FOR COVERT ARTICULATORY REHEARSAL DURING WORD RECOGNITION?

Chaitra Rao[1], Nandini Singh[1]; [1]National Brain Research Centre, Mansesar, India

Despite its implication in sub-vocal rehearsal (working memory) and the fronto-temporal auditory-motor loop (speech processing), the role of the left precentral gyrus (L_PCG) in visual word recognition remains underspecified. We present for the first time evidence supporting a critical role for the L_PCG in reading a phonologically transparent orthography. Two fMRI experiments assessed neural activation during overt word reading in Hindi, written in Devanagari script (henceforth Hindi/Devanagari), whose alphasyllabic orthography promotes awareness of sound – symbol mapping by highlighting fine-grained phonetic distinctions including vowel length (इ vs. ई: /ɪ/ vs. /i:/), minimal contrasts (इ vs. ख: /ka/ vs. / kha/) and phonetic compositionality of syllabic akṣaras (/kɪ/: क + ि = कि; /ku:/: क + ू = कू). 3T fMR images (30 axial T2 slices at TR/TE=2s/35ms, flip angle=90°, FOV=230mm, 64×64 matrix, in-plane resolution 3.59mm×3.59mm, slice thickness=4mm, 1mm gap) were acquired as groups of 21 and 14 native adult readers read a 240-word list and compared respectively against passive fixation (exp. 1) and articulatory baselines (exp. 2 – responding "Hindi," to false-font strings). Analyses (SPM5) revealed activation (FDR $p<.05$) in both experiments of universal reading network areas (bilateral posterior occipital, left occipito-temporal and inferior frontal), besides robust L_PCG activation (MNI -54 0 26) corresponding to sites previously implicated in sub-lexical phoneme and syllable as well as pseudoword processing. We attribute the observed L_PCG activation to covert articulatory rehearsal, which we propose is integral to reading the highly transparent, alphasyllabic Devanagari orthography. Further corroboration from transparent alphasyllabaries is needed.

C46 DISTINCT BRAIN NETWORKS UNDERLYING WORD SEGMENTATION REVEALED BY INDEPENDENT COMPONENT ANALYSIS

Diana Lopez-Barroso[1,2], Pablo Ripollés[1,2], Josep Marco-Pallarés[1,2], Antoni Rodríguez-Fornells[1,2,3], Ruth De Diego-Balaguer[1,2,3]; [1]Cognition and Brain Plasticity Group [Bellvitge Biomedical Research Institute-IDIBELL, L'Hospitalet de Llobregat, Spain, [2]Dept. of Basic Psychology, University of Barcelona, Barcelona, Spain, [3]Catalan Institution for Research and Advanced Studies, ICREA, Barcelona, Spain

Word segmentation (i.e. detecting word boundaries from a continuous speech) is one of the most difficult problems that learners should face when learning both first and second language. Although previous neuroimaging studies have shed light on the neural processes supporting it, functional connectivity studies during this process are lacking. In the present work, we used a multivariate method, Independent component analysis (ICA), to examine the brain functional networks active while participants were required to learn artificial language streams made by concatenated syllables. These speech streams contained both statistical regularities and prosodic cues that could be exploited for segmentation. ICA method allows the separation of the underlying brain activity into a set of spatially independent networks each of them synchronized in their time course. It has been proposed that ICA can extract the networks that represent the functional integration of an active brain. Results showed three different active networks while subjects were segmenting speech: i) an audio-motor network that showed activation mainly in bilateral superior temporal gyri, precental gyri and supplementary motor area; ii) a sensory-motor network extending mainly through both pre and post central gyri and the supplementary motor area; iii) a network showing a more left lateralized activation covering the classical language related areas in left frontal, temporal and parietal lobes. In addition, the default network appeared negatively correlated with the task. These results provide further evidence and support the functional integration hypothesis considering that complex cognitive processes as language learning are subserved by different identifiable separated brain networks

C47 NONINVASIVE BRAIN STIMULATION FACILITATES SPEECH MOTOR LEARNING

Jennifer Chesters[1], Hsin-jen Hsu[1], Dorothy Bishop[1], Riikka Mottonen[1]; [1]Oxford University

Anodal transcranial direct current stimulation (tDCS) has been shown to increase neuronal excitability and enhance learning, for example in motor and language tasks. Here, we investigated whether anodal tDCS can modulate learning to articulate novel sound sequences (non-words). 14 healthy participants were trained on a set of complex non-words. During training, participants repeated each word 10 times as accurately as possible. In the brain stimulation session, participants completed the training whilst receiving 20 minutes of 1mA anodal tDCS applied to left inferior frontal cortex. In a control session,

participants completed the training combined with sham stimulation. These sessions were separated by at least one week. Effects of training were measured at 1 hour and 24 hours after training. In these post-training tests participants repeated the trained set and an untrained non-word set. We found an interaction between the effects of training and brain stimulation on accuracy of non-word repetition ($F1,13= 9.15$, $P =.01$). Specifically, when training was combined with anodal stimulation, trained non-words were repeated more accurately than untrained non-words at one hour after training, and this training-induced improvement was maintained 24 hours later ($F1,13= 28.12$, $P =.001$). However, when training was combined with sham stimulation, training had no effect of on accuracy of non-word repetition. Our results demonstrate that anodal tDCS of left inferior frontal cortex can improve learning of speech motor skills. This suggests that non-invasive brain stimulation may have a clinical application in the treatment of speech disorders.

Orthographic Processing, Writing, Spelling

C48 ON MODALITY OF THE VISUAL WORD FORM AREA

Philipp Ludersdorfer[1], Eugenia Kulakova[1], Matthias Schurz[1], Fabio Richlan[1], Martin Kronbichler[2,1], Heinz Wimmer[1]; [1]University of Salzburg, [2]Paracelsus Private Medical University Salzburg

The Visual Word Form Area (VWFA) in the left occipito-temporal cortex is considered to be critically involved in fluent word reading. One of several critical issues concerns its modality. The original unimodal visual characterization by L. Cohen and S. Dehaene (Cohen et al., 2000; 2002) was questioned by Price and Devlin (2003; 2011), who argued for multimodality of the VWFA. We present data from three fMRI studies which examined the response of the VWFA to printed and spoken words or sentences. We found little support for the implication of the multimodality assumption, that the VWFA should exhibit activation to both printed and spoken stimuli. Two of our studies failed to identify the VWFA with common activation when printed and spoken stimuli were compared to the fixation baseline. One study did find such common VWFA activation when spoken sentences were compared to tone-matching, but the response of the VWFA was "zero" activation to spoken sentences, compared to "negative" activation to tone-matching. We conclude that it is important to distinguish between the modality of how printed words are represented and how such representations are accessed. We propose that unimodality applies to the representations (assumed to be visual orthographic), and multimodality applies to modes of access, with reading representing the typical visual mode and writing representing the typical non-visual mode of access to orthographic word memories.

C49 WRITTEN SENTENCE PRODUCTION IN DYSLEXIA: A PRODUCT AND PROCESS PERSPECTIVE

Frøydis Morken[1], Turid Helland[1]; [1]University of Bergen

In dyslexia research, writing has received less attention than reading. This study examined written sentence production in children with dyslexia (DYS) and children with typical literacy skills (TYP). Product and process perspectives were combined, looking at spelling, grammar, and semantic errors, together with transcription fluency and revisions. To isolate these lower-order writing components from higher-order skills, sentence dictation was employed. Moreover, relations to rapid naming (RAN) and working memory (WM), benchmark deficits in dyslexia, were examined. Hypotheses: (1) DYS would write more slowly, and produce more errors; (2) DYS would make fewer revisions; (3) RAN and transcription fluency would correlate; and (4) WM and number of errors would correlate. Participants were 42 children (13 DYS, 29 TYP), age 11. Sentences of varying length and orthographic complexity were read aloud twice. The child typed them as correctly as possible on a computer, without time constraints. A programme for key-stroke logging was used, allowing monitoring of the writing process and analysis of the output. Furthermore, tests of RAN (Stroop colour naming) and WM (WISC, digit span) were administered. Data were analysed with repeated measures ANOVA and t-tests. Hypothesis (1) was largely confirmed. Especially semantic errors showed clear group differences. Hypothesis (2) was not confirmed (no group differences). Hypothesis (3) and (4) were largely supported. This indicates that: (1) children with and without dyslexia work equally hard with text production, but children with dyslexia produce poorer output, (2) RAN influences writing processing, (3) WM influences output. This should influence teaching and learning strategies.

C50 MODULATING WORD DECODING FLUENCY IN DYSLEXIC AND NORMAL READERS WITH DIRECT CURRENT STIMULATION OF THE LEFT TEMPOROPARIETAL JUNCTION

Nicola Savill[1,2], Nicholas Davis[1], R. Martyn Bracewell[1], Guillaume Thierry[1]; [1]Bangor University, [2]University of York

The left temporoparietal junction (lTPJ) is consistently activated in fMRI tasks involving reading and is implicated in processing correspondences between the orthographic and phonological form of written words. It is reliably found underactive in dyslexic relative to normal individuals during reading tasks. This study investigated whether increasing neural excitability in the lTPJ using anodal transcranial direct current stimulation (tDCS) would induce immediate improvements in reading fluency in dyslexic and normal reading adults. We tested right-handed, native speakers of English, who were either normal, skilled readers or had a diagnosis of developmental dyslexia, before and after anodal tDCS (1.5 mA, 15 mins) over the lTPJ. We measured performance on (a) standardised measures of word (WRE) and

nonword reading efficiency (NWRE) and (b) equivalent versions of a phonological decoding fluency task (PDT), in which participants rapidly discriminated pseudowords on the basis of their phonology (i.e., decided whether pseudowords were homophonic to real words) over two sessions (one active and one sham) a minimum of one week apart. We found significantly larger improvements in WRE and NWRE after anodal tDCS as compared to sham stimulation in both groups. For normal readers, tDCS improvements were specific to NWRE. Critically, dyslexic readers showed greater relative improvements in WRE and NWRE after tDCS, with the greatest change for NWRE. PDT performance indicated that improvements were not reducible to generic tDCS effects. These data suggest that anodal stimulation of lTPJ can boost reading efficiency and may have potential as a clinical intervention in dyslexic readers.

C51 REPETITION, SEMANTIC, AND PHONOLOGICAL MASKED PRIMING: AN MEG STUDY

Lesley A. Sand[1], Peitzu Tsai[2], Alice F. Jackson[1], Donald J. Bolger[1]; [1]University of Maryland, [2]San Jose State University

Previous research has suggested that the time course of visual word recognition progresses in a cascading manner ~100-400ms post-stimulus for orthography, phonology, morphology, and semantics (Holcomb & Grainger, 2007) or occurs near-simultaneously at ~100-250ms (Pulvermuller, 2009). Masked priming studies present conflicting findings: when repetition- and semantic priming were employed concurrently, repetition effects occurred in both N250 and N400 components, but no semantic effects were shown (Holcomb & Grainger, 2009), but when presented in separate experiments, semantic priming was observed in the N400 (Holcomb, 2005). The present MEG study attempts to distinguish the time course of visual word processing using masked repetition-, phonological-, and semantic priming within the same group of participants. We predict that 1) the M170 will be modulated by repetition priming and, to a lesser degree, phonological priming, and 2) the M350 will be modulated by semantic priming. MEG data was collected while participants completed a masked priming lexical decision task. Primes consisted of identical, semantically related, phonologically related, and unrelated words of similar length and frequency. ANOVA analyses of peak amplitude and latency in the M170 (100-250ms) and M350 (275-500ms) time windows yielded significant differences in the M170 time window, such that unrelated primes elicited the latest peak and identical primes elicited the earliest peak. Peaks for semantic and phonological primes were earlier than the peak for unrelated primes. These findings provide support for the notion of near-simultaneous processing suggested by Pulvemuller and colleagues (2009).

C52 LATERALITY IN VENTRAL OCCIPITOTEMPORAL CORTEX CORRELATED WITH LATERALITY IN PRECENTRAL AND INFERIOR FRONTAL GYRI DURING WORD PROCESSING

Mohamed L Seghier[1], Cathy J Price[1]; [1]Wellcome Trust Centre for Neuroimaging, Ion, UCL, UK-London

Introduction: In 82 skilled readers, we previously showed that the determinants of lateralization for words varied between posterior (pvOT), middle (mvOT) and anterior (avOT) ventral occipitotemporal subregions [1]. Here, we used a covariance analysis, across subjects, to search the whole brain for areas where the degree of laterality varied similarly with that in one or more of the vOT subregions. Methods: FMRI data were collected at 1.5T while subjects read aloud or made semantic decisions on written words. First-level analyses used standard procedures in SPM8. Voxel-based laterality maps (LM) coded hemispheric differences for each task, at each voxel, for each subject [1]. Second-level covariance over LM searched the whole brain for voxels that correlated across subjects with laterality in each seed region (pvOT, mvOT or avOT). Results: All effects are reported at $p<0.05$ corrected. During semantic decisions, laterality of word activation correlated (1) in pvOT with laterality in precentral gyrus, (2) in mvOT with laterality in pars triangularis, ventral precentral and dorsal supramarginal gyrus, (3) in avOT with laterality in pars orbitalis, posterior prefrontal and dorso-medial thalamus. During reading aloud, laterality of word activation in mvOT correlated with laterality in precentral gyrus, but correlations with laterality in pvOT or avOT were not significant in any region. Conclusion: Lateralization for words in different vOT subregions is correlated with lateralization in different frontal regions. Future work is needed to investigate effective connectivity between these regions. [1] Seghier and Price (2011). Explaining left lateralization for words in the ventral occipitotemporal cortex. JNeurosci 31:14745.

C53 FORGET ABOUT THOSE CONSONANTS... IF YOU CAN!

Stéphanie Massol[1], Manuel Carreiras[1,2], Jon Andoni Duñabeitia[1]; [1]Basque Center on Cognition, Brain and Language (BCBL); Donostia, Spain, [2]Ikerbasque, Basque Foundation for Science; Bilbao, Spain

The present ERP study explores whether or not two explicitly presented letter strings that share the same consonants but that differ in their vowels are processed as being highly similar. We expected that two strings sharing their consonants would exert mutual co-activation as compared to two strings without consonantal overlap. In order to explore the extent to which this consonantal overlap corresponds to a mere perceptual similarity or if it is influenced by feedback lexical mechanisms, word-word pairs as well as word-nonword pairs were tested. Targets were presented preceded by a referent word that could either share all the consonants at the same position or have no letters in common. Participants performed an explicit perceptual matching task. Results showed a

clear-cut lexical influence in the early N1 component, where only word-word pairs showed a relatedness effect. Starting at 200ms, a generalized relatedness effect was found for word-word and word-nonword pairs in the N2/P3 complex. Next, we run a replication of this study with string pairs that shared all the consonants but in a different absolute position (while keeping their relative positions intact). Interestingly, a highly similar pattern of ERP results was found showing that in spite of the mismatch of the concrete positions of the shared consonants, as long as the relative order of the consonants is preserved the two strings exert mutual interference. These data highlight the importance of consonants in reading and demonstrate that strings containing the same consonants are processed as being highly similar to each other.

C54 AUTOMATIC NEURAL PROCESSING OF UNATTENDED LEXICAL INFORMATION IN VISUAL MODALITY

Yury Shtyrov[1], Francesca Carota[1], Clare Cook[1], Galina Goryainova[2], Lucy J. MacGregor[1]; [1]MRC Cognition & Brain Sciences Unit, Cambridge, UK, [2]University of St. Petersburg, Russia

Previous studies have established that the brain is capable of automatic lexical analysis of spoken language even in the absence of attention on the linguistic input. This was attributed to the activation of strong and robust word memory traces in the brain. Such an account would predict the automatic activation of these memory traces upon any presentation of linguistic information, irrespective of the modality in which it is presented. However, to date, linguistic experiments in the visual modality have not been able to explore this phenomenon, as they have usually presented stimuli (even if masked) in the focus of attention. Here, we present a series of neurophysiological studies in different languages which investigated the possibility of automatic processing of unattended lexical stimuli in the visual modality. Matched words and pseudowords were presented to volunteers outside the focus of attention while they were engaged in a non-linguistic visual dual task of detecting colour combinations in the centre of their visual field. Event-related EEG and MEG responses revealed a complex time course of brain activation dynamics underpinning lexical processing. Differential processing of words and pseudowords started early, from around 100 ms, and continued over extended time of a few hundred milliseconds. The results suggest that automatic neural processing of linguistic information is a universal phenomenon taking place in the visual as well as auditory modality. The earliest attention-independent neural activity to lexical stimuli may reflect the first-pass processing of linguistic information in the brain that precedes attention-dependant stages.

Phonology, Phonological Working Memory

C55 THE INTERPLAY BETWEEN SOUND AND EMOTIONAL CONTENT OF WORDS: AN ERP STUDY

Susann Ullrich[1], Markus Conrad[1,2], Arash Aryani[1], Arthur M. Jacobs[1]; [1]Freie Universitaet Berlin, Germany, [2]Universidad de La Laguna, Tenerife

The old discussion whether there is a relation between sound and meaning in language is still up-to-date. Quite some amount of research throughout the 20th century indicates that such thing as phonosymbolism exists, meaning a non-arbitrary relation between sound and meaning – contrary to Saussure's statement "The link between signifier and the signified is arbitrary" (1916). We are, thus, focussing on correlations between semantic affective values of German words, i.e. valence and arousal ratings, and the sounds they contain. Extrapolated predictions for whole words' emotional sound values from subsyllabic affective values already showed systematic and significant correlations with the respective whole word ratings (Conrad et al., in prep.). To test whether interactions between sound and meaning can also be seen at the level of brain activity, we are currently running a lexical decision EEG experiment involving a 2x2 design (comparing negative valence/high arousal and neutral valence/low arousal at both the semantic and sound level) to decipher the influence of words´ sound on the perception of their semantics in terms of differential EEG patterns. Data will be ready to present at the SNL conference in October. Our hypotheses involve effects of consistency between words´ sound and emotional semantic content in the ERP data. In particular, we expect these consistencies to modulate the size of classical ERP components for the processing of emotion-laden words as an early posterior negativity (EPN) and a late positive complex (LPC), suggesting that consistent sublexical sound properties facilitate emotion processing.

C56 CHARTING THE FUNCTIONAL RELEVANCE OF BROCA'S AREA FOR VISUAL WORD RECOGNITION IN ENGLISH USING FMRI-GUIDED TMS

Katherine L. Wheat[1,2], Piers L. Cornelissen[3], Alexander T. Sack[1,2], Teresa Schuhmann[1,2], Rainer Goebel[1,2], Leo Blomert[1,2]; [1]Maastricht University, NL, [2]Maastricht Brain Imaging Centre, NL, [3]University of York, UK

Previous magnetoencephalography (MEG; Wheat et al., 2010) and electroencephalography (EEG; Ashby, 2011) results show phonological effects at Broca's area (specifically pars opercularis of left inferior frontal gyrus and precentral gyrus; LIFGpo/PCG) within ~100 ms of viewing a word, consistent with involvement in fast phonological access or conflict-resolution mechanisms. However, in a recent transcranial magnetic stimulation (TMS) study in Dutch, LIFGpo/PCG was not shown to be functionally relevant for reading aloud until 225 ms after viewing a written word (Wheat et al., 2012),

later than suggested by MEG and EEG in English. We hypothesise that native English readers learn to make use of the frontal reading network for the early stages of visual word recognition in order to disambiguate between competing pronunciations, resulting in differences in the timing of LIFGpo/PCG involvement between Dutch (less orthographically opaque) and English (more opaque). Native-English speaking participants read aloud English words while receiving chronometric TMS. The target site was defined from each individual's fMRI localiser. Double-pulses of TMS (40 Hz) were applied at 8 different latencies from target onset; 0-25, 50-75, 100-125, 150-175, 200-225, 250-275, 350-375, and 500-525 ms. Baseline VRTs were calculated from no-pulse trials at the start and end of the session. Preliminary analyses show significant ($p<.05$) differences from baseline as early as 100 ms after viewing a word. Differences between two word categories (consistent, high-frequency, high-imageability words, and inconsistent, low-frequency, low-imageability words) will also be explored. There may be differences in the recruitment of reading related areas between native-Dutch and native-English readers.

C57 NEURAL ACTIVITY DURING AUDITORY LANGUAGE PROCESSING IN OF BILINGUAL AND MONOLINGUAL DEVELOPMENT

Arturo Hernandez[1], Pilar Archila-Suerte[1], Victoria Wagner[1], Isabell Wartenburger[2]; [1]University of Houston, [2]University of Potsdam

The current set of studies are designed to uncover the nature of auditory language processing in a group of early German-English, Spanish-English and English monolinguals. All three groups were tested with auditory language stimuli. The results revealed strong effects of language proficiency in the bilingual groups for both simultaneous and sequential bilinguals. Specifically, simultaneous German-English bilinguals show stronger activity in the superior temporal gyrus in German relative to English. This pattern is similar to what is observed in monolingual chidden. However, sequential Spanish-English bilinguals showed increased activity in the STG during early development with an increase in brain activity in executive function areas across development. Specifically, there was increased activity in general executive control areas especially in late childhood with some residual activity still present in adulthood. Taken together these results reveal a considerable amount of plasticity in the language system across development. They also elucidate how bilinguals may utilize different neural resources to process auditory language and how those resources change with age and proficiency.

Signed Language

C58 READING ABILITY IN ADULT DEAF NATIVE SIGNERS IS POSITIVELY ASSOCIATED WITH THEIR ABILITY TO JUDGE THE GRAMMATICALLY OF THEIR NATIVE SIGN LANGUAGE

Mary Rudner[1], Eleni Orfanidou[2,3], Velia Cardin[2], Cheryl Capek[4], Bencie Woll[2], Jerker Rönnberg[1]; [1]Linnaeus Centre HEAD, Swedish Institute for Disability Research, Linköping University, Sweden, [2]Deafness, Cognition and Language Research Centre, University College London, UK, [3]Department of Psychology, University of Crete, Greece, [4]School of Psychological Sciences, University of Manchester, UK

For deaf native sign language users, learning to read means acquiring a second language. With limited access to the phonology of spoken language, it is difficult to establish the connection to orthography, which is a key to reading for hearing individuals. For hearing individuals, reading ability is often associated with working memory capacity (WMC) and phonological processing abilities (PPA). However, this association is not as clear-cut for deaf individuals, whose reading ability is usually poorer and who may have a different route to reading. In the present study we compared English reading skill (Vernon-Warden Reading Comprehension Test Revised, 1996) in adult deaf native users of British Sign Language (BSL, n=24) with hearing, non-signing native English speakers (n=24) matched for age and non-verbal intelligence. We also explored the association between reading level, PPA and WMC in both groups and between reading level and performance on the BSL Grammaticality Judgement Task (BSLGJT; Cormier et al., 2012) in deaf signers. Consistent with previous findings, the average reading level was lower for deaf signers than for hearing non-signers (mean reading age: 16 years vs. adult, respectively) and, for hearing non-signers, reading level was positively associated with WMC and PPA. In contrast, for deaf signers, we found no association between reading skill and WMC, English PPA or BSL PPA; instead, reading level was positively associated with BSLGJT performance. These novel findings suggest that, in deaf native signers, higher level sign language skills, such as grammatical knowledge, may provide a route to reading.

C59 THE ONLINE PROCESSING OF CLASSIFIER CONSTRUCTIONS IN AUSTRIAN SIGN LANGUAGE (ÖGS): AN ERP STUDY

Dietmar Roehm[1], Julia Krebs[1], Ronnie Wilbur[2]; [1]University of Salzburg, [2]Purdue University

Very few ERP studies have investigated sign language processing with real-time video presentations (e.g. Capek et al., 2009). Previous studies of lexical-semantic processing in sign language have shown that semantically deviant structures lead to N400 effects similar to spoken/written language. The picture for morphosyntactic processing is less clear. Capek et al. (2009) and Hosemann et al. (2011) report an early negativity–late positivity (LAN/P600) pattern for verb agreement violations (path movement

violations). However, little or none is known about the processing of classifier constructions (CLs) although classifiers are regarded as highly specific and unique for sign language (Emmorey, 2003). A special characteristic of CLs is that they meet the phonological form for a single, simple sign but are morphosyntactically complex. The present study investigates whether violations of CLs in ÖGS lead to lexical-semantic processing effects (N400) or morphosyntactic processing effects (LAN/P600). Two conditions (MOTORBIKE B-CL-UP OPPOSITE+PART WHAT …) in which the sentence final classifier sign (MOTORBIKE B-CL-DOWN) either was correct (palm side) or incorrect (palm down) were presented as real-time videos to 15 deaf native signers. ERPs were calculated with respect to two trigger points reflecting different parameters in sign production: (i) offset of the pre-critical sign ("WHAT"), and (ii) handshape of the classifier (a widely accepted indicator of the start of a sign). The Results show that incorrect compared to correct classifiers elicit an LAN / P600 pattern which typically shows up for morphosyntactic violations in spoken/written language. These findings lend credence to the postulated complexity of classifier constructions.

Syntax, Morphology

C60 GENETIC FACTORS IN THE CEREBRAL ASYMMETRIES FOR LANGUAGE AND MUSIC

Daniela Sammler[1,2], Angela D. Friederici[1], Roeland Hancock[3], Roberta Bianco[1], Thomas G. Bever[3]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]University of Glasgow, Glasgow, UK, [3]University of Arizona, Tucson, USA

It is widely debated whether human right-handedness and the left-cerebral dominance for language are genetically linked. Evidence for this assumption comes from studies showing that right-handers with purely dextral family backgrounds (FS-) display more strongly left-lateralized brain activations during language comprehension tasks than right-handers with familial sinistrality (FS+; i.e. who have one or more left-handed relatives). Behaviorally, this variability in cerebral asymmetry has been linked to a stronger reliance on syntactic information in FS- than FS+ right-handers. The present EEG-study contrasted this FS-mediated variability in syntactic processing style and cerebral asymmetry in language and music. 24 FS- and 24 FS+ right-handers (all native German speakers and nonmusicians) participated in two separate language and music experiments presenting sentences and chord sequences with and without syntactic violations – phrase-structure violations in language and harmonic violations in music. FS- individuals showed a left-lateralized early anterior negativity to language phrase-structure violations and a right-lateralized early anterior negativity to music-syntactic violations. Conversely, FS+ individuals showed bilateral patterns to both kinds of stimuli. Furthermore, the degree of lateralization of both the language- and music-syntactic negativity was correlated with the participants' genetic liability of being left-handed. The combined findings demonstrate a domain-general covariation of familial handedness and cerebral asymmetry for syntax processing. More generally, this suggests a partly genetic basis for the functional cortical organization of language and music and syntactic processing style. Experimental research and clinical applications should regularly include familial handedness as a variable.

C61 TOWARDS A NEUROCOMPUTATIONAL MODEL OF THE ACTOR-STRATEGY IN LANGUAGE COMPREHENSION

Phillip Alday[1], Matthias Schlesewsky[2], Ina Bornkessel-Schlesewsky[1]; [1]Philipps Universität Marburg, [2]Johannes Gutenberg Universität Mainz

Neurophysiological data from typologically diverse languages provide evidence for an actor-based interpretation strategy in language comprehension (Bornkessel-Schlesewsky & Schlesewsky, 2009). It seeks to identify the participant primarily responsible for the state of affairs ("actor") as quickly and unambiguously as possible. Here, we present an initial quantitative model of the actor-strategy, which follows from constraints in the time (word order) and space domains (person, number), as well as reflecting broad organizational principles (animacy) or language-specific cues (agreement and morphological marking). Based on these cues and their language-specific weighting, it provides several measures of the degree of competition for the actor role between arguments, including unweighted ("DIST"; Manhattan metric) and weighted distance measures ("SDIFF"; scalar difference of the dot products of the argument feature and weight vectors). We tested the predictiveness of these measures using an ERP study on sentence processing in German. Participants (n=37) read simple transitive sentences (structure: NP-Verb-NP) with varying word order, informativity (ambiguity) of case marking and relative prominence of the two arguments. Linear mixed effects modeling revealed that, while both metrics correlated with ERP amplitude (N400 and P600), SDIFF provided better model fits than DIST. These findings suggest that a weighted measure of actor competition is a better predictor of electrophysiological responses than an unweighted distance metric. This indicates that actor competition and its neural implementation cannot be reduced solely to similarity-based interference, but must rather take into account the language-specific importance of the critical information sources. We will further discuss qualitative differences between N400 and P600.

C62 NEURAL CORRELATES OF PROCESSING ENGLISH PASSIVE SENTENCES

Aya Meltzer-Asscher[1], Jennifer Mack[1], Julia Schuchard[1], Cynthia K. Thompson[1]; [1]Northwestern University

Introduction: Research examining the neural mechanisms of noncanonical sentence processing indicates a left-hemisphere network including anterior and posterior perisylvian regions (Ben-Shachar et al., 2003; Fiebach et

al., 2005; Thompson et al., 2010). This work has primarily focused on wh-structures (e.g, object relatives). Although passive sentences likewise involve noncanonical argument mapping, they differ from wh-structures in their syntactic properties (Chomsky, 1981) and processing (Osterhout & Swinney, 1993). In several previous studies, passive sentences have elicited inferior frontal gyrus (IFG) activation (Kinno et al., 2008; Ye & Zhou, 2009; Yokoyama et al., 2006, 2007), but mixed findings have been reported with respect to posterior activations. Methods: 12 young adults performed a sentence-picture matching task using fMRI. Reversible active and passive sentences were presented auditorily in separate blocks. Scanning took place on a Siemens TIM Trio 3T scanner. Data analysis was performed in SPM8 with group analyses thresholded at $p < .005$ (uncorrected). Results: Passive sentences, relative to active sentences, elicited greater activation in the left IFG (BA 44, 45) and left superior temporal gyrus (STG)/angular gyrus (AG). The reverse contrast showed no activated areas. Discussion: English passive sentences activated a network similar to that found for wh-structures. Greater activation in the left IFG likely reflects the increased syntactic processing demands of noncanonical structures. Passive sentences also recruited the left STG and AG, which may support non-canonical argument mapping (Hirotani et al., 2011). This suggests that despite linguistic and processing differences between passives and wh-structures, their neural correlates overlap substantially.

C63 SENSITIVITY TO SYNTACTIC COMPLEXITY THROUGHOUT THE DOMAIN-GENERAL "MULTIPLE DEMAND" SYSTEM

Evelina Fedorenko[1], Edward Gibson[1], Zuzanna Balewski[1], Nancy Kanwisher[1]; [1]MIT

fMRI studies that examine contrasts between structures that do vs. don't contain non-local syntactic dependencies typically report activations in posterior LIFG and posterior LMTG (e.g.,Friederici,2012, for a recent meta-analysis). However, patients with widely different lesion sites – including well outside of IFG/MTG – have been shown to experience difficulty with syntactically complex structures (e.g.,Caplan,2007). We hypothesized that some of these lesions could affect parts of the fronto-parietal "multiple demand (MD)" network (e.g.,Duncan,2010), a set of domain-general brain regions that include regions in the dlPFC, parts of the insular cortex, regions along the precentral gyrus, pre-SMA/SMA, parts of the anterior cingulate, and regions in the IPS. MD regions have been implicated in many complex behaviors, and we thought they may play a role in understanding non-local linguistic dependencies. In two fMRI experiments, we first identified MD regions functionally in each (neurologically intact) subject using a working-memory task where participants were asked to remember eight (hard condition) or four (easy condition) locations (Expt1) or digits (Expt2). We then examined these regions' responses to syntactically complex vs. simpler structures (object- vs. subject-extracted relative clauses/clefts/wh-questions) in a reading (Expt1) and a sentence-picture-matching task (Expt2). Both experiments revealed reliable sensitivity to syntactic complexity throughout the MD system, bilaterally. In summary, although traditional random-effects analyses find quite focal activations for syntactic complexity contrasts, these effects are present across many brain regions outside of posterior LIFG/LMTG, including those sensitive to general cognitive demands. These results support the role of domain-general regions in some aspects of linguistic processing.

C64 HIGHER SELF-REPORTED AWARENESS IMPAIRS 'GUT-FEELING': SEGREGATING IMPLICIT AND EXPLICIT SEQUENCE PROCESSING

Julia Udden[1,3], Stephen Whitmarsh[2,3], Karl Magnus Petersson[1,3], Henk Barendregt[4]; [1]Donders Institute for Brain, Cognition and Behaviour, Centre for Cognitive Neuroimaging, Radboud University Nijmegen, Netherlands, [2]Radboud University, Faculty of Science, Nijmegen, The Netherlands, [3]Max Planck Institute for Psycholinguistics, Nijmegen, the Netherlands, [4]Institute for Computing and Information Sciences, Radboud University Nijmegen, Nijmegen, Netherlands

Our 'gut-feeling' guides us through complex decision in the absence of deliberate thinking about rules. Here we investigated how affective and attention traits influence decisions based on gut-feeling. We used an artificial grammar learning paradigm where participants were presented with consonant sequences in a five day working memory task. Unbeknownst to them, sequences were generated according to complex rules. They had to classify novel items according to preference (like/dislike). After debriefing, they made grammaticality judgments (grammatical/non-grammatical) on other novel items. As in previous studies, participants distinguished grammatical from non-grammatical sequences based on gut-feeling in both of these classification sessions. Using the Five Factor Mindfulness questionnaire (FFMQ), we assessed whether individual differences in affective and attention traits predicted classification behavior. We found that lower FFMQ scores (lower self-reported awareness) predicted preferences congruent with the grammar, as well as higher accuracy. In addition, we assessed the participants' working memory and their ability to explicitly state properties of the grammar. These two measures reliably predicted variance in the classification performance, but did not correlate with FFMQ or explain the above mentioned interaction with the FFMQ when all factors were analysed in an overall ANOVA. Thus, we have segregated three components of individual differences in how implicitly acquired grammatical rules are used: 1) working memory 2) ability to make an explicit description of the grammar and 3) mindfulness. The mindfulness trait might thus characterize the efficiency of aspects of an implicit information processing system segregated from explicit processing abilities for reasoning about the grammar.

C65 MONITORING DISAGREEMENT CONFLICTS BUT INTEGRATING UNAGREEMENT MISMATCHES: FMRI EVIDENCE

Ileana Quinones[1], Nicola Molinaro[1], Simona Mancini[1], Juan Andrés Hernández[2], Manuel Carreiras[1,3,4]; [1]Basque Center on Cognition Brain and Language, BCBL, Donostia-San Sebastián, Euskal Herria, Spain, [2]University of La Laguna, Tenerife, Spain, [3]Ikerbasque, Basque Foundation for Science, Bilbao, Spain, [4]Departamento de Filología Vasca, EHU/UPV, Bilbao, Spain

The goal of this fMRI study was to investigate the neuro-anatomical substrates of subject-verb agreement computation and semantic integration. Here we compare the comprehension of well-formed sentences ("Los pintores3.pl trajeron3.pl los cuadros a la galería" [The painters3.pl brought3.pl the paintings to the gallery]) and ill-formed sentences with a person agreement violation ("*El pintor1.sg trajiste2.sg los cuadros a la galería" [The painter1.sg (you-)brought3.sg the paintings to the gallery]), but we also take advantage of the unagreement phenomenon in Spanish: a subject-verb person mismatch that nonetheless results in a grammatical sentence ("Los pintores trajimos los cuadros a la galería" [The painters3.pl (we)brought1.pl the paintings to the gallery]). The subject-verb dependency established in this construction implies a shift in the interpretation of the subject from 3rd-person to 1st-person plural, making the phrase "The painters" be re-interpreted as "We painters". Person agreement violation evoked increase of activation in parietal and medial and superior frontal regions bilaterally, associated to the monitoring/reanalysis operations. Both person agreement violation and unagreement produced a significant increase of activation in the left dorsolateral medial frontal cortex, probably associated with an initial morphosyntactic mismatch detection processing. On the other hand, grammatical sentences (unagreement and standard agreement) increased activation in medial temporal and inferior frontal regions in the left hemisphere, regions that have been related to syntactic-semantic integration. Additionally, unagreement as compared to standard agreement sentences increased activation in the left dorsal angular gyrus, supporting the idea that that unagreement processing entails semantic difficulties associated to the re-interpretation of the speech-act participants.

C66 NEURAL CORRELATES OF THE HEAD-POSITION EFFECT IN PLAUSIBILITY MANIPULATIONS

Dirk-Bart Den Ouden[1], Michael Walsh Dickey[2]; [1]University of South Carolina, [2]University of Pittsburgh

Introduction A previous fMRI study found an interaction between hemisphere and plausibility cues in garden-path sentence processing (1). Sentences like 'While the man hunted the plane flew over the woods' were associated with higher right-hemisphere activation, while sentences like 'While the man hunted the deer paced in the zoo' were associated with higher left-hemisphere activation. These patterns may reflect how we process different types of 'error signals', one a violation of verb argument subcategorization preferences and the other a general pragmatic violation. Alternatively, the patterns may reflect the head-position effect (2), it being more difficult to discard a thematic role association the longer it has been maintained. Here, we tested the potential neural correlates of this head-position effect, using fMRI. Methods 16 Right-handed English speakers (12 females; mean age 21) performed a comprehension task, comparing sentences like 1ab, including sentences with subcategorization implausibility and global implausibility cues. 1) a. While the man hunted the surprisingly fast deer ran into the woods. (short distance) b. While the man hunted the deer that was surprisingly fast ran into the woods. (long distance) Results The contrast between sentences with a long distance between the initial association of 'deer' with 'hunted' and the disambiguating cue ('ran') and those with a short distance revealed bilaterally increased activation in STG, Heschl's gyrus and MTG, extending into left-hemisphere supramarginal gyrus. Conclusion A head-position effect is reflected in increased bilateral superior temporal activation. We will present more detailed results, analyses and interpretations of this general pattern.

C67 BROCA'S REGION AND ASPECTS OF NEGATION: A NEW SELECTIVITY PATTERN IN BROCA'S APHASIA, AND A MODEL

Yosef Grodzinsky[1], Trace Love[2], Michele Ferrill[2], Roberto Guttierez[2], Isabelle Deschamps[1], Peter Pieperhoff[3], Katrin Amunts[3], Lewis Shapiro[2]; [1]McGill University, [2]SDSU/UCSD, [3]FZ Jülich

A new perspective on how Broca's region participates in sentence perception may be emerging. Initial hints come from an fMRI study investigating neural mechanisms connecting sentence processing in German with numerical cognition (Heim et al., 2012): a conjunction computing the contrast between sentences containing a negative quantifier (e.g., less-than half of the circles are blue), and sentences with a positive one (more-than half of the circles are blue), surprisingly revealed clusters in Brodmann's Areas 44, 45. This is unexpected. We offer an explanation, and new neuropsychological results. A PARAMETRIC PROPORTION PARADIGM presented auditory sentences with negative (less-than-half, few) or positive (more-than-half, many) quantifiers, alongside an image depicting 50 circles, some blue, some yellow. Blue/yellow proportion was a parameter, systematically varied across images presented with each sentence (40/10, 35/15, 30/20…). A Truth-Value Judgment Task was deployed with English speaking, focally brain damaged patients with Broca's aphasia (n=3 currently), whose comprehension profiles conformed to a movement deficit pattern (Grodzinsky, 2000). Error rate was the dependent measure. Lesion masks, coregistered with cytoarchitectonic probability maps (Amunts et al., 1999), helped compute precise lesion characteristics. RESULTS HIGHLIGHTS: comprehension was near-normal on sentences with positive quantifiers, but dropped drastically to chance with negative quantifiers.

Task difficulty did not affect performance. ACCOUNT IN BRIEF: representations of sentences with negative (but not positive) quantifiers contain a highly abstract form of syntactic displacement (I. Heim, 2006). If previously, Broca's region was viewed as implicated in syntactic movement, the new results suggest that its role is more general and abstract.

C68 THE P600 INDEXES RATIONAL ERROR CORRECTION WITHIN A NOISY-CHANNEL MODEL OF HUMAN COMMUNICATION

Edward Gibson[1], Laura Stearns[2], Leon Bergen[1], Marianna Eddy[1], Evelina Fedorenko[1]; [1]MIT, [2]Wellesley College

Traditional interpretations of the N400/P600 components have been challenged by the discovery of the so-called "semantic P600" effects for sentences like "Every morning the eggs would *eat*…" (Kuperberg_et_ al.,2003;Kim&Osterhout,2005). We propose and test a novel account of the P600 within a noisy-channel model of human communication (Shannon,1949;Levy_et_al.,2009). In this model, a speaker wishes to convey a meaning *m* and chooses an utterance *u* to do so. This utterance is conveyed across a channel that may corrupt *u* (e.g., due to speaker/perceiver errors), resulting in a received utterance *ũ*. The listener must then use *ũ* to recover *m*. We propose that P600 indexes the process of repairing the corrupted utterance *ũ*. This account explains the semantic P600 effects – because there is a close alternative which the producer plausibly intended (e.g.,"be eaten" instead of "eat") – as well as a number of previously unexplained P600 effects in the literature (e.g.,see Brouwer_et_ al.,2012,for a review). In an ERP experiment, participants read sentences with typical semantic and syntactic violations, control sentences without violations, and critical sentences where the target word was semantically implausible but phonologically/orthographically close to an expected neighbor (e.g., "The storyteller could turn any incident into an amusing *antidote*", instead of the expected *anecdote*). The existence of such a neighbor makes the plausibly intended word recoverable. The noisy-channel account therefore predicts a P600 effect in this condition. This prediction was confirmed: a P600 effect – similar to that elicited by the typical syntactic violations (number agreement errors in our materials) – was observed.

C69 PROCESSING GENDER AGREEMENT VIOLATIONS CONTAINING EMOTIONAL WORDS IN SPANISH: AN ERP STUDY

Marcos Díaz[1], Isabel Fraga[1], Juan Carlos Acuña-Fariña[1]; [1]Universidade de Santiago de Compostela

Previous studies using ERPs have provided electrophysiological evidence of the brain´s sensitivity to gender agreement during sentence comprehension (Wicha, Moreno, & Kutas, 2005). Other studies explored the pattern of ERPs evoked by emotional words, as well as the differences between emotional word processing and neutral word processing (Bernat, Bunce, & Shevrin, 2001). The main purpose of the present study is to investigate the processing of emotional words in a gender agreement violation task with the ERP technique. Sixteen participants volunteered to do this experiment. The materials were formed by 300 sentences (100 fillers and 200 experimental sentences of the kind "Subject-Verb-Direct Object"). The distribution of the experimental items was as follows: 50 experimental sentences were grammatically correct and had a neutral word, another 50 were grammatically correct and contained an emotional word, and the remaining 100 sentences were identical to the preceding sentences, but they were ungrammatical. Participants had to respond to grammaticality of sentences by pressing two buttons. Overall, the results showed an early component (P100/ N100) elicited by the emotional conditions, a left anterior negativity (LAN) sensitive to grammaticality of sentences (elicited by the ungrammatical conditions), and a late positivity (P600) which was sensitive to emotional words and to grammaticality, but with no interaction between these two factors. These results constitute evidence that emotional word processing and syntax processing are two different processes that begin at different moments but overlap at a certain moment, after which they proceed in parallel with no interaction between them.

Poster Session D

Saturday, October 27, 3:20 pm – 5:20 pm, Ground Floor Foyer and 1st Floor

Auditory Perception, Speech Perception, Audiovisual Integration

D1 MOTOR EXCITABILITY DURING LISTENING TO SPEECH IS NOT MODULATED BY INTELLIGIBILITY

Rowan Boyles[1], Kate Watkins[1], Riikka Mottonen[1]; [1]University of Oxford

Transcranial magnetic stimulation (TMS) studies have shown that the excitability of the articulatory motor cortex is enhanced during listening to speech versus non-speech sounds. This enhanced excitability could be due to internal modelling of the speaker's articulatory movements. Such a process might be recruited preferentially when speech intelligibility is compromised. Here, we used TMS to test whether decreasing the intelligibility of speech increases the level of excitability in the motor cortex. Participants were presented with semantically coherent and anomalous English sentences masked by signal-correlated noise (SCN) producing five levels of signal-to-noise ratio (SNR) (Davis et al., 2011). Intelligibility (i.e., participants' ability to repeat the sentences) was strongly reduced by decreasing SNR. Coherent sentences were more intelligible than anomalous ones at all levels of SNR. In the TMS study, we used single pulses to elicit motor-evoked potentials (MEPs) in the lip (n =8) and hand (n = 12) muscles while participants listened to the sentences, SCN and white noise (WN). Listening to sentences enhanced both lip and hand

MEPs relative to SCN and WN. The enhancement of the lip MEPs was greater than enhancement of the hand MEPs. However, the SNR level and the semantic coherence of the sentences had no effect on MEP sizes. In sum, in line with previous studies, our findings show that the excitability of the articulatory motor cortex is enhanced during passive listening to speech. We found no support for the hypothesis that the level of excitability would increase when the intelligibility of speech is compromised.

D2 ACOUSTICALLY INVARIANT DECODING OF SPOKEN SYLLABLES USING ARTICULATORY REPRESENTATIONS: EVIDENCE FROM SEARCHLIGHT FMRI

Samuel Evans[1], Matthew, H Davis[1]; [1]MRC Cognition & Brain Sciences Unit

The acoustic form of speech is highly variable yet human listeners have an unmatched ability to identify speech sounds from degraded input. The failure to find simple mappings between acoustic cues and perceptual interpretation has led researchers to suggest that speech is perceived by reference to the intended motor gestures of the speaker (Liberman & Whalen, 2000). Recent brain imaging data has led to a resurgence of this motor theory (Wilson et al. 2004), although the interpretation of previous fMRI studies remains controversial (Scott et al. 2009). Here we maximised acoustic differences and looked for commonalities in the multivariate pattern of fMRI responses to syllables following transformation by noise-vocoding (NV), sine-wave synthesis (SW) and for the original clear speech. We acquired sparse imaging data from 17 participants performing a one-back detection task on 6 syllables (ba/da/ma/na/ab/ad), spoken by 2 speakers, presented in 3 forms of speech (NV/SW/ Clear). Whole brain searchlight Representational Similarity Analysis (RSA) identified a response in the left precentral gyrus that was characterised by increased similarity to the same syllable identity, even when comparisons were made between dramatically different forms of speech (e.g. /ba/ syllables in NV speech were more similar to SW speech /ba/ than /da/). This region overlapped with activation evidenced in a separate functional localiser that compared overt and covert production of the same syllables. These results suggest that response patterns in motor cortex contain information on the identity of spoken syllables irrespective of their acoustic form.

D3 THE SOUND OF YOUR LIPS: HAPTIC INFORMATION SPEEDS UP THE NEURAL PROCESSING OF AUDITORY SPEECH

Treille Avril[1], Camille Cordeboeuf[1], Coriandre Vilain[1], Marc Sato[1]; [1]Gipsa-Lab, Département Parole & Cognition, CNRS UMR 5216 & Grenoble Université - France

The human ability to follow speech gestures through visual modality can be considered as a core component of speech perception. Remarkably, speech can be perceived not only by the ear and by the eye but also by the hand. Indeed, a few behavioral studies provide evidence for audio-tactile interaction in speech perception, with participants presented with syllables heard and felt from manual tactile contact with a speaker's face. Given the multisensory nature of speech perception, one fundamental question is whether sensory signals are integrated at an early stage in the cortical speech processing hierarchy and may reflect predictive, anticipatory, mechanisms. The present EEG study aimed at further investigating early cross-modal interaction in speech perception. To this aim, we compared auditory-evoked N1/P2 responses during auditory, audio-visual and audio-haptic syllable perception. Participants were seated at arm's length from a female experimenter and were instructed to listen to the produced syllables with their eyes closed in the auditory condition, to look at the experimenter's face in the audiovisual condition, and to keep their eyes closed with their right hand placed on the experimenter's lip and jaw in the audio-haptic condition. In line with previous studies, auditory-evoked N1 amplitude was attenuated during audio-visual compared to auditory speech perception, as well as to audio-haptic speech perception. Crucially, shortened latencies of N1 responses were observed during audio-haptic and audio-visual speech perception compared to auditory speech perception. Altogether, these results suggest a predictive role of haptic and visual information and early cross-modal integrative mechanisms in speech perception.

D4 MOTOR CORTEX EXCITABILITY WHEN LISTENING TO ACCENTED SPEECH

Joseph Devlin[1], John Hogan[1], Daniel Kennedy-Higgins[1], Magdalena Sliwinska[1], Patti Adank[2]; [1]UCL, London, UK, [2]University of Manchester, Manchester, UK

Recent TMS studies using motor evoked potentials (MEPs) demonstrate that speech perception modulates the excitability of the motor system underlying speech production. Such results challenge language models with strict functional-anatomical segregation of speech production and comprehension networks. Although the nature of the contribution made to speech comprehension is not yet fully understood, evidence of increased motor system activation during degraded or noisy speech relative to clear speech supports the view that the motor system plays a more prominent role in challenging speech conditions. The current study directly investigated this hypothesis by measuring motor system excitability during both clear speech and a challenging artificial accent condition. Sentences were presented to participants over headphones and MEP amplitudes from the orbicularus orbis muscle (lips) were collected and compared across conditions. MEPs recorded during the artificial accent condition averaged over the participants were over 10% larger than for the clear speech condition (0.59mV vs. 0.52mV, respectively). Moreover, this pattern was observed in each of the participants individually. These results provide supporting evidence for a revised version of the classic Motor Theory of Speech Perception in which difficult comprehension relies on especially recruited motor areas specific to speech production.

D5 AUDIOVISUAL SPEECH INTEGRATION DOES NOT RELY ON THE MOTOR SYSTEM: EVIDENCE FROM INTACT MCGURK FUSION IN BROCA'S APHASIA

William Matchin[1], Michelle Ferrill[2,3], Corianne Rogalsky[1], Tracy Love[2,3], Greg Hickok[1]; [1]University of California, Irvine, [2]San Diego State University, [3]University of California, San Diego

Visual speech influences the perception of heard speech. A classic example of this is the McGurk effect, whereby an auditory /pa/ overlaid onto a visual /ka/ induces the fusion percept of /ta/. Recent behavioral and neuroimaging research has highlighted the importance of i) articulatory representations and ii) motor speech regions of the brain, particularly Broca's area, in processing visual speech. Alternatively, audiovisual fusion may be accomplished by the sensory system through multisensory integration in the posterior superior temporal sulcus (pSTS). Previous fMRI and behavioral data from our lab demonstrated that activity in frontal-motor brain regions does not track with audiovisual speech integration and that articulating a speech syllable consistent with the auditory portion of a McGurk stimulus does not reduce audiovisual fusion. We further tested the hypothesis that the motor speech system and speech motor areas are important for audiovisual speech integration by testing patients with damage to frontal-motor brain regions and speech production deficits (Broca's aphasics) on whether they show intact McGurk fusion. We presented patients with auditory and audiovisual syllables embedded in low-amplitude Gaussian noise as well as a McGurk stimulus. The results demonstrate that patients with damage to the pars opercularis of Broca's area, classically implicated in speech production, as well as other parts of motor cortex, show robust McGurk fusion. This confirms our prediction that the motor system is not important for audiovisual speech fusion.

D6 IN VIVO FUNCTIONAL AND MYELOARCHITECTONIC MAPPING OF HUMAN PRIMARY AUDITORY AREAS

Frederic Dick[1], Adam Taylor Tierney[2], Antoine Lutti[3], Oliver Josephs[1,3], Martin I. Sereno[1], Nikolaus Weiskopf[3]; [1]Birkbeck/UCL Centre for NeuroImaging, London, UK, [2]Northwestern University, Evanston, IL, USA, [3]Wellcome Trust Centre for Neuroimaging, UCL Institute of Neurology, University College London, London, UK

In contrast to vision, where retinotopic mapping alone can define areal borders, primary auditory areas such as A1 are best delineated by combining in vivo tonotopic mapping with post mortem cyto- or myelo-architectonics from the same individual. We combined high-resolution (800 μm) quantitative T1 mapping with phase-encoded tonotopic methods to map primary auditory areas (A1 and R) within the 'auditory core' of human volunteers. We first quantitatively characterize the highly myelinated auditory core in terms of shape, area, cortical depth profile, and position, with our data showing considerable correspondence to post-mortem myeloarchitectonic studies, both in cross-participant averages and in individuals. The core region contains two 'mirror-image' tonotopic maps oriented along the same axis as observed in macaque and owl monkey. We suggest that thee two maps within the core are the human analogues of primate auditory areas A1 and R. The core occupies a much smaller portion of tonotopically organized cortex on the superior temporal plane and gyrus than is generally supposed. The multi-modal approach to defining the auditory core will facilitate investigations of structure-function relationships, comparative neuroanatomical studies, and promises new biomarkers for diagnosis and clinical studies.

D7 INVESTIGATING AUDITORY-MOTOR PROCESSING OF SPEECH SOUNDS BY COMBINING TMS WITH EEG AND MEG

Riikka Mottonen[1], Gido van de Ven[1], Kate E. Watkins[1]; [1]University of Oxford

Transcranial Magnetic Stimulation (TMS) provides a powerful tool to investigate the role of the motor cortex in processing of speech sounds. TMS-induced disruptions within the articulatory motor cortex can impair performance in speech tasks. These motor influences are feature-specific: disruptions in the motor lip area impair performance in tasks that involve lip-articulated sounds (e.g., 'ba'), but have no effect on tasks that involve only sounds that are articulated by the tongue (e.g., 'da', 'ga'). Our recent TMS and EEG study showed that the motor disruptions influence also auditory discrimination of speech sounds that are outside the focus of attention (Mottonen et al., 2012). However, these influences were non-specific. Here, we aimed to determine whether changes in the focus of attention affect the feature-specificity of motor influences on processing of speech sounds using combined TMS and MEG. We presented 'ba', 'da' and 'ga' sounds in two conditions. In the Ignore condition, the participants focused on watching a silent film, whereas in the Attend condition they pressed a button when they heard a repeated sound. TMS-induced disruptions of the motor lip area modulated P50m responses to lip-articulated 'ba' sounds in the Attend condition only. Furthermore, we found a later non-specific TMS-induced modulation of auditory-cortex responses sounds in both Attend and Ignore conditions. These findings suggest that the articulatory motor cortex affects late processing of both attended and ignored speech sounds and that the early feature-specific effects emerge when the features of the speech sounds are attended.

D8 THE SELECTIVE ROLE OF DORSAL PREMOTOR CORTEX IN SPEECH PERCEPTION: A ROLE IN EXPLICIT PHONEME JUDGEMENTS BUT NOT SPEECH COMPREHENSION

Katya Krieger-Redwood[1], Gareth M. Gaskell[1], Shane Lindsay[1], Beth Jefferies[1]; [1]University of York, Psychology Department

The motor theory of speech perception proposes that the areas involved in producing language are also involved in perceiving it. Neuroimaging studies show premotor cortex (PMC) activation during phoneme judgement tasks;

however, these tasks are not a naturalistic assessment of speech perception in that they may involve cognitive control and/or metalinguistic knowledge. Other aspects of speech processing, such as mapping sounds onto meaning, may proceed without the involvement of motor speech areas. Moreover, activation in fMRI studies does not conclusively demonstrate that motor speech areas play an essential role in speech perception. In contrast, disruption following TMS allows for causal inferences. The current study examined two speech perception tasks, which required explicit phoneme decisions and semantic judgements respectively, following TMS to three sites: PMC, posterior superior temporal gyrus (pSTG) and a control site, occipital pole (OP). TMS to PMC disrupted explicit phonological judgements but not semantic judgements. This pattern was site-specific: TMS to a site involved in auditory processing, pSTG, disrupted performance in both language tasks, while TMS to the control site had no effect on performance in either task. These findings confirm that PMC is important for explicit phonological judgements, while crucially adding that PMC is not necessary for all aspects of speech perception, motivating revision of the motor theory of speech perception.

D9 PREDICTION OF ESSENTIAL LANGUAGE SITES BY FMRI AS RECORDED BY BOTH STIMULATION MAPPING AND LOCAL FIELD POTENTIALS

Thomas Pieters[1], Christopher Conner[1], Nitin Tandon[1]; [1]UT Health Science Centers at Houston, Houston Texas

Introduction Functional MRI (fMRI) is widely used to study language functions in humans. Patients with subdural electrodes (SDEs) provide a unique opportunity to study language in other ways, including cortical stimulation mapping (CSM) and local field potentials (LFPs). Methods Seventeen patients underwent pre-implantation scanning using a 3T MR scanner with an eight-channel SENSE head coil. Functional images were obtained (33 slices, 3mm thickness) during two visually cued noun and verb generation tasks. Electrodes were implanted and patients performed the same naming tasks as during fMRI. Data were collected at 1000Hz and analyzed to remove artifacts. Response was measured as the t-value of the average mid-gamma (60-120Hz) power within a time window. All patients underwent CSM to identify essential language sites (ESLs) during a noun generation task. Electrodes where stimulation produced speech deficits were deemed ESLs. T-values from 2562 fMRI data points were used as comparison values to determine overlap with CSM and a thresholded t-value of mid-gamma band activity. Results The results show that when using verb generation fMRI task to predict positive mid-gamma band activity (t-value>=11.3) there is 78.12% sensitivity and 69.74% specificity (F1=73.69%). When using the same task to predict ESLs based on a positive CSM result, there is 57.94% sensitivity, and 55.13% specificity (F1=56.5%). Ongoing analysis will evaluate network dynamics during this process. Conclusion Different modalities of study allow identification of aspects of underlying networks in language processes. Analysis produces a timeline of activity during fMRI and points to the "essential versus involved" processes of language processing.

Lexical Semantics

D10 THE NEURAL REPRESENTATION OF EVENT NOUNS

Suzanne Pendl[1], Colin J. Humphries[1], William L Gross[1], Jeffrey R. Binder[1]; [1]Medical College of Wisconsin

Event nouns (e.g., circus) differ from non-event nouns (e.g., dandelion) in their reference to dynamic temporal and spatial configurations. We asked whether the dynamic nature of event concepts leads to recruitment of specific brain regions. Fifteen volunteers underwent event-related fMRI, during which they read individual nouns and indicated with button presses whether or not they could experience the indicated entity with their senses. The 40 event nouns and 40 non-event nouns were matched on word frequency, imageability, length, orthographic neighborhood size, constrained bigram frequency, and constrained trigram frequency. A mix of abstract words and pseudowords served as filler items. Event words more strongly activated the left posterior middle temporal gyrus (pMTG; -59, -50, 1), left angular gyrus (AG; -32, -77, 37), and left inferior frontal gyrus (IFG; -40, 7, 26). While all of these regions have been identified previously as belonging to the semantic system, these results suggest a unique neural representation for the semantic content of event words. Event concepts depend on knowledge of thematic relationships, spatial relationships, temporal sequences, actions, and causality. A region of the left pMTG overlapping with the focus we observed here was recently linked with processing of causality. Regions including the left AG have been implicated in processing thematic relationships between words in comparison to taxonomic relationships. The present results, together with these previous findings, suggest that portions of the left MTG and left AG are involved in processing specific kinds of knowledge that are unique to event concepts.

D11 SPATIAL SEQUENCE PROCESSING INFLUENCES THE COMPREHENSION OF TEMPORAL SEQUENCING CONCEPTS

Jin Xue[1], Jie Yang[2]; [1]School of English Language, Literature and Culture and Center for Language and Cognition, Beijing International Studies University, China, [2]Sackler Institute of Developmental Psychobiology, Department of Psychiatry, Weill Cornell Medical College, New York, USA

Embodied theories suggest that conceptual knowledge is grounded in sensory-motor system. However, the embodied nature of abstract concepts is still unclear, and the contribution of the sensory-motor system to the comprehension of abstract meanings is unknown. To address the issues, the current study investigates whether spatial sequencing processing can influence the

comprehension of temporal sequencing concepts. In each trial participants processed spatial sequencing information before they read a temporal sequencing phrase described by a vertical spatial morpheme. Event-related potentials were recorded on the temporal sequencing phrases and the results indicated that when the spatial sequencing information was consistent with the information indicated by the spatial morpheme in temporal sequencing phrases, participants exhibited smaller N400 amplitudes than when the spatial sequencing information was inconsistent with the information indicated by the spatial morpheme. These results directly prove that spatial sequencing processing can modulate the comprehension of temporal sequencing concepts, and that the sensory-motor system can functionally contribute to the processing of abstract meanings.

D12 DO EXPECTATIONS INFLUENCE THE WAY UNRELATED UPCOMING WORDS ARE PROCESSED? AN EVENT-RELATED BRAIN POTENTIALS STUDY

Jakub Szewczyk[1]; [1]Jagiellonian University

In the last years there has been an increasing acknowledgement of anticipatory mechanisms in language comprehension. It has been shown that processing a coherent passage often results in prediction of how it may unfold in the future on the level of corresponding linguistic representations. This research has primarily focused on testing level of activation on predicted words, or words directly associated with them via agreement relations. In this study we test predictions from a different perspective. We explicitly introduce a "prediction" so we can be sure that readers expect a specific word. This opens possibility to see how readers process words preceding the predicted word, which do not have an apparent relation with the predicted word. To this end, ERPs were recorded while participants read a-few-sentence-long stories. In Expectation Condition, just before the story-final sentence, participants were given a short information that in the upcoming sentence a specific word would appear (which indeed did). In No Expectation Condition no such predictive information was given. We also manipulated the congruity of the predicted word with the final sentence, as well as constraint strength of the story. For the Expectation Condition, we found a fronto-central negativity appearing at the first word of the story final sentence, continuing throughout presentation of most of the words preceding the actual target word. The strength of the effect was modulated both by congruity and constraint strength, as well as by the word serial position in the story-final sentence. Alternative accounts of these results are discussed.

D13 WHEN COERCION COMES AS A SURPRISE: AN ERP STUDY IN GERMAN

Francesca Delogu[1], Matthew Crocker[1], Heiner Drenhaus[1]; [1]Saarland University

Complement coercion refers to expressions where an object noun denoting an entity is combined with an event-selecting verb (e.g., began the book). Such expressions are argued to require coercion of the entity-type noun into an eventive representation (e.g. read the book) (Jackendoff, 1997), an account supported by increased processing costs (e.g., Traxler et al., 2002). In an ERP study, Kuperberg et al. (2010) contrasted coercion expressions with the default event-sense associated with coercing expressions (read) and implausible animacy-violated sentences (astonished), as in 'The journalist began/read/astonished the book'. Both coerced and animacy-violating nouns elicited similarly enhanced N400s, which were interpreted as reflecting semantic processing cost (triggered by coercion and semantic mismatch). Using sentences like 'John began/read/bought the book', we investigated whether such coercion effects may rather be explained in terms of surprisal (Levy, 2008): Animacy violations were replaced with a neutral noncoercing condition (bought), testing our hypothesis that the N400 effect for coerced nouns reflects lower contextual predictability. Our results showed a similarly enhanced and distributed N400 effect for nouns in the less predictive coercing (began the book) and neutral contexts (bought the book) relative to predictable contexts (read the book). Contrary to standard coercion accounts predicting an N400 effect for coerced nouns relative to both neutral and predictable conditions, our findings support the view that the N400 effect for coerced nouns reflects increased surprisal (Levy, 2008) for less predictable words. Kuperberg's findings can similarly be accounted for in terms of predictability rather than enriched semantic composition.

D14 MEANING COMPOSITION AND THE LEFT FRONTAL CORTEX

Maria Mercedes Pinango[1], Emily Foster-Hanson[1], Cheryl Lacadie[1], R. Todd Constable[1]; [1]Yale University

We compare Product-for-Producer metonymy "Anna reads/meets Needham everyday" and Circumstantial metonymy "The filet-mignon wants it/comes with rice and vegetables" (metonymy/literal), traditionally analyzed as emerging from categorically distinct processes (lexical vs. pragmatic respectively). Research indicates that lexical metonymy is computationally isolable1,2. Contrary to the traditional view, we hypothesize that metonymies are implemented by one semantic mechanism: the real-time establishment of a non-syntactic (anaphoric) dependency. Accordingly, both metonymies should recruit the same cortical region. Methods. 3-Tesla magnet; 16 Subjects; Two contrasts (four conditions): Product-for-Producer vs. literal and Circumstantial vs. literal (50 sentences per condition=200 sentence-script). Results: Both contrasts elicited activation in the left frontal cortex ($p<.05$,corrected). No other activations were observed.

Interestingly, results also showed a frontal-lobe internal distinction: whereas the locus of the Product-for-Producer Metonymy is BA47/32, with tangential activation in BA45/46/9, and 8, the locus of Circumstantial Metonymy is BA44/8 with tangential activation in BA45/9, and 6. Our results suggest that despite differences in encoding (lexical-permanent vs. pragmatic-temporary), both metonymies recruit the same cortical area, and therefore can be argued to depend on the same linguistic mechanism. Difference in locus of activation further suggests that they place different demands on the processor: only Circumstantial Metonymy, requiring immediate yet temporary establishment of co-referentiality (e.g., between "filet-mignon" and person_who_ordered_filet-mignon) engages BA44, a region independently associated with timing constraints during sentence comprehension3. Crucially our results question the syntactic role of BA44 and support neurocognitive models that allow linguistic composition to emerge robustly from non-syntactic processes including semantico-pragmatic composition. 1)Frisson&Pickering,2007; 2) Schumacher et al.,2011; 3)Rogalsky&Hickok,2009.

D15 BRAIN AND BEHAVIOURAL CORRELATES OF ACTION SEMANTIC DEFICITS IN AUTISM.

Rachel Moseley[1], Bettina Mohr[2], Michael Lombardo[3], Simon Baron-Cohen[3], Friedemann Pulvermüller[1,4]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK, [2]Anglia Ruskin University, Cambridge, UK, [3]Autism Research Centre, University of Cambridge, UK, [4]Free University of Berlin, Germany

Action-perception circuits comprising sensorimotor neurons are purported to be critical to many higher cognitive abilities, including semantic processing of action-related language. If this is so, motor dysfunction should entail cognitive deficits in this domain. In order to test this hypothesis, action-word processing was investigated in individuals with autism spectrum conditions (ASC), which are characterised by motor impairments and abnormalities of motor systems. During passive reading, fMRI was employed to interrogate semantic action-related motor cognition and its corresponding brain activation in high-functioning adults with ASC. Participants with ASC exhibited hypoactivation of motor cortex in general language processing relative to typically developing (TD) controls, significantly lower activity in motor cortex during action-word processing, and, intriguingly, a correlated deficit in semantic processing of action-related words. This physiological-behavioural link, manifest in our ASC subjects, suggests that motor systems are functionally integral to efficient semantic processing: deficits in motor regions and/or the interaction between brain systems, as is characteristic of ASC, would therefore be suggested to derail the typical development of action-perception circuits involved in general language processing and action semantics. As hypoactivity in the motor system during processing also correlated with increased autistic symptomatology, we suggest that degradation of action-perception circuits, as demonstrated in the data, might play a causal role in not only the semantic but other higher cognitive symptoms of ASC. Further EMEG time-course investigation of this data is forthcoming.

D16 A DIRECT COMPARISON OF 'ARCUATE FASCICULUS-ONLY' VS. DUAL PATHWAY NEUROCOMPUTATIONAL MODELS OF LANGUAGE

Taiji Ueno[1], Satoru Saito[1,2], Mattew A. Lambon Ralph[1]; [1]Neuroscience and Aphasia Research Unit, School of Psychological Sciences, University of Manchester, UK, [2]Department of Cognitive Psychology in Education, Graduate School of Education, Kyoto University, Japan

The classic neuroanatomical model of language was based on a single dorsal neural pathway underpinned by the arcuate fasciculus (arcuate-fasciculus only model, e.g., Geschwind. 1965). Contemporary neuroscience indicates that the 'ventral' language pathway might also be crucial (Hickok & Poeppel, 2007; Parker et al., 2005; Rauscheker & Scott, 2009; Saur et al., 2008). It is unclear in these models, however, if both repetition (systematic mapping from auditory input) and speaking (arbitrary mapping from semantic input) – are underpinned mainly via the dorsal pathway or if speaking is underpinned via the ventral pathway (e.g., Duffau et al., 2008; Schwartz et al 2009). We compared, therefore, our neurocomputational dual pathway model (Ueno et al., 2011) against a new, arcuate-only neurocomputational model. The latter model was 'hard-wired' so that both semantic input (for speaking) and auditory input (for repetition) were propagated only through the arcuate pathway. Unlike the existing dual pathway model, the arcuate-only model struggled to learn all three language tasks (speaking, comprehending and repeating) and exhibited very poor nonword-repetition. Performance was improved somewhat by a massive inflation of the computational resource provided at the junction layer between auditory- and semantic-input to the arcuate pathway. Unlike the computationally-efficient dual pathway model, however, lesions to the arcuate-only model never elicited conduction aphasia, consistent with analyses suggesting that the model never fully separates and encodes the auditory-motor systematic mappings which are crucial for nonword repetition.

D17 UNILATERAL NEOCORTICAL AND MESIAL TEMPORAL LOBE LESIONS DISRUPT SEMANTIC MEMORY REPRESENTATIONS

Pablo Campo[1], Claudia Poch[1], Mercedes Belinchón[1], José Manuel Igoa[1], Rafael Toledano[2], Irene García-Morales[2,3], Antonio Gil-Nagel[2]; [1]Facultad de Psicología. Universidad Autónoma de Madrid, [2]Hospital Ruber Internacional, [3]Hospital Clínico-Universitario San Carlos

It is currently accepted that semantic-lexical system partially relies on the anterior temporal lobe (ATL), and that bilateral damage to this region is required to cause significant semantic impairment. However, more controversy exists about the impact of unilateral ATL damage in semantic memory. Recently, some studies have shown mild semantic memory disruption associated with unilateral ATL damage, which was more severe when

the left hemisphere was affected, suggesting hemispheric differences in contribution to semantics. Nonetheless, these results were observed in patients with extensive damage, mainly ATL resection and stroke. In the current study we examined expressive (i.e. semantic fluency) and receptive (i.e. naming, semantic association) semantic skills in 12 patients with small well-defined lesions on MRI located at the left anterior-basal aspect of the temporal lobe, 12 patients with left mesial temporal lobe epilepsy (mTLE), and 12 matched healthy controls. Patients performed worse than controls in most of the administered tests, thus indicating that semantic impairment could not be explained only by retrieving semantic information during selection of the lexical concept but by a degradation of semantic representations. Interestingly, there were also significant differences between both groups of patients in a verbal semantic association task, with mTLE patients performing worse, and showing higher error rates for abstract concepts. These data provide compelling evidence that lesions within anterior temporal lobe disrupt semantic memory, although of mild clinical significance.

D18 NAMING ACROSS MODALITIES IN PATIENTS WITH SEMANTIC DEMENTIA, PROGRESSIVE NON-FLUENT APHASIA, AND ALZHEIMER'S DISEASE

Amanda Garcia[1], Alison Paris[1], Joshua Troche[1], Jinyi Hung[1], Jamie Reilly[1]; [1]University of Florida

While picture naming is the typical measure of naming ability in dementia patients, the examination of naming through other modalities can provide additional insight into dementia patients' abilities. This study presented familiar items across three modalities (visual, auditory, and motion) to patients with Alzheimer's Disease (AD, N=1), Semantic Dementia (SD, N=1), and Progressive Non-fluent Aphasia (PNFA, N=3). In the first task, patients were given information from one modality and asked to name the item. Next, patients were presented with information from two modalities and asked if they belonged together. Patients were hypothesized to perform best at visual and worst at motion naming; however, the discrepancy between naming across the three modalities would be smaller for the SD patient due to relative sparing of posterior temporal and perisylvian cortices. Additionally, SD and AD patients were hypothesized to perform significantly worse at matching items without visual cues in the second task due to the increased reliance on semantic knowledge in this combination, while PNFA patients would perform equally well. As predicted, chi-square tests revealed that while better at visual naming, our SD patient showed no significant difference in naming performance across the three modalities. All other patients showed significant differences across the modalities, $p < .05$, generally due to better performance in visual naming. Contrary to our hypothesis, no patient showed significant differences in matching across the three modalities in the second task, probably due to the lower cognitive demand of the forced-choice task.

D19 SEMANTIC CATEGORY EXEMPLAR GENERATION FOR MANIPULABLE AND NON-MANIPULABLE OBJECTS IN APHASIA: A VOXEL-BASED LESION SYMPTOM MAPPING STUDY

Jamie Reilly[1], Harnish Stacy[2], Park Heyjin[1], Rodriguez Amy[3], Paris Alison[1], Benjamin Michelle[4], Garcia Amanda[1], Bennett Jefferey[1], Edmonds Lisa[1], Dickey Michael[5], Towler Stephen[1], Crosson Bruce[6]; [1]University of Florida, [2]Ohio State University, [3]University of Queensland, [4]University of Alabama, [5]University of Pittsburgh, [6]Emory University

A controversial approach to semantic representation is embodied cognition. Embodiment predicts that cortical regions dedicated to perception and action are integral for word meaning. Accordingly there exists neural segregation for manipulated objects (e.g., tools) relative to non-manipulated objects (e.g., buildings). Patient-based naming studies have yielded mixed results with respect to embodiment, and issues of localization remain unclear. PARTICIPANTS: 16 adults with aphasia status post >6 months left MCA-territory ischemic stroke [mean age=68.8 yrs, 10m/6f]. TASK: Participants viewed category cues (e.g., school supplies) and verbally generated an exemplar (e.g., pencil). Categories were either "Manipulable" (N=16) or "Non-manipulable" (N=37). We scored responses offline and correlated results with lesion distributions obtained by manually tracing each patient's lesion in native space (T1-weighted image),masking lesions and normalizing brains to MNI-space. Groupwise correlations were conducted via MRIcron's Brunner-Munzel nonparametric lesion mapping function (cluster threshold=8 voxels). RESULTS: More accurate exemplars were produced in non-manipulable relative to manipulable categories [44% vs. 40%, $p<.01$]. Lesion correlations revealed areas of overlap, including regions of STG, MTG, precentral gyrus, & insula. Naming impairment correlated with damage to left frontal rolandic operculum, supramarginal gyrus, and inferior parietal lobule for manipulable objects and to post-central gyrus, putamen, pallidum, and IFG for non-manipulable objects. DISCUSSION: Category generation relies on a common and unique network of brain regions. Damage to unique regions of frontal cortex predicted impairment for generating manipulable objects. These results are grossly consistent with embodiment but can be reconciled within the context of a more "disembodied" approach to semantic representation.

D20 THE ANGULAR GYRUS SUPPORTS HETEROMODAL SEMANTIC REPRESENTATIONS

Michael Bonner[1], Jonathan Peelle[1], Murray Grossman[1]; [1]Department of Neurology, University of Pennsylvania

The angular gyrus is a heteromodal association region with inputs from all unimodal association cortices. In this study, we tested the hypothesis that semantic memory relies on heteromodal representations in the angular gyrus, where sensory and motor feature information converge. In BOLD fMRI, participants (n=20) viewed single words and indicated by button press if each word

was real. Stimuli included words with strongly associated features (determined in a norming study) in three modalities: Auditory (e.g., thunder; n=40), Visuomotor (e.g., handshake; n=40) and Visual (e.g., goldfish; n=40). There was also an Abstract word category with minimal sensory associations (e.g., essence; n=40). Categories were matched for word length and lexical frequency. Foils were pronounceable pseudowords (n=120). Functional localizers identified visual, auditory and motor cortical regions. All word categories activated the angular gyrus to an equal extent, consistent with this region representing heteromodal semantic information. Additionally, all three concrete word conditions activated regions overlapping with the corresponding functional localizer: Auditory words recruited superior temporal regions associated with auditory perception; Visuomotor words recruited ventral temporal and occipital regions associated with visual perception and visuomotor integration; and Visual words recruited ventral temporal regions associated with visual perception. Finally, diffusion tensor imaging revealed evidence of white matter connections between the angular gyrus and each of these regions of modality-specific semantic activation but not between modality-specific regions. These findings support a heteromodal, integrative role for the angular gyrus in semantic memory, and implicate a network of unimodal and heteromodal association cortices in the neural instantiation of concepts.

D21 ACTION VERB COMPREHENSION REFLECTS ON-LINE SENSITIVITY TO MOTOR SPECIFICITY AND SENTENCE MEANING: AN EEG STUDY USING MU OSCILLATIONS

Kevin Lam[1,2], Marcel Bastiaansen[3], Ton Dijkstra[1], Shirley-Ann Rueschemeyer[4]; [1]1Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, The Netherlands, [2]International Max Planck Research School (IMPRS) for Language Sciences, The Netherlands, [3]Max Planck Institute for Psycholinguistics, The Netherlands, [4]University of York, United Kingdom

Embodied theories of language share the common position that comprehension entails contributions of sensorimotor experiences obtained during the learning of concepts. The theories, however, differ in how they specify the role of such contributions: Stable and context invariant, or flexible and context sensitive. Our experiment offers new insight to the study of embodied language: (1) Theoretically, we show that motor activation to action verb understanding is flexible and sensitive to sentence context – when the overall sentence meaning is non-motoric, action verbs no longer show the predicted motor activation that occur when the sentence meaning is motoric; (2) Methodologically, we show that the motor-based mu oscillations (8 – 12 Hz) recorded from scalp EEG – previously confined to the action execution and observation domain – is sensitive to the verb's motoric specificity (e.g., push is more specific than deliver), making it a useful measure to test temporally sensitive hypotheses on action-related language comprehension. Thus we refine the role of motor contributions during language comprehension at the sentence level using a temporally sensitive motor-based measure.

D22 VERBS FOR ACTIONS AND VERBS FOR CONSEQUENCES SHOW DISTINCT NEURAL PATTERNS IN THE BRAIN

Tor Endestad[1], Magnus Lindgren[2], Janne von Koss Torkildsen[3], Peter Gärdenfors[4]; [1]Department of Psychology, University of Oslo, Norway, [2]Department of Psychology, Lund University, Sweden, [3]Department of Biological and Medical Psychology, University of Bergen, Norway, [4]Department of Philosophy, Lund University, Sweden

Introduction The present study investigated the contrast between the neural correlates of verbs denoting actions and verbs denoting consequences of actions (results). Focus for the study was the general division of verbs into manner verbs and result verbs that has been proposed in linguistics (Rappaport Hovav & Levin, 2010). Methods Twenty-five healthy subjects performed a block designed similarity decision task with triads of verbs in a paradigm similar to Kemmerer et al. (2008). The material consisted of 240 trials of action verbs (manner), result verbs (motion and property) and a control condition with wingdings. The selected result and manner verbs were matched on frequency and word length, and were as similar as possible on dimensions like imageability, concreteness, and partition). fMRI data was collected on a 3T scanner. Results Both action and result verbs showed patterns of activation that were distinct from wingdings, involving inferior frontal and temporal regions. The contrast result versus action verbs showed significantly more activation in left Supplementary Motor Area, Inferior Frontal Gyrus insula, left Parietal Lobule (hlP3)) and Calcarine and Lingual Gyrus bilaterally. The reversed contrast of action versus result did not show any significant activations. Conclusion Result verbs (which involve more complex manipulations) elicited activity in a series of cortical areas associated with syntactic, sensory, and executive processing in addition to the areas recruited in the processing of manner verbs. These results point toward a model for verb processing including both shared and unique networks for action and result verbs.

D23 EXPLORING SENTENCE UNDERSTANDING WITH TMS

Imke Franzmeier[1], Janine Reis[2], Evelyn C. Ferstl[1]; [1]University of Freiburg, [2]Neuro Center University Clinic Freiburg

Contextual integration and lexical access are processed in distinct cortical areas (Lau, Phillips, & Poeppel, 2008, Nature Reviews Neuroscience, 9), i.e. angular gyrus (AG) and middle temporal gyrus (MTG), respectively. Exploring the anatomical framework for sentence processing, Franzmeier, Hutton and Ferstl (2012, Cognitive Neuroscience, 3) applied single pulse TMS on the superior part of the temporal lobe, bordering the AG. Stimulation successfully disrupted contextual semantic integration while lexical access remained unaffected. In the current study, TMS is used to functionally and anatomically

differentiate these aspects. Twenty participants performed a semantic decision task. Sentences with different cloze probability endings (expected, unexpected, semantically incorrect) were presented. After the presentation of the sentence ending, a single TMS pulse was applied to the MTG, AG, or Vertex. Stimulation location was determined by neuronavigation. Intensity was set to 110% of the individual motor threshold. Reaction times and accuracy were measured. Participants responded highly accurately (95%). Expected endings were answered most accurately and faster than unexpected and incorrect endings ($p<.001$). Overall, stimulation did not affect accuracy or response times ($F's<2$). This outcome was unexpected as stimulation parameters, such as localisation, were more precisely adjusted to the underlying paradigm than in Franzmeier et al.'s study. A modified paradigm with repetitive TMS is currently carried out to shed light on facets in the paradigm of Franzmeier et al.'s and the current study. Taken together, information from single pulse and repetitive TMS studies is collected to acquire efficient parameter settings (stimulation timing, intensity, localisation) for neurolinguistic TMS studies.

D24 INVOLVEMENT OF RIGHT ANTERIOR TEMPORAL LOBE IN PROCESSING SOCIAL CONCEPTS: A TMS STUDY

Gorana Pobric[1]; [1]School of Psychological Sciences, University of Manchester

Studies of semantic dementia patients, imaging and repetitive TMS have suggested that the bilateral anterior temporal lobes (ATLs) underpin a modality-invariant representational hub within the semantic system. However, questions remain regarding functional specialization across a variety of knowledge domains within the ATL region. Specifically, it has been proposed that right superior anterior temporal cortex is crucial in semantic processing of social concepts. However, direct evidence for the functional relevance of right superior ATL is still missing. Offline rTMS was used to test the hypothesis that this ATL sub region contributes to the processing of social concepts. Participants made synonym judgments about social and non-social abstract words. The social and non-social words were matched for psycholinguistic (frequency, imageability, familiarity, semantic diversity) and behavioural (response times and accuracy) variables. We also examined performance on a number magnitude judgment task as our control task. Offline rTMS was applied at 1Hz for 10 min at 62% of machine output over right superior ATL (MNI: 53, 8, -13) and over occipital pole as a control site. After right ATL TMS stimulation, performance was selectively impaired on the processing of social concepts, but not on equally demanding non-social abstract concepts and the nonsemantic cognitive task. These findings confirm that right ATL is a critical part of a neural network supporting social conceptual knowledge.

Motor Control, Speech Production, Sensorimotor Integration

D25 A NEURAL MECHANISM FOR PREVENTING SLIPS OF THE TONGUE: FMRI EVIDENCE FOR INTERNAL ERROR CORRECTION

Kayoko Okada[1], William Matchin[1], Sara Alshara[1], Gregory Hickok[1]; [1]University of California, Irvine

Error correction is an important component of the speech production process. Although slips of the tongue are not uncommon in everyday experience, they are in fact rare compared to the number of words successfully spoken (~1%). Further, the rate of slips that result in non-words is even lower and indeed below the rate expected by chance, suggesting a mechanism that limits non-word errors. While models of speech production often posit an internal monitor, the neural instantiation of error correction has remained elusive. The present fMRI experiment investigates internal error correction in speech production using stimuli designed to induce errors. Subjects were visually presented with tongue twister stimuli from previous experiments. Half of the trials were biased to induce non-word slips and half were biased to induce word slips. On each trial, subjects rapidly produced a set of four words and then indicated whether or not they correctly produced the sequence. A contrast of bias towards non-words>words revealed significantly greater activity in left posterior middle temporal gyrus (pMTG). Crucially, this was true even on error free trials. Our speech production task designed to induce speech errors revealed a region in left pMTG that was more active when the stimuli biased the potential error toward a non-word rather than a word. The fact that this region's activity was strongly modulated by the potential for word versus non-word errors that were never committed indicates that it plays a role in detecting and correcting errors internally, prior to overt production.

D26 PREDICTING BEHAVIORAL RESPONSES TO CONFLICT IN LANGUAGE PRODUCTION FROM EEG MARKERS OF ANTERIOR CINGULATE ACTIVITY IN THE FLANKER TASK

Dan Acheson[1,2], Peter Hagoort[1,2]; [1]Neurobiology of Language Department, Max Planck Institute for Psycholinguistics, [2]Donders Institute for Brain, Cognition and Behaviour

Language producers are often faced with interfering responses while speaking. In order to mediate these effects and to prevent errors from occurring, individuals must monitor themselves. Recent evidence suggests that monitoring in production may occur via domain-general, action monitoring mechanisms in the anterior cingulate cortex (ACC) that are sensitive to the detection of response conflict. The present work was designed to address the extent to which the ACC is involved in the language production by relating electrophysiological markers of ACC activity in a nonlinguistic task to behavioral markers of conflict in a language production task. Subjects performed an arrow version of the flanker task while EEG was recorded, where conflict was induced when the central

(response) arrow faced in a different direction than the flanking arrows (e.g., >><>>). Reliable electrophysiological markers of this conflict were present in greater the N2 and P2 responses to conflicting than non-conflicting trials, and to the error-related negativity (ERN) when there was an overt error. Interference was induced in language production using the picture-word interference task, in which pictures were named while semantically related, unrelated or neutral (XXXXX) distractors were overlaid on the picture. Results showed reliable correlations between the slowdown in picture naming speeds for semantic ally-related distractor words relative to unrelated words and all three electrophysiological markers of conflict in the flanker task. The results thus demonstrate that the language production system likely engages domain-general monitoring systems to mediate conflict during production.

D27 SPATIO-TEMPORAL BRAIN ACTIVATION PATTERNS OF SEMANTIC COMPETITION DURING OVERT SPEECH PRODUCTION

Andrea Krott[1], Camillo Porcaro[2], Maria Teresa Medaglia[3], Antje S. Meyer[4]; [1]University of Birmingham, [2]Newcastle University, [3]Newcastle University, [4]Max Planck Institute for Psycholinguistics and Radboud University

The time course of brain activation during word production has been studied utilizing electroencephalography. The interpretation of such findings is complicated by the fact that articulatory movements may mask the cognitive components of interest. Therefore, studies have typically used covert speech production tasks or focused on processes during the first few hundred milliseconds of the word planning process, assuming that those are artifact-free. In the present study, EEG was recorded while participants overtly named pictures accompanied by semantically related vs. unrelated written distractor words. The goal was (a) to investigate how the removal of motor artifacts, utilizing Independent Component Analysis, affected the spatio-temporal neural activation patterns during word planning and (b) to use the resulting clean data to explore the neural correlates of the expected semantic interference effect up to speech onset. A comparison of the raw and cleaned data revealed that speech artifacts occurred already during the first few hundred milliseconds. A source localization analysis showed that the cerebral sources of only the cleaned data were consistent with previous brain imaging findings. Importantly, the cleaned data showed more robust ERP effects of distracter relatedness after 400ms than the raw data. Timing and source localizations of all ERP effects together suggest that semantic relatedness between targets and distractors affected picture naming at several processing steps: higher-level visual processing, self-monitoring, and comparison processes between the phonetically prepared responses to picture and distractor. Overall, findings demonstrate the usefulness of ICA as a tool for motor artifact removal in overt speech production.

D28 THE EFFECT OF EMBODIED SPATIAL EXPERIENCES ON LANGUAGE PROCESSING

Li-An Chu[1], Fan-Pei Yang[1]; [1]National Tsing Hua University, Hsinchu, Taiwan

The effect of embodied spatial experiences on language processing is a long-standing question. It is likely that the embodiment effect may be stronger in sport players. The current research hypothesized that volleyball players might exhibit an interesting activation pattern in response to terms related to moves associated with particular positions in the court due to mental representation of the court and positions formulated during their past experiences. Seven right-handed subjects (4 males and 3 females, mean age=23.5) participated in the study. We had three conditions: match, mismatch, and unrelated. Each trial contained the terminology as a probe, the position as a target, and a focal point. Participants were asked to decide whether the terminology and the position of the court in a pair were matched, indicating their decision by pressing the buttons. All image processing was performed using SPM5, P<0.005, uncorrected. One sample T-test showed that participants activated the right precuneus, the left caudate and the left ACC for the match pairs. In contrast, the left ACC, the right insula, the right caudate, the right putamen, the left fusiform gyrus and the left postcentral gyrus were activated for the mismatch pairs. Our results suggested that sport players involved regions for visuospatial imagery, mental simulations, word recognition and error detection in processing of sports terminology. The engagement of the semantic processing network was enhanced when the conflict between language and evoked imagery increased. The above results showed that embodied domain-specific semantic memory affected linguistic processing and modulated somatosensory and language systems.

D29 FUNCTIONAL SUBDIVISIONS OF BROCA'S AREA AND VENTRAL PREMOTOR CORTEX AS REVEALED BY DIRECT CORTICAL STIMULATION

Christian A Kell[1], Agi Oszvald[1], Ines Kropff[1], Andrea Szelenyi[1], Volker Seifert[1], Mitchel S Berger[2]; [1]Goethe University Frankfurt, [2]University of California San Francisco

Direct cortical electrical stimulation of left prefrontal regions has been shown to elicit speech arrest and anomia suggesting that these regions are involved in speech production. Speech arrest has been defined as an inability to produce any speech output, but is usually claimed if stimulation interferes with counting. Besides speech production, counting also entails an overlearned sequential selection of linguistic items and thus does not necessarily point to speech motor representations only. We investigated speech arrest further by dissociating between linguistic selection and speech motor control to better define the location of speech motor representations. Besides counting and picture naming, awake brain surgery patients also recited the alphabet and repeated over and over syllables (letters). We hypothesized that disruption

of syllable repetition upon direct electrical stimulation could be observed in brain regions representing speech motor routines while counting arrest without disruption of syllable repetition would point to regions involved in linguistic selection. In 6 of 7 patients studied so far, speech arrest sites could be grouped in either rostral counting arrest sites with unimpaired syllable repetition (phonological selection) or more posterior sites in which stimulation interfered with both syllable repetition and counting. Despite large variability in exact location, these two groups of speech arrest sites lay in pars opercularis and ventral premotor cortex rostral of positive motor sites (primary motor) and posterior of anomia sites (lexical selection). Our results suggest that despite considerable inter-individual variability left inferior frontal subregions can be identified individually on the basis of detailed language mapping.

D30 ELECTROPHYSIOLOGICAL RESPONSES TO THE SEMANTIC BLOCKING EFFECT IN LANGUAGE PRODUCTION: A TEST OF FOUR HYPOTHESES

Dan Acheson[1,2], Lesya Ganushchak[3], Jan-Mathijs Schoffelen[2], Peter Hagoort[1,2]; [1]Neurobiology of Language Department, Max Planck Institute for Psycolinguistics, [2]Donders Institute for Brain, Cognition and Behaviour, [3]Psychology of Language Department, Max Planck Institute for Psycholinguistics

The blocked naming paradigm has been used to study lexical access in production and involves repeatedly naming pictures drawn from semantically-related or unrelated categories. Behaviorally, the semantic blocking effect shows up as a slowdown in naming semantically-related relative to unrelated pictures over subsequent blocks, despite overall decreases in naming times relative to the first block. Numerous explanations have been given to this effect including competitive lexical selection, response exclusion and implicit learning. EEG was recorded while subjects repeatedly named sets of five semantically-related and unrelated pictures five times within a trial. We predicted that ERP differences would show different signatures depending on the locus of the semantic blocking effect: lexical competition around the time of lexical access (~250 ms), response exclusion closer to responding (~400 ms), and implicit learning as a monotonic change in the EEG response across blocks. Stimulus-locked results showed ERP differences in the form of a centrally-distributed negativity peaking between 240-320 ms. Blocking effects mirrored behavioral results where the only differences observed were between the first block and each subsequent block, which did not differ. The results are thus most consistent with the lexical competition account, however, the scalp distribution and timing of the EEG response suggest the involvement of the anterior cingulate cortex during the task. We thus propose a fourth possibility: Part of the semantic blocking effect may reflect the detection of response conflict and subsequent slowdown in behavior that typically follows this detection. Additional time-frequency and response-locked analyses are conducted to test these hypotheses.

D31 INVESTIGATING DISTINCT NEURAL SYSTEMS FOR THE PRODUCTION OF SPEECH AND EMOTIONAL VOCALIZATIONS

Zarinah Agnew[1], Carolyn McGettigan[1], Liliya Ward[1], Oliver Josephs[1], Sophie Scott[1]; [1]University College London

Evidence suggests that the neural control of production of emotional vocalizations may be fundamentally different to that of speech sounds. Emotional vocalizations may be more akin to vocalizations made by non-human primates in that many are universal, i.e. recognizable across distinct cultures. Conversely, speech sounds are highly over-learnt articulations that are not consistent across cultures. Given these differences, it has been suggested that emotional vocalizations may rely on different, evolutionarily older, neural systems. In the present study functional neuroimaging was used to investigate these articulatory subsystems for the first time, by comparing the production of speech sounds and emotional vocalizations. Subjects were cued to either produce an emotional vocalization or a speech sound related to i) disgust, ii) sadness, iii) amusement or iv) relief. A 1.5 Tesla Siemens Avanto system and 32 channel head coil were used to acquire T2*-weighted whole brain dual echo-planar images using a clustered sparse acquisition to deal with head motion. Breathing was monitored throughout in order to investigate neural activity associated with changes in breathing across conditions. We report significant differences in the neural control of these two classes of complex voluntary movements of the articulators. Emotional vocalizations were associated with activity in premotor and inferior frontal cortices whereas speech elicited greater activity in posterior temporal cortices. These data suggest that there may be different neural pathways for the control of these two types of movement. These data are discussed in light of current models of speech production.

D32 FMRI DIFFERENCES BETWEEN SEMANTICALLY VERSUS PHONOLOGICALLY CUED SPEECH PRODUCTION

Suz Prejawa[1], Marion Oberhuber[1], 'Oiwi Parker Jones[1], Thomas Hope[1], Sue Ramsden[1], Mohamed L. Seghier[1], Alex P. Leff[2], David W. Green[3], Cathy J. Price[1]; [1]Wellcome Trust Centre for Neuroimaging, University College London, UK, [2]Institute of Cognitive Neuroscience, University College London, UK, [3]Cognitive, Perceptual and Brain Sciences, University College London, UK

Background: Speech can be produced semantically (e.g. naming objects), phonologically (e.g. repeating pseudowords), or from physical attributes (e.g. naming colours). Previous studies have reported brain activation differences for picture naming versus word reading; sound naming versus auditory word repetition; word reading versus pseudoword reading; or auditory word repetition

versus auditory pseudoword repetition. However, the results are confounded by activation related to perceptual and/or familiarity differences. The present study avoided perceptual confounds by comparing semantically versus phonologically cued speech in both the visual and auditory modalities. Familiarity differences were avoided by manipulating semantic and phonologically cued speech independently in a 2x2x2 factorial design. Experimental design: Factor 1= Semantically (S) cued; Factor 2= phonologically (P) cued; Factor 3 = stimulus modality (V/A). SPV =reading words; SPA=auditory word repetition; SV= picture naming; SA=naming environmental sounds; PV=reading pseudowords; PA=auditory repetition of pseudowords; V-features=naming colours; A-features=naming gender from humming. Data: 26 young adults, 3T MRI scanner; analysed with standard procedures (SPM12). Results: By independently manipulating semantic and phonological processing, we offer new interpretations of language activations. For example, we show that activation in (1) the left dorsal supramarginal gyri that has previously been reported for phonological relative to semantic decisions is the consequence of producing speech in the absence of semantic cues rather than in the presence of phonological cues; (2) the absence of phonological cues increases activation in the right inferior frontal sulcus and left posterior cerebellum; and (3) the most significant effect of phonological cues is to increase activation in the left putamen.

D33 USING FTCD TO EXAMINE LANGUAGE LATERALISATION DURING OVERT AND COVERT FLUENCY TASKS

Eva Gutierrez[1], Heather Payne[1], Anna Safar[2], Mairead MacSweeney[1]; [1]University College London, [2]Radboud University Nijmegen

Functional transcranial Doppler sonography (fTCD) is a non-invasive, fast and safe way of establishing hemispheric dominance during cognitive tasks (see Deppe et al., 2004;Bishop et al., 2009). The gold standard task for demonstrating lateralisation during speech production is phonological fluency (PF). Due to concerns about artefacts induced during overt production, previous studies have required covert production. In this study we tested this assumption by contrasting lateralisation during both covert and overt production. We also tested semantic fluency (SF) to assess consistency of hemispheric dominance across different language tasks. Nineteen right-handed English speakers were tested in four conditions: PF–overt; PF-covert; SF-overt; SF-covert. Laterality indices (LIs) for 12 participants who had sufficient remaining trials following artefact rejection were calculated for each task. Those with LIs significantly different from zero were classed as left or right lateralised, as appropriate. The remainder were classed as 'bilateral'. Our data showed an increase of rejected epochs for the overt conditions. Additionally, we observed a larger percentage of left lateralised subjects for PF than SF. However, this was driven by the relatively low level of left lateralisation during the SF-overt task, compared to the other three conditions (PF-overt, PF-covert, SF-covert). Our results demonstrate that lateralization can be assessed with fTCD during overt tasks, allowing a more natural experimental situation, although more trials should be included to compensate for artefacts. More research is needed to fully understand the nature of within individual variation in language lateralisation during language tasks with different demands.

D34 THE ROLE OF THE INFERIOR PARIETAL CORTEX IN SENSORIMOTOR REPRESENTATIONS FOR SPEECH

Vincent Gracco[1,2], Isabelle Deschamps[1,2], Douglas Shiller[1,3], Lucas Dangler[1,2], Benjamin Elgie[1,2], Shari Baum[1,2]; [1]Centre for Research on Brain, Language and Music, [2]McGill University, [3]Université de Montréal

The human parietal cortex has been associated with a range of cognitive functions from multisensory integration to action understanding and imitation. In most speech production models, the parietal cortex is either not represented (Hickok et al., 2011; Hickok, 2012; Houde & Nagarajan, 2011) or is relegated to somatosensory error detection (Tourville & Guenther, 2011). Recently, it has been suggested that the inferior parietal cortex through the auditory dorsal pathway may play a more general role in sensorimotor integration and control for speech (Rauchecker & Scott, 2009; Rauschecker, 2010). Here we report the results from four experiments on speech production and speech perception using functional neuroimaging and repetitive transcranial magnetic stimulation (rTMS) focusing on the supramarginal gyrus within the inferior parietal lobe (IPL). Under normal, externally generated speech or passive speech processing, we find a lack of neural activation in the IPL and no rTMS effects after IPL inhibition. In contrast, during encoding/decoding of pseudowords and speech motor adaptation to altered auditory feedback, we find substantial activation in the IPL bilaterally and complementary behavioral changes following rTMS inhibition of IPL areas in the right and left hemisphere. The data suggest, consistent with other sensorimotor behaviors, that the IPL is part of a higher order network that is recruited for learning, updating or evaluating multimodal sensorimotor representations. For speech production and perception this process is independent of the motor control or perceptual processing of speech in real-time with the IPL actively engaged when sensorimotor transformations are required.

Orthographic Processing, Writing, Spelling

D35 COMBINED MEG AND FMRI ACCOUNTS PROVIDE A SPATIOTEMPORAL DESCRIPTION OF SEMANTIC VS. PERCEPTUAL PROCESSING OF WRITTEN WORDS

Mia Liljeström[1], Johanna Vartiainen[1], Maria Peltonen[1], Riitta Salmelin[1]; [1]Aalto University

Previous research examining the relationship between MEG and fMRI activations in language tasks has demonstrated systematic differences between MEG evoked responses and fMRI BOLD signals within several cortical regions. Here, we examine the effect of experimental task (semantic vs perceptual decision) on MEG and fMRI signals in reading. We recorded MEG data from 13 and fMRI data from 10 healthy participants. The participants performed two judgment tasks, focusing either on the visual properties (color: "Is the word printed in blue or green?") or the semantic properties (object size: "Is this object bigger or smaller than a rubber boot?") of the visually presented words. Data analysis for the fMRI data was performed in SPM8, whereas MEG areal mean signals were characterized by measuring the mean amplitude in four time windows (50–150 ms, 150–200 ms, 250–500 ms, and 500–700 ms). Cortical dissociation between the two tasks appeared differently in fMRI and MEG signals. In fMRI, we observed task-specific effects in the left occipito-temporal cortex (LOTC), left inferior frontal gyrus (LIFG), and right posterior cingulate cortex. MEG suggested sustained differentiation between the two tasks over the left temporal and right occipito-temporal areas in the later time windows (>250ms). The combined use of MEG and fMRI yields a more comprehensive characterization of the functional roles of the cortical regions involved in reading than either method by itself.

D37 IDENTIFYING THE LANGUAGE NETWORK THROUGH FUNCTIONAL CONNECTIVITY: CONTRASTING TASK CONDITIONS AND THE RESTING STATE WITH FMRI AND MEG

Aaron Newman[1], Nathaniel Crawford[1], Cassandra Taylor[1], Jason Newport[1], Jean Saint-Aubin[2], Raymond Klein[1]; [1]Dalhousie University, Halifax, NS, Canada, [2]Universite de Moncton, Moncton, NB, Canada

Functional connectivity (FC) refers to correlations in activity between different brain regions, and offers the opportunity to move beyond "neo-phrenology" to understand how different brain regions interact and are modulated during language processing. FC analyses can be performed on brain scans acquired during task performance as well as during the resting state (RS). Although numerous functional networks have been identified in RS scans, the classical left-lateralized language processing network has not been among these. Here we investigated whether the language network could be identified using seed-based FC analyses, and what modulations of the language network would be observed in comparing (a) reading text vs. viewing scrambled text; and (b) reading vs. RS. Seed ROIs were identified using a localizer scan contrasting reading and viewing consonant strings. The choice of seed ROI strongly influenced the FC maps obtained. However, we developed an "aggregate" FC map by combining the maps derived from multiple seed ROIs, which reliably identified a bilateral but left-lateralized network involving classical language areas including ventral and dorsal lateral frontal cortex, the superior temporal sulcus, and the basal ganglia. This network showed stronger FC during reading than when viewing scrambled words, however surprisingly similar FC was observed when contrasting reading with the RS. We suggest that, like other functional networks, the language network is functionally connected at rest as well as during task performance. Stronger FC during reading than during viewing scrambled words may be due to disruption of the network by language-like stimuli.

D38 TAKING THE DUAL ROUTES IN CASCADE TO GET FROM PRINT TO SPEECH: WHERE AND WHEN THE EFFECTS OF INSTRUCTIONS, WORD FREQUENCY, AND WORD TYPE INTERSECT ALONG THE WAY.

Ron Borowsky[1], Layla Gould[1], Crystal Zhou[2], Stan Hrybouski[2], Zohaib Siddiqi[2], Brea Chouinard[2], Jacqueline Cummine[2]; [1]University of Saskatchewan, [2]University of Alberta

OBJECTIVE: We explored whether reliance on the ventral-lexical stream during word reading can be enhanced by the instructed reading strategy, or whether it is impervious to such strategies. Specifically, by instructing participants to first decide whether the target spells a word, and to name it only if it does, can reliance on the orthographic lexical system be observed both in terms of brain activation and response behaviour? METHOD: We examined Instructions: name all vs. name words (based on spelling), Word Type: regular words vs. exception words (amongst an equal proportion of nonwords), and Word Frequency (WF) in print (log10 HAL WF) in an experiment while measuring fMRI BOLD and overt naming reaction time (RT) simultaneously. RESULTS: Instructions to name words increased overall reliance on the ventral-lexical stream, as measured by visible BOLD activation and the WF effect on RT. The analysis of joint effects on RT revealed overadditive interactions of WF with both Instructions and Word Type, and additivity between Instructions and Word Type. CONCLUSIONS: The fMRI data supports the notion that reliance on the ventral lexical stream can be strategically enhanced by instructions that require orthographic lexical assessment prior to responding. The pattern of joint effects on RT supports a dual-stream, cascaded architecture for basic reading processes (i.e., at least some degree of stage-like processing involving a delay in the onset of activation of target representations between systems).

D39 SOMETHING INTERESTING HAPPENED ALONG THE WAY: DISSOCIATIONS BETWEEN NAMING ONSET RT AND RESPONSE DURATION AS A FUNCTION OF LEXICAL-BASED READING.

Layla Gould[1], Jacqueline Cummine[2], Ron Borowsky[1]; [1]University of Saskatchewan, [2]University of Alberta

We examined reaction time (RT) joint effects among Instructions (INST), Word Frequency (WF), and Word Type (WT) in a word naming task by using the additive factors method (if two variables interact overadditively on RT, then they affect a common system, whereas if two variables are additive on RT, then they affect separable systems). The pattern of additive and overadditive joint effects on RT among INST, WF, and WT supported a cognitive chronometric architecture consisting of at least two cascaded stages of processing, with the orthographic lexical system as the locus of the INST x WF interaction, and the phonological output system as the locus of the WF x WT interaction. Instructions and WT showed an additive pattern, suggesting that INST and WT affect separable systems. The joint effects of WF, WT, and INST on naming RT thus support a cascaded model. We also examined response duration (RD) in this data by recording and hand-marking vocal responses, which provides evidence that basic reading processes are ongoing even after the initiation of a vocal response, and supports the notion that the more lexically a word is read, the shorter the RD. As such, the effects of WT and INST on RD were opposite to their effects on RT. Given the dissociating effects between RT and RD, these results provide new challenges to all models of basic reading processes.

D40 ELECTROPHYSIOLOGICAL CORRELATES OF LEXICAL ACCESS DURING SPEECH AND WRITTEN PRODUCTION.

Cristina Baus[1], Albert Costa[1,2]; [1]Center of Brain and Cognition (CBC), Universitat Pompeu Fabra, Barcelona, Spain, [2]Institut de Recerca i Estudis Avançats (ICREA), Barcelona, Spain

Along with speaking, writing (especially typewriting) has become an important way of communication in our daily life. However, relative to speech production, little is known about the cognitive processes underlying written production. Some of those processes are common to both modalities, especially those occurring early in the course of naming/writing a word (e.g., lexical access), but some others occur only in the writing modality (e.g. Phoneme-Grapheme conversion). The question is whether early cognitive processes unfold over time similarly in the course of naming/writing a word or the existence of extra processes in the writing modality affects the timing at which those early processes occur. By means of a picture naming/writing task, we explored the electrophysiological correlates of lexical frequency (taken as index of lexical access) during three production modalities: naming, typewriting and handwriting. Behaviourally, the results showed faster latencies when naming than when writing, especially for typewriting. Importantly, the frequency effect (faster reaction times for high than for low-frequency words) was present in the three modalities. The ERPs results revealed that high-frequency started to diverge significantly from low- frequency ERPs at different times depending on the modality, earlier in the naming modality (around 200 ms after the onset of picture presentation) than in the handwriting (270 ms) and typewriting (300 ms) modalities. These results suggest that latter processes occurring while writing but not while speaking (e.g., phoneme-grapheme conversion) affect the timing at which lexical access occurs. The results are discussed in the framework of speech and written production models.

Syntax, Morphology

D42 A NOISY-CHANNEL ACCOUNT OF APHASIC LANGUAGE COMPREHENSION

Edward Gibson[1], Chaleece Sandberg[2], Evelina Fedorenko[1], Swathi Kiran[2]; [1]MIT, [2]BU

Broca's aphasics have long been known to preferentially use plausibility information when it conflicts with syntactic information (e.g.,Caramazza&Zurif,1976). For example, an implausible sentence like "The girl was kicked by the ball" is often interpreted by Broca's aphasics according to semantic cues ("the girl" – agent; "the ball" – patient). We propose and evaluate a novel explanation for this observation, within a noisy-channel model of communication (Shannon,1949; Levy et al.,2009). In this model, a speaker wishes to convey a meaning *m* and chooses an utterance *u* to do so. This utterance is conveyed across a channel that may corrupt *u* (e.g., due to speaker/perceiver errors). We hypothesize that Broca's aphasics assume the existence of more noise in the channel. In the presence of more noise, a rational comprehender should rely more on what was plausibly intended rather than on the signal itself. Furthermore, plausibility should exert stronger influence on the interpretation of implausible structures that have a "close" plausible alternation. Aphasic, age-matched and younger controls performed an act-out task across two alternations: active-passive (two insertions/deletions are required to change between structures; e.g., deleting "was" and "by" in "the ball was kicked by the girl" results in "the ball kicked the girl"); and double-object/prepositional phrase object (DO/PO) (only one insertion/deletion is needed to change between structures). As predicted, the aphasics relied most on plausibility in the DO/PO constructions (70%, across 80 trials, n=8) than in the active/passive constructions (34%), and these biases were much stronger than in the two control groups.

D43 THE ROLE OF THE LEFT IFG AND MTG DURING THEMATIC PRIMING: AN FMRI STUDY

Sharlene Newman[1], Donghoon Lee[2], Evie Malaia[3], Benjamin Pruce[1], Roy Seo[1]; [1]Indiana University, Department of Psychological and Brain Sciences, Bloomington, Indiana, USA, [2]Pusan National University, Department of Psychology, Busan, South Korea, [3]Southwest Center for Mind, Brain, and Education, University of Texas at Arlington, Texas, USA

Introduction: Behavioral studies of word priming have revealed facilitation effects for cross-grammatical class pairs (thematic priming; e.g., verbs priming nouns) that were similar to that observed for within-class pairs (semantic priming). However, it is unclear whether the underlying mechanism for thematic priming is the same or different from semantic priming. This study assessed semantic and thematic priming using fMRI during a lexical decision task. Methods/Results: 18 participants performed a lexical decision on 320 thematically or semantically related word pairs pseudorandomized with an equal number of word-nonword pairs. The processing of target words semantically related to primes (e.g. tiger – cow) elicited fMRI suppression effects in inferior occipital/temporal cortex including the fusiform and lingual gyri, as well as in bilateral prefrontal cortex, medial prefrontal cortex, posterior cingulate cortex and the cerebellum; the processing of target words thematically related to primes (e.g. graze – cow) elicited enhancement effects in left posterior MTG (BA 22/39) and BA 47. Discussion: The results indicate that the neural mechanisms underlying the two priming phenomena are different: semantic priming is based on neural suppression of sensory-motor information within inferior temporal/occipital regions, while thematic priming is based on the active process (enhancement effects) of integration of local syntactic (thematic) structural information within the left-lateralized language network. Conclusions: These results support both automatic activation of extended verb frame as suggested by lexicalist accounts, and automaticity of phrase-structure building processes, at least when both noun and verbs are present in the input, as suggested by combinatorial theories.

D44 DYNAMIC FREQUENCY CORRELATES OF (MORPHO-) SYNTACTIC PROCESSING: INDUCED BETA BAND ACTIVITY CORRELATES WITH THE SUCCESSFUL COMPOSITION OF AGREEMENT, ABSTRACT CASE, AND THEMATIC RELATIONS.

Jessamy Norton-Ford[1], Jon Sprouse[1]; [1]University of California, Irvine

Currently, the most widely-used method in electrophysiological linguistic research is the event-related potential, or ERP. While ERPs reflect dynamic amplitude information, recent work has begun to uncover dynamic frequency correlates of grammatical processing. Such work has found correlations of beta activity and (morpho-)syntactic processing (Bastiaansen, 2009), with increased beta in cases where syntactic structure can be successfully (grammatically) composed. Using wavelet analysis and RSVP, this work examines the dynamic frequency response to three syntactic violations, all of which typically demonstrate LANs in the amplitude domain: case violations, subject-verb agreement violations, and θ-criterion violations. Cluster-based permutation tests yield significant clusters of increased lower beta (13-18Hz) activity in bilateral posterior regions 500-800ms post-stimulus for successful case and agreement processing relative to violations, and increased lower beta activity following successful θ-role processing relative to violations throughout a 0-800ms time-window. These results are broadly consistent with Bastiaansen (2009), which indicate a correlation of successful syntactic composition and lower beta activity, but crucially (i) expand such findings to cases of successful (morpho-)syntactic agreement and thematic assignment, (ii) raise questions about the differences in scalp distribution (left frontal in Bastiaansen 2009 versus largely posterior here), and (iii) raise questions about differences in latency (early and sustained in Bastiaansen 2009 versus late here). These differences may be problematic for the interpretation of beta activity as a general index of syntactic binding, and raise the possibility that beta activity suppression may be a correlate of violation detection rather than its increase being a correlate of successful processing.

D45 THE DOS AND DON'TS IN ERP SYNTAX RESEARCH

Karsten Steinhauer[1]; [1]McGill University

Many ERP studies investigating syntactic online processing have reported early negativities (ELANs) that are typically interpreted as evidence for fast, automatic 'syntax-first' processes (e.g., Friederici, 2002; Neville et al., 1991). As discussed in Steinhauer and Drury (2012), most of theses studies have methodological problems, in terms of (a) creating appropriate stimulus materials, (b) the conditions included in the experimental design, (c) data analysis (including time-locking and baseline corrections), and (d) data interpretation. These various methodological shortcomings can result in artefacts that look like ELANs (and other early effects) but have nothing to do with the processes under investigation. In my talk, I will identify and illustrate some of the most important such problems, present data from studies that avoided them, and conclude with a number of recommendations that may be relevant for future ERP studies - in the area of syntactic processing and likely in other domains as well.

D46 ELECTROPHYSIOLOGY OF SYNTACTIC ENCODING DURING SENTENCE PRODUCTION

Inge Timmers[1,2], M. Estela Rubio-Gozalbo[2], Bernadette M. Jansma[1,3]; [1]Maastricht University, [2]Maastricht University Medical Center, [3]Maastricht Brain Imaging Center

During sentence production, lexical entries are selected, retrieved and integrated into meaningful utterances (Bock, 1995). Apart from few indirect and ambiguous findings, the time course of syntactic encoding during sentence production remains unclear. In this study, thirty-three volunteers overtly described a visually animated scene using multi-word utterances that varied with syntactic complexity (word 'W', noun phrase 'NP' or sentence 'S' format; Indefrey et al, 2001), while electroencephalograms were recorded. The content of the scenes differed per trial and not all information (verb) was available immediately, allowing us to infer both on early noun phrase planning (starting immediately after scene onset; related to first

nouns and adjectives) and on later sentence-level planning (when all information is available; adding constituent assembly). Event-related potentials (ERPs) were extracted (-200-2500ms post scene onset; filtered .3-30Hz, baseline corrected -200-0ms, cleaned using Independent Component Analysis, ICA, Onton et al, 2006). Behaviourally, we found that with more syntax, more errors and corrections were made. In the ERP, variation with syntactic complexity was found in two P300-like components: 450-550ms post scene onset ('S' and 'NP'>'W'; anterior effect), and 300-400 ms after all information was available, respectively 1620-1720ms post scene onset ('S'>'NP' and 'W'; posterior effect). Further, a late frontal negativity (650-850ms post scene onset) showed a linear relation with syntax (the more syntax, the larger the negativity). To conclude, it seems feasible to measure syntactic encoding online. The findings suggest that syntactic encoding plays a role within the P300-time window, both for local noun phrase and global sentence planning.

D47 PERSONS ARE NOT NUMBERS: DISENTANGLING AGREEMENT INFORMATION IN THE BRAIN

Simona Mancini[1], Ileana Quiñones[1], Nicola Molinaro[1], Manuel Carreiras[1]; [1]Basque Center on Cognition, Brain and Language

Comprehending subject-verb agreement involves decomposing nominal and verbal forms to extract grammatical information - namely 1st, 2nd and 3rd person, singular or plural number- to subsequently map it to different semantic-pragmatic representations concerning the type of speech participants (1st=Speaker, 2nd=Addressee, 3rd=non-participant) and their numerosity (a single entity vs. a multitude). In this fMRI study in Spanish we investigated whether person and number comprehension engages different neural substrates, because of the inherently different semantic-pragmatic representations they map. Subject-verb agreement was manipulated to create mismatches in person (*El cocinero3.sg cocinaste2.SG un arroz/The cook (you-)cooked rice, PM) and number (*El cocinero3.sg cocinaron3.pl un arroz/The cook (they)cooked rice, NM) to be contrasted with correct sentences (Los cocineros3.pl cocinaron3.pl un arroz/The cooks cooked rice). Twenty-one Participants read 120 experimental sentences that were administered in an event-related design. The processing of both PM and NM led to activity increase in syntactic-violation processing areas, such as left medial frontal areas (BA45/46), and in conflict-monitoring regions, e.g. precuneus and posterior cingulate gyrus. Crucially, contrasts also revealed different activation patterns between the two violations. Higher activity was found for PM in the pars orbitalis (BA47) of the left-inferior frontal gyrus, while activation in the right inferior parietal cortex showed dissociation between NM processing and violation processing (i.e. both NM and PM). Data show that person and number interpretation engages different neural substrates: areas associated with the retrieval of stored conceptual representations for person (i.e. participant-type representations), and areas linked to quantity processing for number agreement (i.e. quantity of participants).

D48 PROBING THE DYNAMICS OF COMPLEX WORD RECOGNITION: AN ERP INVESTIGATION OF THE PROCESSING OF NOVEL COMPOUNDS

Robert Fiorentino[1], Stephen Politzer-Ahles[1], Natalie Pak[1]; [1]University of Kansas

Recent psycholinguistic and neurolinguistic studies have provided evidence that visually-presented words are initially morphologically segmented whenever the letter-string can be exhaustively assigned to existing morphological representations; e.g., "government" primes "govern," and, in masked priming, "brother" primes "broth" (reflecting an ultimately-abandoned 'broth+er' analysis), while "brothel" does not prime "broth" (as "broth" is an existing English morpheme, but "el" is not). Relatively little research has examined this phenomenon for novel complex words (e.g., "armplane") and novel pseudo-embedded words (e.g., "nomplane"). Full decomposition approaches predict morphological decomposition for novel compounds, but predictions are less clear for novel pseudo-embedded words; while they are not exhaustively segmentable into existing morphemes, they may still yield embedded pseudomorpheme activation (considering evidence for facilitory orthographic priming with fully nonce-word primes), and there is no exhaustive monomorphemic analysis of the letter-string for the parser to pursue as an alternative (unlike, e.g., "brothel"). In a series of masked and unmasked priming experiments, we find equivalent priming of novel compound constituents ("armplane"-"plane") and pseudoembedded constituents ("nomplane"-"plane"). Likewise, in an EEG/unmasked priming study (n=12), targets preceded by novel compound and pseudo-embedded primes both elicit reduced N400 amplitudes relative to unrelated primes, but do not significantly differ from one another. These results demonstrate the rapid activation of putative constituents during the processing of potentially-complex novel words; such activation was also evident for pseudoembedded nonwords, unlike findings reported for pseudoembedded real words, demonstrating that morpheme activation may persevere despite the lack of an exhaustive morphological parse when an exhaustive monomorphemic analysis is also unavailable.

D49 LANGUAGE ARCHITECTURE IN THE BRAIN: NEUROANATOMICAL INVESTIGATION OF BASIC HIERARCHICAL STRUCTURES

Emiliano Zaccarella[1,2], Michiru Makuuchi[3], Angela D. Friederici[1,2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig (Germany), [2]School of Mind and Brain, Berlin (Germany), [3]National Rehabilitation Center for Persons with Disabilities, Tokorozawa (Japan)

The structural complexity of human language arises from simple combinatorial operations between linguistic units at sub-sentential level. In the current visual fMRI experiment,

we sought to identify those brain regions supporting the building-up of basic syntactic hierarchies. Minimal phrase structures (auf das Schiff) and sentence structures of equal syllabic length and equal number of merge operations (das Schiff sinkt) have been compared to NP-lists control conditions, with no building processing available (Halm Schiff Saft). Eighteen German adults have been scanned and a phrase/sentence vs. word-list judgment task has been used. Functional data have been analysed with SPM8 with the General Linear Model. A selective involvement of the infero-frontal regions for the syntactic system has been found, with enhancement in BA44/45p and the deep FOP. A partial shift from BA44 to BA45 has been observed between prepositional phrase- and sentence-level structures. This conforms to the view that the most anterior part of the IFG plays a crucial role at sentence level semantics, with the verbal phrase introducing propositional mappings between argument and property. The posterior MTG/STS suggests that this region comes into play during the assignment of thematic roles, which can be either preposition-based or verb-based. It appears then, that both sub-sentential and sentential structures are processed by a fronto-temporal network, with an anterior shift in Broca's area when propositional mapping is requested. Since both number of merge operations and number of words have been kept constant across the structural types, the verb is the crucial factor determining the observed modulation.

D50 THE PAST TENSE DEBATE REVISITED: ELECTROPHYSIOLOGICAL EVIDENCE FOR SUBREGULARITIES OF IRREGULAR VERB INFLECTION

Stefanie Regel[1], Andreas Opitz[2], Gereon Mueller[2], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, [2]University of Leipzig

In neuropsychological and neuroimaging research regular and irregular verb inflection has extensively been studied regarding investigation of mental grammar and lexicon (see Marslen-Wilson & Tyler, 2007; Ullman, 2001). Thereby, past tense inflection of irregular verbs is assumed to consist of rather unsystematic stem alternations, e.g. caught, compared to regular verbs. In current morphological accounts, however, irregular inflection relies on systematic paradigms containing inflectional features [past, finite] that are computed by the syntactic component (Wiese, 2004). In this study, we addressed this issue by examining stem alternations of irregular German verb inflection using event-related brain potentials (ERPs). Participants read series of irregular verb inflection including present tense, past participle and past tense embedded in minimal syntactic contexts. Past tense forms were systematically manipulated and were either grammatical (he sang), or ungrammatical, i.e., compatible by [+past] (*he sung), or incompatible by [-past] (*he sing). Correspondingly, in a second block pseudowords were presented, e.g., tang/*tung/*ting. ERPs for real words revealed a biphasic ERP pattern consisting of LAN and P600 for compatible and incompatible past tense forms in comparison to grammatical ones. Most interestingly, the P600 amplitude was gradually modulated by compatibility with medium amplitude for compatible, and largest amplitude for incompatible forms. ERPs for pseudowords showed a gradual modulation of LAN with largest amplitude for incompatible forms, and medium amplitude for compatible relative to grammatically predicted forms. Irregular verbs seem to consist of subregularities that are morpho-phonologically analyzed and computed independent of lexical representations. Thus, findings are in line with underspecification-based accounts.

Discourse, Combinatorial Semantics

D51 SEMANTIC CONTEXT AFFECTS PREVIEW BENEFIT DURING CHINESE SENTENCE READING

Nan Li[1], Suiping Wang[1]; [1]South China Normal University

A large number of studies have consistently shown that the processing of a word starts when it is in the parafoveal region of the visual field (see Rayner, 2009 for a review). These studies are mainly concerning on how the lexical features of preview information affect the processing of word when it is fixated. Whether and how the context information influence the preview effect remains an open issue. Using the boundary paradigm (Rayner, 1975), the present study aimed to explore the context effects on preview benefit during Chinese reading. Readers read sentences with a 1-character target word while their eye movements were monitored. In Experiment 1, there were preview words semantically related or unrelated with a target word either highly predictable or unpredictable from the sentence context. Both types of the preview words were incongruent in the sentence. The results revealed that the related preview would benefit the word processing when the target was unpredictable in the sentence, but would interfere with the processing when the target was highly predictable in the sentence. In experiment 2, both the semantically related and unrelated preview words were congruent in the sentence. The results showed a semantically related preview could benefit the processing of a highly predictable word when the preview was congruent in the sentence. Taken together, these results suggest that the semantic context can influence the preview effect in Chinese sentence reading. Implications of these results are discussed.

D52 THE ROLE OF READER DEICTIC CENTER IN THE COMPREHENSION OF DEICTIC NARRATIVES: AN ERP STUDY

David Beltran[1], Enrique Garcia[1], Dolores Castillo[1], Manuel De Vega[1]; [1]University of La Laguna

In face-to-face conversations, people use deictic verbs (e.g. come and go) to describe motions toward or from their own deictic center. In narratives, by contrast, the same deictic verbs are used to describe motions from the perspective of fictional characters, whose deictic center is thoroughly established by the writer. This study explores using ERPs whether readers activate their own deictic

center when narratives do not provide it explicitly, and whether it serves as a constraint on the semantic unfolding of sentence meaning – at least as this is indexed by the modulation of the N400 component. To that end, readers were given short paragraphs including critical sentences that resulted from combining proximal (come), distal (go), or stative (be) verbs with local (e.g. Tenerife) and distant (e.g. Barcelona) geographical places. ERPs were measured in response to the geographical place nouns, and we predicted N400 effects when the combination of verb and place in the sentence was inconsistent with the readers' own deictic center, namely proximal verbs with distant places (e.g. "come to Barcelona"), and distal verbs with local places (e.g. "go to Tenerife"). Results revealed that proximal-distant combinations elicited a significantly larger N400 than both proximal-local (e.g. "come to Tenerife") and distal-distant (e.g. "go to Barcelona") combinations, but failed to show a similar effect for the inconsistent distal-local combination. These findings raise the possibility that readers' own deictic center is adopted by default in narratives and that, by mean of this adoption, it incrementally impacts on the comprehension of motion descriptions.

D53 THE NEUROBIOLOGY OF SENTENCE COMPREHENSION IN A NARRATIVE CONTEXT. *Iris Broce[1], Anthony Steven Dick[1], Pascale Tremblay[2], Uri Hasson[3], Michael Andric[3], Steven L. Small[4,5]; [1]Florida International University, [2]Université Laval and Centre de Recherche de l'Institut Universitaire en Santé Mentale de Québec, [3]University of Trento, [4]The University of California, Irvine, [5]The University of Chicago*

In narrative contexts, information conveyed by a sentence depends on how it relates to what was stated previously. Using fMRI, we investigated functional networks associated with semantic revision in situations in which sentences were either improbable given the prior context ("Revision") or probable ("Non-Revision"). For example, the sentence pair "The fireman said that the fire started accidentally. However, police later found gasoline and oil all over the house" appeared in the Revision condition. The pair "Judy told Dan she would be late for their date. When Dan arrived on time, Judy was not there" was Non-Revision. 15 adults passively listened to sentence pairs under these two conditions. Based on prior studies, we expected that left lateral superior temporal and inferior frontal regions involved in semantic processing during language comprehension would be more active when the second sentence required revision of the first sentence's message. This is what we found. Specifically, we found Revision sentences elicited more activity in 1) the inferior frontal sulcus and gyrus of the pars triangularis, a region that is associated with semantic selection; 2) the anterior superior temporal gyrus and sulcus, associated with sentence-level combinatorial semantics 3) and the posterior superior temporal sulcus, associated with language comprehension. We also found right hemisphere activation in rostral and lateral superior frontal gyrus. These results are consistent with recent emphasis on anterior superior temporal-inferior frontal functional interactions for sentence-level language comprehension. However, they also suggest continued involvement of posterior superior temporal regions more classically associated with language comprehension.

D54 GENDER PROCESSING OF REFLEXIVE PRONOUNS IN MANDARIN CHINESE *Jui-Ju Su[1], Nicola Molinaro[1], Joy Chien[4,5], Pei-Shu Tsai[5,6], Denise Wu[4,5], Manuel Carreiras[1,2,3]; [1]BCBL, Basque Center on Cognition, Brain, and Language, Spain, [2]Ikerbasque, Basque Foundation for Science, Spain, [3]Department of philology, University of Basque Country, Spain, [4]Institute of CognNeuroscience, National Central University, Taiwan, [5]Laboratories for Cognitive Neuroscience, National Yang-Ming University, Taiwan, [6]Institute of Neuroscience, National Yang-Ming University, Taiwan*

Pronoun resolution involves successful reference to a proper antecedent. Osterhout et. al. (1997) manipulated gender congruency between antecedents and reflexive pronouns: They found a P600 effect for gender mismatches, that was larger for definitional (mother - himself) as compared to stereotypical (nurse - himself) antecedent role names. Here we implemented a similar experimental design in written Mandarin Chinese in which gender information is expressed in pronouns by unpronounced radicals that convey only semantic information: "人" (human) for 他 (he) and "女" (female) for 她 (she). Eighteen native Chinese speakers participated in this experiment. They read sentences including proper names (i.e. Lady Gaga) or stereotypical role names (i.e. dance teacher) presented word by word at the center of the screen. Comprehension questions were asked on 30% of the sentences. ERPs were recorded from 32 active electrodes (10-20 system). ERPs showed a larger N400 effect on gender mismatches than gender match sentences, and this effect was bigger for stereotypical role names than proper names. This N400 effect for Mandarin Chinese differs from previous results reported in English (P600): Chinese speakers might rely more on the semantic cues (e.g., radicals) when they process gender information in the reflexives. Critically, while the gender information is directly related to proper names, this information has to be inferred in the case of stereotypical role names. These inferences for stereotypes would induce a deeper evaluation of the gender value for role nouns thus triggering more processing costs when a mismatching pronoun is encountered.

D55 THE EVENT-RELATED OPTICAL SIGNAL (EROS) PROVIDES A SPATIOTEMPORAL AND FUNCTIONAL CONNECTIVITY STUDY OF CORTICAL RESPONSES DURING LANGUAGE COMPREHENSION

Edward Wlotko[1], Kara D. Federmeier[1], Monica Fabiani[1], Gabriele Gratton[1]; [1]University of Illinois

The spatiotemporal dynamics of brain areas recruited for language comprehension have been investigated largely by qualitatively comparing data from electromagnetic techniques offering good temporal resolution with neuroimaging data providing good localization power. The event-related optical signal (EROS), an optical imaging technique sensitive to neuronal activity in localized cortical areas, allows interrogation of the timecourse of activity in specific brain regions, obtained within one methodology. EROS was recorded from left and right (LH and RH) frontal and temporal areas known to be important for language comprehension, while participants read sentences completed with either congruent versus anomalous endings (Exp. 1) or entirely plausible sentence endings that varied in constraint/predictability (Exp. 2). Across the two experiments, greater activity for anomalous/unpredictable endings in superior temporal gyrus (STG) around 150-180 ms was observed in both hemispheres. A response in left STG and left anterior temporal cortex (approximately 190-230 ms) was most robust for predictable sentence completions. Such a pattern is consistent with the notion of a predictive comprehension strategy subserved by the left hemisphere: constraining sentential context allows pre-activation of information about likely upcoming stimuli. Finally, functional connectivity (lagged seeded cross-correlation) analyses revealed bilateral intrahemispheric fronto-temporal connectivity patterns. Temporal activity lagged frontal activity by 95-195 ms in the LH and 215-330 ms in the RH. These circuits appeared faster and more robust in the LH, concurring with claims of stronger or more efficacious top-down language comprehension mechanisms in the LH.

D56 PROCESSING LEXICAL SEMANTIC FEATURES ON FUNCTIONAL WORDS--A CASE OF NEGATIVE POLARITY ITEMS

Ming Xiang[1], Julian Grove[1], Anastasia Giannakidou[1]; [1]University of Chicago

Previous ERP research on semantic processing has mainly focused on how the lexical semantic features are processed on content words. In this study, we look at how the lexical semantics of functional words—in particular, the negative polarity item (NPI) "ever"—is accessed and integrated into the discourse. NPIs are known to be subject to particular semantic and pragmatic licensing conditions. Although the exact nature of the licensing conditions is still under debate, it is known that some notion of negation is crucial. In the current study we compared two different grammatical licensors—negative quantifier "no" and universal quantifier "every". They are both downward entailing (DE) operators, satisfying the classic licensing condition in Ladusaw (1979). However, while "no"is negative, "every" is not. 120 sets of 3-condition items were created (60 extra fillers): No/Every/*The clothing models that the genius designer would ever choose have had a lot of experience modeling. ERP results(n=17) showed a P600 for the ungrammatical control at the critical word "ever" compared to both grammatical licensors, but licensor "no" also evoked a much smaller N400 compared to the other two. We take the P600 to reflect the stage of processing at which multiple grammatical constraints have been calculated and both "no" and "every" pass the final evaluation of being grammatical, compared to the ungrammatical control. But N400 reflects the initial stage at which the lexical access/retrieval of "ever" happens, and we propose true negation facilitates the lexical processing of NPIs, but not the related property of downward entailment.

D57 SUPERIOR TEMPORAL ACTIVATION FOR SEMANTIC ANOMALIES REFLECTS A LACK OF LEXICAL PREACTIVATION: AN FMRI STUDY ON ANOMALIES AT THE BORDERLINE OF AWARENESS

S. Tune[1], I. Bornkessel-Schlesewsky[1], F. Hippensteel[2], A. Nagels[1], M. Schiel[2], M. Schlesewsky[3], S. L. Small[2]; [1]Philipps-Universität Marburg, Germany, [2]University of California, Irvine, CA, [3]Johannes Gutenberg-Universität Mainz, Germany

In natural language comprehension, the computation of sentence level meaning is generally influenced by the surrounding context. While processing usually benefits from this additional information, it can also lead to semantic illusions such as the famous "Moses illusion" (Erickson & Mattson, 1981). A recent ERP study (Sanford et al., 2011) showed that so-called borderline anomalies (i.e., sentences in which the semantically incongruous word has a close fit to the global context) elicit distinct ERP responses from easy-to-detect semantic violations with a poor fit to global context. Here, we aimed to illuminate the neural mechanisms underlying the processing of these different types of anomalies. In an auditory event-related fMRI study, German native speakers (n=18, right-handed) listened to context-target sentence pairs of both borderline and easy-to-detect anomalies and non-anomalous counterparts and made a binary plausibility judgement via button press. Group analysis of the BOLD response engendered by target sentences revealed diverging activation patterns for detected anomalies compared to non-anomalous sentences. Easy anomalies showed higher bilateral activation in superior temporal (TTS, PT and STG) and inferior parietal cortices (SMG and AG) than the non-anomalous target sentences. Although the borderline anomalies did not show greater superior temporal activation than the non-anomalous targets, detected anomalies did reveal higher activation in the inferior parietal lobule and the anterior insula. These findings suggest that superior temporal activation

related to "semantic processing" may reflect the degree of contextual/lexical association rather than semantic integration.

D58 THE ANGULAR GYRUS IN COMBINATORIAL SEMANTICS

Amy Price[1], Jonathan Peelle[1], Michael Bonner[1], Murray Grossman[1]; [1]University of Pennsylvania

Thought and language rely on the brain's ability to flexibly combine concepts. However, little is known about the neural basis of this process. The angular gyrus is a heteromodal brain region with reciprocal white matter connections to sensory-motor association cortices, making it a promising candidate for supporting the integration of semantic information. In this study, we tested the predictions that: (1) The angular gyrus is activated during conceptual combination; and (2) The degree of angular gyrus activation reflects the strength of semantic combination. In an fMRI study, 17 participants read psycholinguistically-matched word pairs that could plausibly combine to form a coherent concept ("combinatorial"; e.g., plaid jacket) and pairs that could not ("low-combinatorial"; e.g., galaxy tulip). Combinatorial word pairs were weighted in one of four sensory-motor modalities: sound, touch, motion, and visual form. In a whole-brain analysis, the only region that was more active for combinatorial than non-combinatorial word pairs was the angular gyrus ($p<0.05$ whole-brain corrected). This finding was consistent regardless of sensory-motor modality. We also assessed the strength of semantic combination, derived from co-occurrence frequencies and independent norming data, and used these data in a whole-brain item analysis. Within the combinatorial word pairs, the only region where activity increased parametrically with the strength of combination was the angular gyrus ($p<0.05$ whole-brain corrected). Finally, individual differences in behavioral performance correlated with cortical thickness in the angular gyrus. Together, these findings support the hypothesis that the angular gyrus is a heteromodal binding region that underlies the representation of combined concepts.

D59 WHEN LANGUAGE CHANGES OBJECTS: SIMILARITY IN VISUAL CORTEX PREDICTS THE CONFLICT RESPONSE IN PREFRONTAL CORTEX

Gerry T.M. Altmann[1], Nicholas C. Hindy[2], Sharon L. Thompson-Schill[2]; [1]University of York, UK, [2]University of Pennsylvania, PA

To understand that an object has changed state during an event, we must represent the 'before' and 'after' states of that object. Because a physical object cannot be in multiple states at any one moment in time, these 'before' and 'after' object states are mutually exclusive. In the same way that alternative states of a physical object are mutually exclusive, are cognitive and linguistic representations of alternative object states also incompatible? If so, comprehending an object state-change should involve interference between the constituent object states. Through a series of functional magnetic resonance imaging experiments, we test the hypothesis that comprehension of object state-change, during language understanding, requires the cognitive system to resolve conflict between representationally distinct brain states. We discover that (1) comprehension of an object state-change evokes a neural response in prefrontal cortex that is the same as that found for known forms of conflict, (2) the degree to which an object is described as changing in state predicts the strength of the prefrontal cortex conflict response, (3) the dissimilarity of object states predicts the pattern dissimilarity of visual cortex brain states, and (4) visual cortex pattern dissimilarity predicts the strength of prefrontal cortex conflict response. Results from these experiments suggest that distinct and incompatible representations of an object compete when representing object state-change. The greater the dissimilarity between the described object states, the greater the dissimilarity between rival brain states, and the greater the conflict.

D60 A DISCOURSE-EXPECTED WORD INDUCES AN UPPER THETA INCREASE IN THE HUMAN EEG

Luming Wang[1,2], Yu-Chen Hung[1], Petra B. Schumacher[1,3]; [1]University of Mainz, [2]University of Marburg, [3]University of Köln

A fundamental capability of the human brain is to anticipate upcoming information and to efficiently integrate it with the preceding context. Interestingly, previous studies show that, when the sentence narrows expectation down to one specific word, such as the opposite of black is ... , the target word white engenders a P300, in addition to a reduced N400 (Roehm et al. 2007). Can such an expectation also be induced via discourse processing? We investigated this question and disentangled P300/N400 by separating them with time-frequency analysis, since they are apparently indistinct in ERP terms. EEGs of 24 German participants were recorded while they read context-target sentences like (1) (critical words are capitalized). Results showed N400 and P300 effects, which could be dissociated based on their different frequency characteristics: Whereas a looser expectation (b vs. a: N400) induces an evoked power increase in the lower theta band and a phase locking decrease in the same frequency band, a more specific expectation (a vs. b: P300) engenders an evoked power increase in the upper theta band. Our results thus suggest that the upper theta increase indexes an earlier recognition of an expected word while the lower theta increase indexes a later semantic integration process. Crucially, the relationship between the expectedness of a word and the P300 also holds at the discourse level. (1) a. A medic met a professor for a meeting. He hated THE PROFESSOR ... b. A medic took an anatomy lecture in Heidelberg. He hated THE PROFESSOR ...

Methods

D61 A FACTOR ANALYSIS OF CORTICAL SURFACE AREA ASYMMETRIES

Christine Chiarello[1], Adam Felton[1], David Vazquez[1], Christiana M. Leonard[2]; [1]University of California, Riverside, [2]University of Florida, Gainesville

Population level structural asymmetries are observed for many brain regions. However, there is substantial variation in the direction and degree of such lateral asymmetries, and the extent to which these asymmetries co-vary within an individual is unknown. Knaus et al. (2006, Brain and Language) found that some combinations of periSylvian asymmetries occurred more frequently than others. However, the number of potential asymmetry combinations (81) far exceeded the number of subjects (48), limiting interpretation. We re-examined this issue by performing a whole brain factor analysis of surface area asymmetries, reasoning that asymmetries that are associated with each other should load on the same factor. MRI scans from 200 college students (100 female) were processed through the FreeSurfer pipeline, left/right surface area asymmetries were calculated for each areal parcellation and then entered into a factor analysis using Promax rotation. The optimal solution extracted seven factors. Factor 1 produced positive loadings for frontal and temporo-parietal regions associated with language: supramarginal gyrus, posterior ramus of lateral fissure, planum temporale, inferior frontal sulcus, pars triangularis. Negative loadings for this factor were obtained for surrounding regions: superior temporal sulcus, angular gyrus, middle frontal sulcus. Additional factors suggested associated asymmetries for medial occipital (factor 3), inferior temporal (factor 6), and postcentral (factor 4) cortex. We will report the entire factor solution and discuss benefits and limitations of this analytic approach. We conclude that structural asymmetries are not randomly distributed, and that asymmetries for some language-relevant areas tend to co-vary.

D62 PREDICTING OUTCOME AND RECOVERY AFTER STROKE WITH LESIONS EXTRACTED FROM MRI IMAGES

Thomas Hope[1], Mohamed L. Seghier[1], Alex P. Leff[2], Cathy J. Price[1]; [1]Wellcome Trust Centre for Neuroimaging, University College London, UK, [2]Institute of Cognitive Neuroscience, University College London, UK

Aphasia commonly occurs after stroke, leaving patients keen to learn whether, when, and in what respects, they might be expected to recover. With increasing evidence that recovery can occur even many years post stroke, there is an increasing need for tools to predict that recovery. We employ Gaussian Process Regression to learn the probabilistic relationship(s) between 270 patients' focal brain lesions (extracted from MRI images) and their speech production skills, assessed using the Comprehensive Aphasia Test, at a range of months post stroke (mean=70.82, SD=75.23). Beginning with minimal demographic and lesion volume information only, we build increasingly detailed lesion location information into our predictors, and assess each predictor configuration using leave-one-out cross-validation, regressing patients' predicted speech production scores against those actually assigned to them. Validation results suggest that: (a) learning without lesion site information yields poor predictive performance (R2=0.00, p=0.217); (b) learning with only very coarse lesion site information yields reasonably strong predictive performance (R2=0.54, p=<0.001); but (c) still stronger performance can be achieved using more detailed lesion site information, with feature selection (R2=0.64, p=<0.001). Moreover, because the learned relationship includes time post stroke, the same induction process can be used to predict continuous recovery trajectories through time for individual patients, expressed in probabilistic terms. Given access to patients' MRI images, accurate predictions can be made concerning aphasic stroke patients' speech production skills throughout the first decade and more post stroke. These predictions could be improved by adding other determinants of recovery as predictors.

D63 BOTH INFERIOR TEMPORAL AND INFERIOR FRONTAL LOBES ARE ACTIVATED BY A SEMANTIC CATEGORISATION TASK, BUT ONLY WHEN MEASURED WITH DUAL ECHO FMRI.

Ajay Halai[1], Stephen Welbourne[1], Karl Embleton[1], Laura M Parkes[2]; [1]Neuroscience and Aphasia Research Unit, School of Psychological Sciences, Zochonis Builing, University of Manchester. Manchester, [2]Imaging Sciences Research Group, School of Cancer and Enabling Sciences, Stopford Building, University of Manchester

Neuropsychological studies using semantic dementia patients suggest that semantic memory deficits are related to atrophy of the anterior temporal lobes (ATL); in support rTMS studies show a disruption of semantic tasks following ATL stimulation. However, fMRI evidence for the role of ATL in semantic memory is inconsistent. One main cause is the magnetic susceptibility artefacts (signal loss) associated with standard gradient echo (GE) fMRI within orbitofrontal and inferior/anterior temporal regions. FMRI studies using standard GE tend to implicate left frontal areas and posterior middle temporal gyrus (pMTG), whereas spin-echo (SE) studies have shown bilateral ATL involvement. We conducted an fMRI study, using a semantic categorisation task comparing two improved methods; SE and dual-echo GE, along with standard GE, to determine an optimum fMRI protocol for detecting activity related to semantic processing. The inferior frontal gyrus (IFG) was activated for dual-echo GE and standard GE but not SE, due to reduced contrast to noise with the SE technique. The anterior and posterior inferior temporal fusiform cortex (ITF) was activated for SE and dual-echo GE, but not standard GE, due to reduced susceptibility artefacts. Dual-echo GE was the only method to detect activity within both ITF and IFG regions, while also showing higher signal within ITF regions in comparison to SE. We suggest that both the ITF and IFG are

important to semantic cognition and propose that future fMRI studies should use the dual-echo GE protocol when researching language or semantic memory.

D64 CORRELATES OF WORD RECOGNITION IN FIXATION-RELATED AND EVENT-RELATED BRAIN POTENTIALS

Olaf Hauk[1], Michael Dambacher[2,3], Reinhold Kliegl[2], Werner Sommer[4], Olaf Dimigen[2,4]; [1]Medical Research Council UK, [2]University of Potsdam, [3]University of Konstanz, [4]Humboldt-University Berlin

The word frequency effect has long been a benchmark for computational models of word recognition. However, the "functional locus" of the word frequency effect has still not been unambiguously resolved. We suggest that word frequency effects may occur at different stages of the word recognition process, which behavioral measures alone may not be able to distinguish. Therefore, we investigated the word frequency effect using a combination of event-related potentials (ERPs) and behavioral eye tracking under natural reading conditions. Eye movements and ERPs were simultaneously recorded while participants read lists of unrelated nouns of different word frequencies. In two separate sessions, participants either read the lists in a natural left-to-right fashion, or they were presented in a traditional word-by-word paradigm. ERP data were analyzed using traditional factorial designs, as well as linear mixed-effects models. We found the expected word frequency effects on fixation durations and on N400 brain responses. In both experiments, we also found a frequency effect at earlier latencies around 250 ms, i.e. at the latency of the shortest fixation durations, which was topographically significantly different from the N400 effect. We suggest that "the" word frequency effect is in fact distributed over several stages of the word recognition process. Our methodology paves the way for more detailed investigations of behavior and brain responses in natural reading.

D65 ERP MANIFESTATION OF PSYCHOLINGUISTIC VARIABLES AFFECTING WORD PRODUCTION: A MIXED-EFFECTS REGRESSION MODEL ANALYSIS ON TRIAL BY TRIAL TOPOGRAPHIES.

Andrea Valente[1], Audrey Buerki, Marina Laganaro; [1]FAPSE, University of Geneva, Switzerland

A major effort in cognitive neuroscience of language is to define the temporal and spatial characterization of the core cognitive processes involved in word production. One approach consists in studying the effects of specific psycholinguistic variables known to affect word production processes. So far, studies have analyzed ERP modulations during word production by examining one or two variables with factorials designs. Here we present a novel method, which consists in investigating simultaneously the effects of multiple theoretical relevant psycholinguistic factors on two electrophysiological measures: presence and duration of stable topographic configurations (topographic maps) from picture onset to articulation. 31 participants were recorded with high density EEG during overt picture naming (N=100). ERPs were extracted on a trial by trial basis from picture onset to articulation. Mixed-effects regression models were conducted to examine which psycholinguistic variables affected the duration and presence of topographic maps. Results revealed an effect of visual complexity on an early period of electrophysiological stability (~150 to ~180 ms after picture onset) and effects of name agreement, image agreement and age of acquisition on later maps (from 440 and 620 ms to articulation). This method allowed indentifying the time-windows affected by the psycholinguistic variables that also affected production latencies. This approach appeared reliable to investigate multiple variables simultaneously.

D66 MUTUAL-INFORMATION MEG CONNECTIVITY DURING WORD READING.

Mikel Lizarazu Ugalde[1], Asier Zarraga[1], Manuel Carreiras[1], Nicola Molinaro[1]; [1]Basque Center on Cognition, Brain and Language.

The present study focuses on the functional relation between evoked MEG activity and Mutual Information (MI) connectivity measures during visual word recognition. MI allows for both the assessment of information quantity within a signal and the characterization of relationships between different neural signals [Shanon, 1948]: It measures both linear and nonlinear dependencies and works better than other connectivity measures for noise-contaminated signals. We compared event related activity (ERF) generated when reading Spanish Words and Consonant strings up to 500 ms post stimulus onset to the node strength (sum of weights of links connected to the node) obtained from the MI connectivity matrix. Spanish speakers performed a visual low-level Go-NoGo task on alphabetic stimuli. NoGo trials were Words (CASA, home) and Consonant strings (FGCJ), while Go trials were the same strings with a letter substituted by a dot (C·SA or FG·J). Both the ERFs and the strength values show more activation ($p<0.01$) for Words compared with Consonants in the 300-400 ms time interval:while ERFs mainly showed increase of activity in the left temporal sensors for words (N400m effect), MI strength revealed a more distributed network - involving a larger set of sensors. ERF amplitudes and the strength values for each sensor were highly correlated across time windows. Overall, the present results suggest that increases of activity in left temporal regions related to semantic processing in visual word recognition (N400m) are due to increase connectivity across a larger network of brain regions as evidenced by MI connectivity strength starting around 300 ms.

D67 CO-REGISTRATION OF EYE MOVEMENTS AND ERPS IN NORMAL AND MINDLESS READING

John M. Henderson[1], Steven G. Luke[1], Joseph Schmidt[1], John E. Richards[1]; [1]University of South Carolina

Eyetracking and ERPs represent two important methods for investigating the cognitive and neural bases of language processing. There has recently been strong interest in combining these methods, but a challenge has been

devising approaches for controlling artifacts produced by eye movements in the EEG waveform (Dimigen, Sommer, Hohlfield, Jacobs, & Kliegl, 2011). We report the results of a study in which we compared ERPs time-locked to fixation onset in two reading conditions. In normal reading, subjects read paragraphs of connected text. In a novel "mindless" reading control condition, participants moved their eyes through pseudo-text in which each word was replaced with a geometric shape that preserved word locations and word shapes but eliminated meaning. In both conditions, we simultaneously recorded eye movements and EEG activity. Consistent with prior work (Henderson & Luke, in press), eye movement patterns in the mindless reading condition were similar to those in normal reading. An Independent Components Analysis was used to remove EEG activity associated with electrooculogram (EOG) activity. The corrected EEG time-locked to fixation onsets showed differences between normal and mindless reading in an early ERP component consistent with the lambda wave, as well as an apparent N400 in normal but not in mindless reading. Furthermore, initial analyses suggest word frequency effects in the vicinity of N400 for normal but not mindless reading. The results indicate that co-registration of eyetracking and EEG in connected reading has the potential to become an important tool for investigating the cognitive and neural bases of on-line language processing.

D68 FIXATION-BASED EVENT-RELATED FMRI ANALYSIS DURING VISUAL LETTER STRING PROCESSING

Fabio Richlan[1], Benjamin Gagl[1], Stefan Hawelka[1], Mario Braun[1], Martin Kronbichler[1,2], Florian Hutzler[1]; [1]University of Salzburg, [2]Paracelsus Private Medical University

In the domain of EEG, the technique of fixation-related potentials (FRP) allows investigating neuronal correlates of visual word processing during natural sentence reading. In this approach, an eye-tracker is used to measure the subject's eye-movements and the resting periods on words (fixations) are used as markers for calculating electrophysiological brain potentials. Synchronizing fixations with recordings of electrophysiological data thus allows investigating brain correlates of specific perceptual and cognitive processes related to visual word processing in the context of natural reading. The present study investigated the feasibility of this approach for fMRI. We presented words, pseudowords, unfamiliar Hebrew strings, and line strings in the context of an implicit reading task. A screen contained six items from different categories and participants were unconstrained with respect to direction and pace of their eye-movements (which were recorded by an MR-compatible eye-tracker). Using fixations as onsets for neuronal events we found (1) an activation pattern for words, pseudowords, unfamiliar Hebrew strings, and line strings, which corresponded to the typical task-positive bilateral network for visual letter string processing. (2) We identified differences between reading material (words and pseudowords) and non-reading material (unfamiliar Hebrew strings and line strings) with higher activation for linguistic stimuli in left temporal language regions and higher activation for non-linguistic stimuli in bilateral occipital and parietal regions. (3) Finally, we found activation differences between words and pseudowords with higher activation for words in two left superior temporal regions and higher activation for pseudowords in an anterior portion of the left ventral occipito-temporal cortex.

Author Index

Authors are indexed by abstract number, not page number.
S: indicates a slide presentation, P: indicates a poster presentation.

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

Bus routes:

- 05 | Benta berri
- 08 | Gros - Intxaurrondo
- 13 | Altza
- 16 | Igeldo
- 21 | Mutualidades - Anoeta
- 25 | Benta Berri - Añorga
- 26 | Amara - Martutene
- 28 | Amara - Ospitaleak

bcbl

BASQUE CENTER ON COGNITION, BRAIN AND LANGUAGE

www.bcbl.eu

SOCIETY FOR THE NEUROBIOLOGY OF LANGUAGE

www.neurolang.org

Event sponsored by:

EUSKO JAURLARITZA
GOBIERNO VASCO

HEZKUNTZA, UNIBERTSITATE ETA IKERKETA SAILA

DEPARTAMENTO DE EDUCACIÓN, UNIVERSIDADES E INVESTIGACIÓN