Habilitation à Diriger des Recherches

New insights in spoken language comprehension: an interactive and dynamic view taking into account the identity of speakers

Angèle BRUNELLIERE

Laboratoire Sciences Cognitives et Sciences Affectives (SCALab UMR9193-CNRS & Université de Lille)

Spécialité : Psychologie, psychologie clinique, psychologie sociale Section CNU 16

Ecole doctorale Sciences de l'Homme et de la Société

Université de Lille

Le 13 novembre 2019

Membres du jury

François-Xavier ALARIO	Rapporteur et Président
Séverine CASALIS	Garant
Peter HAGOORT	Rapporteur
Fanny MEUNIER	Rapporteur
Marc SWERTS	Examinateur
Pienie ZWITSERLOOD	Examinateur

Habilitation à Diriger des Recherches

De nouvelles perspectives pour la compréhension du langage parlé : une vision interactive et dynamique intégrant l'identité des locuteurs

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ACKNOWLEDGMENTS

I am truly thankful to the external members of the committee, Dr. François-Xavier Alario, Pr. Peter Hagoort, Dr. Fanny Meunier, Pr. Marc Swerts and Pr. Pienie Zwitserlood for having accepted to evaluate my work and participate in my defense. It is a great honor to receive your feedback on my work.

I would like to thank Pr. Séverine Casalis for having accepted to be my guarantor in the University of Lille and for her advices since I arrived as an associate professor in cognitive psychology in her team.

I would like to thank all the researchers that I have met in my life and who have greatly contributed to develop my interest about the research and to focus on spoken language processing (Dr. Jocelyne Ventre-Dominey, Dr. Peter Dominey, Dr. Christelle Dodane, Dr. Michel Hoen, Pr. Ulrich Hans Frauenfelder, Dr. Sophie Dufour, Dr. François-Xavier Alario, Pr. Christoph Michel, Dr. Mireille Besson, Pr. Noël Nguyen, Pr. Salvador Soto-Faraco).

I have a thinking with strong feeling to my former and current colleagues in language team (Laetitia, Isabelle, Anahita, Gwendoline, Sandrine, Bruno, Laurent and Dominique) for all kinds of entertaining and passionate exchanges.

I would like to thank all my colleagues in SCALab (Jérémie, Solène, Sophie, Clémence, Marie-Charlotte, Yannick, Delphine, Laurent, Marion, Astrid, Gérald, Yvonne, Véronique) or in Psitec (Justine, Jeanne, Céline, Delphine) and all my collaborators in Lille (Cyril, Laurence, Cédric, Pascal) or in other towns (Salvador, Sophie, Alec, Jean-Baptiste) for all kinds of fascinating discussions about the research.

I would like to thank past and current students working with me (in particular, Nara, Carolina, Adèle, Apolline, Alba, Chloé, Emmanuel, Jane) and thank the volunteers to give their time for participating to the research.

My dear love, Bernard, thank you for being in my life.

RESUME (FRANCAIS)

Dans le cadre théorique des processus impliqués dans la compréhension du langage parlé, je propose un programme de recherche visant à comprendre comment les contraintes sémantiques induites par le contexte d'une phrase ainsi que les informations phonologiques relatives aux locuteurs agissent sur la reconnaissance des mots parlés. Conformément aux propriétés des signaux vocaux, j'ai étudié séparément trois sources d'informations phonologiques relatives à l'identité des locuteurs : l'accent régional, l'intention de communiquer et les gestes visuels articulatoires. Jusqu'à présent, les modèles de reconnaissance des mots parlés et du traitement des phrases ne prennent pas en compte les informations phonologiques relatives à l'identité des locuteurs. Ma première ligne de recherche est axée sur l'accent régional des locuteurs et montre que l'accent du locuteur façonne les prédictions phonologiques de l'auditeur pendant la compréhension du langage parlé. Par ailleurs, les contraintes contextuelles provenant de l'accent du locuteur et celles sémantiques de plus haut niveau affectaient de manière interactive la reconnaissance des mots à des niveaux sous-lexical et lexical. Ces résultats sont conformes aux modèles interactifs de reconnaissance des mots parlés et plaident en faveur d'une vision prédictive de la compréhension du langage parlé. Dans une deuxième ligne de recherche, j'ai étudié l'interaction entre les contraintes sémantiques induites par le contexte d'une phrase et l'intention du locuteur. Il apparaît que l'intention du locuteur marquée par l'emphase prosodique dans un contexte de phrases induit des conséquences dans le traitement sémantique, affectant la reconnaissance des mots suivants. De plus, les prédictions *top-down* basées sur des contraintes sémantiques dans le traitement des phrases orales intègrent l'intention du locuteur en augmentant l'actualisation des mots prédits pour minimiser au mieux des erreurs possibles vis-à-vis du signal entrant. Mon troisième axe de recherche s'intéresse à l'interaction entre les contraintes sémantiques induites par le contexte d'une phrase et les gestes visuels articulatoires. Il apparaît que la parole audiovisuelle joue un rôle dans l'encodage de la phrase et la reconnaissance de mots et non simplement dans le traitement auditif. Dans l'ensemble, mes travaux mettent en évidence que les contraintes sémantiques et les informations phonologiques relatives aux locuteurs affectent la reconnaissance des mots parlés à travers un flux de l'information interactif et dynamique entre les différentes sources d'informations fournies par une phrase parlée. Pour avoir une vue complète des processus de compréhension du langage parlé, je défends l'idée qu'il est nécessaire d'une part de caractériser comment le flux descendant basé sur des mécanismes prédictifs assure une compréhension réussie et adaptée du langage parlé en prenant en compte l'identité des locuteurs et d'autre part de développer un modèle multi-niveaux comprenant les différentes représentations linguistiques (phonologique, sémantique et morphosyntaxique) activées à partir du signal de parole.

ABSTRACT (ENGLISH)

In the theoretical framework of the processes involved in spoken-language comprehension, I propose a research program that aims at understanding how the semantic constraints driven by the sentence context, as well as phonological information related to the speakers, act upon spoken-word recognition. In line with the properties of speech signals, I have studied separately three sources of phonological information related to the identity of speakers: regional accent, intention to communicate and visible articulatory gestures. To date, the models for spoken-word recognition and models for sentence processing have not taken into account the phonological information related to the identity of speakers. My first line of research focuses on speakers' regional accent and shows that a speaker's accent shapes the listeners' phonological predictions during spoken language comprehension. In addition, the two contextual constraints— speaker's accent and high-level semantic constraints—imposed by sentence context interacts in word recognition at sub-lexical and lexical levels. These findings are consistent with interactive models of spoken-word recognition and support a predictive view of spoken language comprehension. In my second line of research, I have studied the interplay between semantic constraints driven by sentence context and the intention of speakers. Emphasizing a sentential context induces on-line consequences of semantic processing in discourse that affect the processing of the subsequent words. Moreover, neuronal top-down predictions based on semantic constraints in spoken-sentence processing integrate the speaker's intention by increasing the updating of lexical predictions to minimize prediction errors about the speech input. My third line of research focuses on the interplay between semantic constraints driven by sentence context and visible articulatory gestures. It appears that audiovisual speech contributes to the encoding of spoken utterance and word recognition and not simply to auditory processing. Taken together, my work shows that semantic constraints and the phonological information related to the speaker affects spoken-word recognition through an interactive and dynamic information flow between the different sources of information provided by a sentence. Finally, I defend the idea that a complete view of the processes of the spoken language comprehension needs to characterize how the top-down flow based on predictive mechanisms ensures a successful and adaptive comprehension of spoken language by taking into account the identity of speakers and that it must develop a multi-level model including the different linguistic representations (phonological, semantic and morphosyntactic) activated from the speech input.

CURRICULUM VITÆ (FRANCAIS)

Angèle BRUNELLIERE

Née le 21 novembre 1982, Beaupréau, France

Situation Actuelle

Maître de conférences classe normale en psychologie cognitive à l'Université de Lille dans le laboratoire Sciences Cognitives et Sciences Affectives (SCALab, UMR9193 CNRS)

Adresse professionnelle

Laboratoire Sciences Cognitives et Sciences Affectives,
UMR9193 CNRS, Université de Lille,
Rue du Barreau, BP 60149
59653 VILLENEUVE-D'ASCQ CEDEX

Tel : +00 (0) 3 20 41 72 04
E-mail : angele.brunelliere@univ-lille.fr

Thèmes de recherche

Neurocognition de la compréhension du langage oral, perception de la parole, reconnaissance des mots parlés, traitement sémantique et grammatical, mécanismes de prédiction

Titres et diplômes

2009 Doctorat en Neurosciences, Universités de Genève et Lausanne, Suisse
Titre : Traitement de l'accord : vers une approche neurophysiologique du langage
Directeur de thèse : Pr. Ulrich Hans Frauenfelder

2005 Master 2 Recherche neurosciences, Université Lyon 1, France

2004 Maîtrise biologie cellulaire et physiologie, Université Lyon 1, France

2003 Licence biologie cellulaire et physiologie, Université Lyon 1, France

2002 DEUG Sciences de la Vie, Université Catholique de l'Ouest, France

Expériences professionnelles

Depuis Sept. 2011 Maître de conférences en psychologie cognitive, Université de Lille

Janv. 2011-Août 2011 Chercheur Post-doctoral au Center for Brain and Cognition à l'Universitat Pompeu Fabra dans l'équipe Multisensory research group sous la direction de Pr. Salvador Soto-Faraco

Juin 2009-Déc. 2010 Chercheur Post-doctoral au Laboratoire Parole et Langage (UMR6057 CNRS & Université de Provence) sous la direction de Pr. Noël Nguyen

Mars 2007-Oct. 2008 Participation à un projet portant sur l'étude de l'impact des variations régionales dans la perception des phonèmes sous la direction de Pr. Noël Nguyen et Dr. Sophie Dufour (Laboratoire Parole et Langage, UMR6057 CNRS & Université de Provence).

Nov. 2005-Mai 2009 Doctorante au Laboratoire de Psycholinguistique expérimentale à l'Université de Genève sous la direction de Pr. Ulrich Hans Frauenfelder

Sept. 2004-Sept. 2005 Stagiaire à l'Institut des Sciences Cognitives (UMR5015 CNRS & Université Lyon 1) sous la direction de Dr. Peter Ford Dominey

Financements et bourses

2020-2024 Responsable du projet « L'adaptation des représentations linguistiques en cours d'interaction sociale : une approche dynamique de la communication orale », Agence Nationale de la Recherche, 207000 euro

2019-2020 Responsable d'un cycle interdisciplinaire de conférences sur « S'adapter aux autres : le rôle de la prédiction dans la communication humaine », Financement Maison européenne des sciences de l'homme et de la société Nord-France, 3300 euro

2019-2020 Participation au projet « Prédire des énoncés en dialogue interactif », Financement Maison européenne des sciences de l'homme et de la société Nord-France, responsable : Dr Dominique Knutsen (SCALab)

2019-2020 Participation au projet « Les déficits langagiers au cours de la vie : des troubles du développement aux pathologies neurodégénératives », Financement Maison européenne des sciences de l'homme et de la société Nord-France, responsable : Dr Gwendoline Mahé (SCALab)

2016-2019 Responsable du projet « La nature des représentations et des processus neurocognitifs impliqués dans le traitement de l'accord grammatical », Financement de l'Institut des sciences humaines et sociales (CNRS), 99360 euro

Oct. 2017-Oct. 2022 Obtention d'une prime d'encadrement doctoral et de recherche (PEDR)

Sept. 2017-Fév. 2018 Obtention d'un congé pour recherches ou conversions thématiques (CRCT)

2015-2016 Responsable du projet « Intégration des informations visuelles dans la communication orale », Financement Etablissement, Université Lille 3, 5000 euro

2015-2016 Participation au projet « Segmentation de la parole chez les patients aphasiques », Financement Maison européenne des sciences de l'homme et de la société Nord-France, responsable : Dr. Anahita Basirat (SCALab)

2015 Séjour indoc de 6 mois financé par les relations internationales de l'Universidad de Granada pour un séjour de recherche au SCALab d'une doctorante, Alba Casado (Universidad de Granada)

2014-2015 Responsable du projet « Processus et Représentations dans le traitement des relations d'accord », Financement Etablissement, Université Lille 3, dans le cadre d'un début de collaboration internationale avec l'Université de NYU (New York University), 2000 euro

2014-2015 Co-responsable du projet « Contribution de l'image dans la communication verbale et son évaluation » avec Pr. Séverine Casalis (SCALab), Financement Etablissement, Université Lille 3, 7000 euro

2013-2014 Co-responsable du projet « Etude des interactions entre la réception de contenus visuels et le traitement du langage », avec Pr. Séverine Casalis (SCALab), Financement Interdisciplinary Cluster for the

Advancement of Visual Studies, support scientifique de la plateforme Irdive (Innovation-research in Digital and Interactive Visual Environments, labellisée Equipements d'Excellence), 12800 euro

Mars 2014-Déc. 2014 Co-responsable du projet « Impact de l'image dans la communication verbale » avec Pr. Séverine Casalis, Financement Etablissement, Université Lille 3, 5500 euro

Nov. 2013-Déc. 2013 Responsable du projet « Etude de la prosodie multimodale », Financement Bonus Qualité Recherche-Lille Métropole Communauté Urbaine, 5700 euro

Mars 2013-Déc. 2013 Responsable du projet « Brain correlates of on-line predictions in speech processing **»**, Financement Budget Supplémentaire Université Lille 3-Recherche internationale dans le cadre d'une consolidation d'une collaboration scientifique internationale avec Pr. Salvador Soto-Faraco (Center for Brain and Cognition), 1600 euro

Mars 2013-Déc. 2013 Co-responsable du projet « Speech and Languages Sciences: a Ghent-Rijsel Cooperation » avec Dr. Anahita Basirat (SCALab), Financement Lille-Gand Relations internationales, 1000 euro

2011-2013 Financement post-doctoral décliné – Generalitat de Catalunya – Program Beatriu de Pinós

2011 Participation au projet de recherche « Brainglot Project », Financement Consolider-Ingenio 2010 Scheme, Spanish Ministry of Science and Education, responsable : Pr. Nuria Sebastian-Gallès (Center for Brain and Cognition)

2009-2010 Participation au projet ANR BLANC « Imitation in Speech: From sensory-motor integration to the dynamics of conversational interaction » (ANR-08-BLAN-0276-01), responsable : Pr. Noël Nguyen (Laboratoire Parole et Langage, UMR6057 CNRS & Université de Provence)

Nov. 2005-Mai 2009 Obtention de deux financements Fonds National Suisse (FNS 105314-109987, FNS 100014-120353) sur l'étude du traitement de l'accord, 150000 CHF

2008 Bourse de voyage par Academic Society of Geneva pour une participation à la conférence CNS2008, San Francisco, Avril

2006 Bourse de voyage par l'Association Francophone de la Communication Parlée pour une participation à la conférence JEP2006, Dinard, Juin

2004-2005 Obtention d'une bourse de mérite de DEA du Ministère de l'Education Nationale

Collaborations

- Pr. Alec Marantz (Morphology Lab, New York University)
- Pr. Salvador Soto-Faraco (Center for Brain and Cognition, Universitat Pompeu Fabra)
- Dr. Sophie Dufour (Laboratoire Parole et Langage, UMR6057 CNRS & Université de Provence)
- Dr. Jean-Baptiste Van der Henst (Institut des Sciences Cognitives – Marc Jeannerod, UMR5304 CNRS & Université de Lyon 1)
- Dr. Pascal Denis (Centre de Recherche en Informatique, Signal et Automatique de Lille, UMR9189 & Université de Lille)
- Dr. Cyril Auran, Dr. Laurence Delrue, Dr. Cédric Patin (Laboratoire Savoirs, Texte, Langage, UMR8163 CNRS & Université de Lille)
- Dr. Anahita Basirat, Dr. Isabelle Bonnotte, Dr. Jérémie Jozefowiez, Dr. Dominique Knutsen, Dr. Laetitia Perre (SCALab)

Séjours de recherche

2017 New York University, Morphology Lab, 8 jours

2015 Universitat Pompeu Fabra, Center for Brain and Cognition, 15 jours

2015 New York University, Morphology Lab & David Poeppel Lab, 8 jours

Expertise scientifique

- Expertise pour des comités de sélection

2014 Rapporteur au sein de deux comités de sélection pour le recrutement d'un poste de maître de conférences en Psychologie du Langage (Université de Lille 2 et Université de Reims Champagne-Ardennes)

2015 et 2017 Vice-président d'un comité de sélection pour le recrutement d'un poste de maître de conférences en Psychologie du Langage (Université de Lille 3)

- Expertise pour l'évaluation de projets scientifiques

Depuis 2013 Expertise pour National Science Foundation (agence indépendante aux Etats-Unis pour le financement de la recherche scientifique fondamentale), Expertise pour Innoviris Brussels (agence indépendante pour le financement de la recherche scientifique dans la région bruxelloise), Expertise pour Netherlands Organisation for Scientific Research (agence indépendante aux Pays-Bas pour le financement de la recherche scientifique fondamentale), Expertise pour l'Agence Nationale de la recherche (ANR) en France : Appel à projets Accueil de Chercheurs de Haut Niveau

- Expertise pour des revues scientifiques

Biological Psychology, Brain and Language, Neuropsychologia, Human Brain Mapping, Brain and Cognition, Brain Research, International Journal of Psychophysiology, Journal of Experimental Psychology: Human Perception and Performance, Journal of Experimental Psychology: Learning, memory and Cognition, Frontiers in Psychology, Language, Cognition & Neuroscience, Cognition and Emotion, Language Learning, Neuroscience Letters, Journal of Neurolinguistics

Encadrements

- Doctorant

2016-en cours Encadrement principal, Université de Lille (co-directeur : Pr. Séverine Casalis, SCALab)
Jane Aristia : « La nature des représentations et des processus neurocognitifs impliqués dans le traitement de l'accord grammatical »

Mars 2015-Août 2015 Encadrement d'une doctorante de l'Universidad de Granada pendant un séjour indoc de 6 mois, Alba Casado : « The influence of voice speaker during gender processing »

- Master 2

2018 M2 européen de psychologie : psychologie des processus neurocognitifs et sciences affectives, Université de Lille, Emmanuel Farce : « The influence of expressive prosody on prediction mechanisms during auditory sentence processing »

2017 M2 MIASHS Sciences Cognitives pour l'Entreprise, Université de Lille3, Chloé Monnier : « Influence de la prosodie expressive sur les processus anticipatoires du langage oral »

2015 M2 européen de psychologie : psychologie des processus neurocognitifs et sciences affectives, Université de Lille 3, Adèle Delalleau : « Parole audiovisuelle et compréhension de la phrase : étude en potentiels évoqués »

- Master 1

2018 M1 MIASHS Sciences Cognitives pour l'Entreprise, Université de Lille, Eva Carru : « La propagation de l'activation au sein d'une catégorie sémantique à travers la typicalité »

2017 M1 de psychologie, Université de Lille 3, Emmanuel Farce : « L'influence de la typicalité sur la reconnaissance des mots écrits »

2016 M1 MIASHS Sciences Cognitives pour l'Entreprise, Université de Lille 3, Chloé Monnier : « Influence de la prosodie expressive sur les processus anticipatoires du langage oral »

2016 M1 de psychologie, Université de Lille 3, Jordan Alves : « L'influence de la présentation audiovisuelle sur le traitement de la parole »

2016 M1 de psychologie, Université de Lille 3, Aleksandar Ivkovic : « Etude de la perception des phonèmes et des mots en Nord de France »

2015 M1 de psychologie, Université de Lille 3, Laure Grosz : « Etude électrophysiologique de l'influence de la parole visuelle sur la segmentation lexicale pour l'apprenant d'une seconde langue » (co-directeur : Anahita Basirat, SCALab)

2015 M1 de psychologie, Université de Lille 3, Apolline Delobeau : « Apport des mouvements des lèvres dans les mécanismes prédictifs du langage oral »

2014 M1 de psychologie, Université de Lille 3, Adèle Delalleau : « L'influence de l'emphase sur la compréhension de la phrase parlée : étude en potentiels évoqués »

- Licence, Stage de recherche et Vacations

6 étudiants en Licence 3 de Psychologie, Université de Lille, 5 étudiants en Licence MIASH Parcours Sciences Cognitives, Université de Lille

Stage de recherche : 1 doctorant en Psychologie de l'Universitat Pompeu Fabra, 1 étudiant en Master Neurosciences de l'Universitat Pompeu Fabra, 1 étudiant en Licence de Biologie, Université de Tours, 4 étudiants en M2 européen de psychologie : psychologie des processus neurocognitifs et sciences affectives, Université de Lille, 3 étudiants en M1 de Psychologie, 6 étudiants en orthophonie, Université de Lille

Vacations sur des projets financés : 3 étudiants en Master en Traduction et Langues étrangères, 5 étudiants en Master 1 de Psychologie

- Suivi doctoral

Suivi doctoral de 5 doctorants en Psychologie, Université de Lille (Noelia Do Carmo : 2013-2016, Gary Boddaert : 2015-en cours, Camille Cornut : 2017-en cours, Florian Salomé : 2017-en cours, Ségolène Guérin : 2019-en cours)

Vulgarisation scientifique et pédagogique

2017 Vulgarisation et Valorisation de la recherche sur le langage : participation à l'appel à projets UOH (Université Ouverte des Humanités) :"Cité-langage : trajets dans les sciences du langage" : réalisation de vidéos francophones pour la diffusion de travaux sur le cerveau et le langage, accessibilité libre des vidéos par tout public et création d'un outil pédagogique pour les lycées et les universités

Activités d'enseignement, responsabilités pédagogiques et collectives

- Activités d'enseignement

Depuis Sept. 2011, mes enseignements représentent en moyenne 210 heures par an. Comme on peut le voir dans le tableau en dessous, le contenu de ces enseignements concerne la psychologie du langage, la méthodologie de la recherche, la biologie et les neurosciences à différents niveaux (L1, L2, L3, M1, M2) et dans des différentes formations (Licence de Psychologie, Master européen de psychologie : psychologie des processus neurocognitifs et sciences affectives, Licence de Mathématiques et Informatique appliqués aux sciences humaines (MIASH), parcours Sciences Cognitives, Diplôme Universitaire (DU) Préparation à l'examen d'entrée d'orthophonie). Mes enseignements présentent donc une diversité d'un point de vue thématique, des formations concernées et des niveaux dispensés. J'ai pris soin de m'impliquer dans des enseignements permettant une bonne adéquation entre ma formation initiale, mes activités de recherche, et une culture générale pluridisciplinaire autour de la cognition.

Intitulé	Formation	Niveau	Effectif	Volume
Psychologie du langage	Licence Psychologie	2	670	16h CM
Psychologie du langage	Licence Psychologie	3	60	4h CM et 8h TD
Psychologie du langage	Licence MIASH Sciences Cognitives	2	20	16h CM et 32h TD
Psychologie du langage	Master Psychologie	2	30	3h CM
Neurocognition du langage	Master Psychologie	1	60	4h CM et 6h TD
Neurosciences fonctionnelles	Licence Psychologie	3	450	20h TD
Introduction aux Neurosciences	Licence MIASH Sciences Cognitives	1	50	4h CM et 8h TD
Neurosciences fonctionnelles	Licence MIASH Sciences Cognitives	1	50	8h CM et 16h TD
Biologie et Neurosciences	DU Préparation à l'examen d'entrée d'orthophonie	1	30	4h CM et 8h TD
Techniques de neuroimagerie	Master Psychologie	1	60	6h TD
Méthodologie de la recherche	Licence Psychologie	3	450	32h TD
Méthodologie de la recherche	Master Psychologie	1	60	6h TD

CM : Cours magistraux, TD : Travaux dirigés

Dans l'ensemble de mon activité pédagogique, je me suis attachée à proposer des enseignements dans les modalités les plus adaptées aux matières enseignées et à la réceptivité des étudiants. Je construis mes enseignements en poursuivant un double but, à savoir l'acquisition des connaissances et des compétences visées par la matière enseignée, mais aussi la construction d'une représentation disciplinaire mettant en relation les contenus enseignés avec les autres cours de la formation et avec l'orientation professionnelle. Cette manière d'envisager l'enseignement m'amène donc de fait à modifier régulièrement non seulement le contenu et l'organisation des matières que je dispense, mais également et surtout à proposer et à coordonner l'organisation de contenus avec d'autres intervenants en tant que responsable de nombreuses unités d'enseignement. L'ensemble de mes enseignements sont nourris d'exemples concrets et de mises en pratique des contenus dispensés par la réalisation d'exercices et d'exposés, et l'utilisation de la méthode de *peer-reviewing*. Je m'attache à construire des enseignements permettant une forte interactivité avec les étudiants pour confronter leurs compréhensions aux contenus visés et la pédagogie inversée est souvent mobilisée.

Un autre axe très particulier de mon activité pédagogique est mon implication dans la méthodologie de la recherche. En effet, j'ai à cœur qu'une formation universitaire puisse être une chance de développer à la fois des compétences générales suivant une démarche scientifique et des compétences de réflexion et de synthèse. De même, la construction de mes enseignements en méthodologie de la recherche est tournée vers le fait de faire découvrir la recherche aux étudiants, de manière ludique et créative, sans tomber dans la simplicité, et surtout en mettant en avant les applications concrètes de la recherche, les enjeux de demain et les liens possibles entre les métiers de la recherche et la formation professionnelle visée des étudiants. En ce sens, je coordonne deux unités d'enseignement sur la méthodologie de la recherche, amenant à la gestion de 12600 heures dispensées.

- <u>Responsabilités pédagogiques et collectives</u>

A partir de 2020, co-responsable de l'équipe Langage du laboratoire SCALab et représentante ERAMUS de l'UFR de Psychologie

2014-en cours Responsable des unités d'enseignement (UE) en biologie et en méthodologie expérimentale dans la licence de Mathématiques et Informatique appliqués aux sciences humaines (MIASH)-Université de Lille

2014-en cours Responsable de l'UE Initiation à la recherche en Licence 2 et de l'UE Séminaire de recherche et de stage en Licence 3 de Psychologie-Université de Lille

2014-en cours Membre de jury d'année de Licence 3 de Psychologie-Université de Lille

2011-en cours Membre du comité éthique de l'Université de Lille et membre pour des jurys de soutenance de mémoire en Psychologie et en Mathématiques et Informatique appliqués aux sciences humaines

2014-2019 Responsable des enseignements en biologie dans le Diplôme Universitaire Préparation à l'examen d'entrée en Orthophonie (PrEEO)-Université Lille et membre du jury d'admission et d'année pour le diplôme PrEEO-Université de Lille

2015-2018 Responsable des unités d'enseignement (UE) en psychologie du langage dans la licence de Mathématiques et Informatique appliqués aux sciences humaines (MIASH)-Université de Lille 3

2015-2017 Membre extérieur du conseil d'UFR de Biologie-Université de Lille 3

2013-2019 Membre élu du conseil scientifique du laboratoire SCALab

2011-2018 Responsable de la gestion du matériel EEG et des espaces EEG

PUBLICATIONS ET COMMUNICATIONS

- Revues internationales à comité de lecture

21 articles acceptés, 14 en premier auteur, 2 en dernier auteur
* quand les co-auteurs sont des étudiants de master ou de doctorat que j'ai encadrés

1. Basirat, A., Allart, E., **Brunellière, A.**, & Martin, Y. (accepté). Audiovisual speech segmentation in post-stroke aphasia: a pilot study. *Topics in stroke rehabilitation*.

2. **Brunellière, A.**, Delrue, L., & Auran, C. (sous presse). The contribution of audiovisual speech to lexical-semantic processing in natural spoken sentences. *Language, Cognition & Neuroscience*, https://doi.org/10.1080/23273798.2019.1641612

3. **Brunellière, A.**, Auran, C., & Delrue, L. (2019). Does the prosodic emphasis of sentential context cause deeper lexical-semantic processing? *Language, Cognition & Neuroscience*, *34*, 29-42. https://doi.org/10.1080/23273798.2018.1499945

4. **Brunellière, A.**, & Bonnotte, I. (2018). To what extent does typicality boost semantic priming effects between members of their categories? *Journal of Cognitive Psychology*, *30*, 670-688. https://doi.org/10.1080/20445911.2018.1523174

5. Basirat, A., **Brunellière, A.**, & Hartsuiker, R. (2018). The role of audiovisual speech in the early stages of lexical processing as revealed by ERP word repetition effect. *Language Learning*, *68*, 80-101. https://doi.org/ 10.1111/lang.12265

6. **Brunellière, A.**, Perre, L., Tran, T.M., & Bonnotte, I. (2017). Co-occurrence frequency evaluated with large language corpora boosts semantic priming effects. *The Quarterly Journal of Experimental Psychology*, *70*, 1922-1934. https://doi.org/10.1080/17470218.2016.1215479

7. Casado, A.M.*, & **Brunellière, A.** (2016). The influence of sex information into spoken words: a mismatch negativity (MMN) study. *Brain Research*, *1650*, 73-83. https://doi.org/10.1016/j.brainres.2016.08.039

8. **Brunellière, A.**, & Soto-Faraco, S. (2015). The interplay between semantic and phonological constraints during spoken-word comprehension. *Psychophysiology*, *52*, 46-58. https://doi.org/10.1111/psyp.12285

9. **Brunellière, A.**, & Frauenfelder, U.H. (2014). On the locus of grammatical context effects on word recognition. *L'Année Psychologique*, *114*, 447-467. https://doi.org/10.4074/S0003503314003029

10. **Brunellière, A.**, Sánchez-García, C.*, Ikumi, N.*, & Soto-Faraco, S. (2013). Visual information constrains early and late stages of spoken-word recognition in sentence context. *International Journal of Psychophysiology*, *89*, 136-147. https://doi.org/10.1016/j.ijpsycho.2013.06.016

11. **Brunellière, A.**, & Soto-Faraco, S. (2013). The speakers' accent shapes the listeners' phonological predictions during speech perception. *Brain and Language, 125*, 82-93. https://doi.org/10.1016/j.bandl.2013.01.007

12. Dufour, S., **Brunellière, A.**, & Frauenfelder, U.H. (2013). Tracking the time course of word frequency effects in auditory word recognition with event-related potentials. *Cognitive Science*, *34*, 489-507. https://doi.org/10.1111/cogs.12015

13. Dufour, S., **Brunellière, A.**, & Nguyen, N. (2013). To what extent do we hear phonemic contrasts in a non-native regional variety? Tracking the dynamics of perceptual processing with EEG. *Journal of Psycholinguistic Research*, *42*, 161-173. https://doi.org/10.1007/s10936-012-9212-8

14. Nguyen, N., Dufour, S., & **Brunellière, A.** (2012). Does imitation facilitate word recognition in a non-native regional accent? *Frontiers in Psychology, 3*, 480. https://doi.org/10.3389/fpsyg.2012.00480

15. **Brunellière, A.** (2011). Brain response to subject-verb agreement during grammatical priming. *Brain Research*, *1372*, 70-80. https://doi.org/10.1016/j.brainres.2010.11.052

16. **Brunellière, A.**, Dufour, S., & Nguyen, N. (2011). Regional differences in the listener's phonemic inventory affect semantic processing: A mismatch negativity (MMN) study. *Brain and Language*, *117*, 45-51. https://doi.org/10.1016/j.bandl.2010.12.004

17. **Brunellière, A.**, & Frauenfelder, U.H. (2010). Mismatch Negativity: a tool for studying morphosyntactic processing? *Clinical Neurophysiology*, *121*, 1751-1759. https://doi.org/10.1016/j.clinph.2010.03.053

18. Deguchi, C.*, Chobert, J.*, **Brunellière, A.**, Nguyen, N., Colombo, L., & Besson, M. (2010). Pre-attentive and attentive processing of French vowels. *Brain Research*, *1366*, 149-161. https://doi.org/10.1016/j.brainres.2010.09.104

19. **Brunellière, A.**, Dufour, S., Nguyen, N., & Frauenfelder, U.H. (2009). Behavioral and electrophysiological evidence for the impact of regional variation on phoneme perception. *Cognition*, *111*, 390-396. https://doi.org/10.1016/j.cognition.2009.02.013

20. **Brunellière, A.**, Franck, J., Ludwig, C., & Frauenfelder, U.H. (2007). Early and automatic syntactic processing of person agreement. *Neuroreport*, *18*, 537-541. https://doi.org/10.1097/WNR.0b013e3280b07ba1

21. **Brunellière, A.**, Hoen, M., & Dominey, P.F. (2005). ERP correlates of lexical analysis: N280 reflects processing complexity rather than category or frequency effects. *Neuroreport*, *16*, 1435-1438. https://doi.org/10.1097/01.wnr.0000177008.98860.69

- <u>Conférences internationales à comité de lecture (soumission avec articles)</u>

3 articles acceptés, 2 en premier auteur, 1 en dernier auteur

1. **Brunellière, A.**, & Dufour, S. (2013). Electrophysiological evidence for benefits of imitation during the processing of spoken words embedded in sentential contexts. *In Proceedings of Interspeech,* Lyon, 25-29 Août, 1345-1349.

2. **Brunellière, A.**, Dufour, S., & Nguyen, N. (2010). Y a-t-il un impact de l'imitation sur la reconnaissance des mots parlés dans un accent régional non-natif. *Journées d'Etudes sur la Parole*, Mons, 25-28 Mai, 321-324.

3. Dodane, C., & **Brunellière, A.** (2006). Lecture silencieuse et oralisée des phrases relatives : le rôle de la prosodie, *Journées d'Etudes sur la Parole*, Dinard, 12-16 Juin, 117-120.

- Conférences internationales avec communication affichée

22 posters acceptés, 16 en premier auteur, 3 en dernier auteur
* quand les co-auteurs sont des étudiants de master ou de doctorat que j'ai encadrés

1. **Brunellière, A.**, & Delrue, L. (2019). Predicting while comprehending spoken sentences: the influence of speakers' communicative intentions on predictions. *European Society for Cognitive Psychology*, 25-28 Septembre, Tenerife.

2. **Brunellière, A.**, & Delrue, L. (2019). The role of prosodic emphasis in speaker's communicative intention and in listeners' word prediction during spoken-language comprehension. *Architectures and Mechanisms for Language Processing*, 6-8 Septembre, Moscou.

3. Knutsen, D., Col, G., & **Brunellière, A.** (2019). How do dialogue partners jointly manage mental load to navigate the interaction? *Architectures and Mechanisms for Language Processing*, 6-8 Septembre, Moscou.

4. **Brunellière, A.**, & Delrue, L. (2019). The robustness of prediction effects based on article-elicited negativity in spoken language comprehension depends on the communicative intentions of listeners and speakers. *Society for the Neurobiology of Language*, 20-22 Août, Helsinki.

5. Aristia, J.*, **Brunellière, A.**, & Marantz, A. (2019). Tracking brain prediction based on associative representations in subject-verb agreement, *Cognitive Neuroscience Society,* 23-26 Mars, San Francisco.

6. **Brunellière, A.,** & Delrue, L. (2017). When the expressive prosody meets word prediction in spoken-language comprehension. *Society for the Neurobiology of Language*, 7-11 Novembre, Baltimore.

7. Aristia, J.*, & **Brunellière, A.** (2017). Tracking the neurophysiological correlates during the computation of agreement dependencies: the access of grammatical feature and associative representations in spoken language. *Society for the Neurobiology of Language*, 7-11 Novembre, Baltimore.

8. **Brunellière, A.,** Farce, E.*, & Bonnotte, I. (2017). Typicality effects in a lexical decision task and in a categorization task. Classical or renewed interpretation. *Architectures and Mechanisms for Language Processing*, 7-9 Septembre, Lancaster.

9. **Brunellière, A.**, & Delrue, L. (2017). The effect of word prediction across the different modalities of incoming speech. *International Convention of Psychological Science*, 23-25 Mars, Vienne.

10. Basirat, A., & **Brunellière, A.** (2016). Audiovisual speech enhances word segmentation in continuous speech. *Workshop on audiovisual speech processing and language learning*, 28-29 Novembre, Barcelone.

11. **Brunellière, A.,** Delrue, L., Soto-Faraco, S., & Foucart, A. (2016). Audiovisual speech speeds up on-line language processes during spoken sentence comprehension. *Workshop on audiovisual speech processing and language learning*, 28-29 Novembre, Barcelone.

12. Do Carmo-Blanco*, N., **Brunellière, A.**, & Jozefowiez, J. (2015). EEG correlates of contingency judgments in a streamed-trial procedure. *British Neuroscience Association*, 12-15 Avril, Edinburgh.

13. Do Carmo-Blanco*, N., **Brunellière, A.**, & Jozefowiez, J. (2015). Neural attenuation of positively and negatively contingente visual stimuli. *Society for Psychophysiological Research*, 30 Septembre-4 Octobre, Seattle.

14. **Brunellière, A.**, Dufour, S., & Nguyen, N. (2010). Electrophysiological evidence for the impact of non-native regional accent imitation on sentence comprehension. *The Second Annual Neurobiology of Language Conference*, 11-12 Novembre, San Diego.

15. **Brunellière, A.**, & Frauenfelder, U.H. (2009). Anticipatory processing of subject-verb agreement: An involvement of theta-band activity. *Society for Neuroscience*, 17-21 Octobre, Chicago.

16. **Brunellière, A.**, & Frauenfelder, U.H. (2008). Neurophysiological evidence for anticipatory processing of subject-verb agreement. *Lemanic-Neurosciences Annual Meeting*, 12-13 Septembre, Diablerets.

17. **Brunellière, A.**, & Frauenfelder, U.H. (2008). Morpho-syntactic priming effects in spoken language processing. *Annual Conference on Architectures and Mechanisms for Language Processing*, 4-6 Septembre, Cambridge.

18. **Brunellière, A.**, Dufour, S., Nguyen, N., & Frauenfelder, U.H. (2008). Electro-physiological and behavioural correlates of phoneme perception. *Forum of European Neuroscience*, 12-16 Juillet, Genève.

19. **Brunellière, A.**, & Frauenfelder, U.H. (2008). Morpho-syntactic context effects in spoken language processing: An ERP study. *Brain talk: Discourse with and in the Brain: the impact of the context on language processing*, 2-3 Juin, Lund.

20. **Brunellière, A.**, & Dominey, P.F. (2008). Between LAN and P300: markers for dissociable aspects of rule processing. *Cognitive Neuroscience Society*, 12-15 Avril, San Francisco.

21. **Brunellière, A.**, Franck, J., & Frauenfelder, U.H. (2007). Is mismatch negativity sensitive to morphosyntactic violations? *Lemanic-Neurosciences Annual Meeting*, 14-15 Septembre, Diablerets.

22. **Brunellière, A.**, Ludwig, C., Franck, J., & Frauenfelder, U.H. (2006). Early and automatic morpho-syntactic processing of person agreement: An ERP study. *Lemanic-Neurosciences Annual Meeting*, 8-9 Septembre, Diablerets.

- <u>Séminaires invités</u>

3 Sept. 2015 *Universitat Pompeu Fabra* (Barcelone, Espagne)

19-20 Sept. 2013 *Universitat Pompeu Fabra* (Barcelone, Espagne)

19 Fév. 2011 *Laboratoire Parole et Langage* (Aix-en-France, France)

9 Août 2010 *Universitat Pompeu Fabra* (Barcelone, Espagne)

CURRICULUM VITÆ (ENGLISH)

Angèle BRUNELLIERE

Born on 21rst, November 1982, Beaupréau, France

Current Situation

Associate professor in Cognitive Psychology at the University of Lille (Cognitive Science and Affective Science laboratory, SCALab, UMR9193 CNRS)

Professionnal Address

Laboratoire Sciences Cognitives et Sciences Affectives,
UMR9193 CNRS, Université de Lille,
Rue du Barreau, BP 60149
59653 VILLENEUVE-D'ASCQ CEDEX

Phone: +00 (0) 3 20 41 72 04
Email: angele.brunelliere@univ-lille.fr

Research Topics

Neurocognition of spoken-language comprehension, speech perception, spoken-word recognition, semantic and grammatical processing, predictive mechanisms

Education

2009 PhD in Neuroscience, Universities of Geneva and Lausanne, Switzerland
Title: Traitement de l'accord : vers une approche neurophysiologique du langage ("Studying agreement processing: a neurophysiological approach of language processing")
PhD surpervisor: Pr. Ulrich Hans Frauenfelder

2005 MSc in Neuroscience, University of Lyon 1, France

2003 3rd year of BSc in Cellular Biology and Physiology, University of Lyon 1, France

2002 2nd year of BSc in Cellular Biology and Physiology, Université Catholique de l'Ouest, France

Research Activities

Since Sept. 2011 Associate professor in Cognitive Psychology, University of Lille

Jan. 2011-Aug. 2011 Postdoctoral researcher at the Center for Brain and Cognition (Universitat Pompeu Fabra) in the Multisensory research group under the supervision of Pr. Salvador Soto-Faraco

June 2009-Dec. 2010 Postdoctoral researcher at the Laboratoire Parole et Langage (UMR6057 CNRS & Université de Provence) under the supervision of Pr. Noël Nguyen

March 2007-Oct. 2008 Participation in the scientific project "studying the impact of regional variations in phoneme perception" under the supervision of Pr. Noël Nguyen and Dr. Sophie Dufour (Laboratoire Parole et Langage, UMR6057 CNRS & Université de Provence).

Nov. 2005-May 2009 Phd Student at the Laboratoire de Psycholinguistique expérimentale (University of Geneva) under the supervision of Pr. Ulrich Hans Frauenfelder

Sept. 2004-Sept. 2005 MSc researcher at the Institut des Sciences Cognitives (UMR5015 CNRS & University of Lyon 1) under the supervision of Dr. Peter Ford Dominey

Grants and awards

2020-2024 Principal Investigator for the project entitled "Adapting linguistic representations during social interactions: a dynamic view of spoken human communication", grant from the French National Research Agency, 207,000 euro

2019-2020 Principal Investigator for an interdisciplinar worskhop entitled "Adapting to others: the role of prediction in human communication", grant from Maison européenne des sciences de l'homme et de la société Nord-France, 3,300 euro

2019-2020 Participation in the project entitled "Predicting in interactive settings", grant from Maison européenne des sciences de l'homme et de la société Nord-France, principal investigator: Dr Dominique Knutsen (SCALab)

2019-2020 Participation in the project entitled "Language disorders across lifespan: from developmental disabilities to neurodegenerative diseases", grant from Maison européenne des sciences de l'homme et de la société Nord-France, principal investigator: Dr Gwendoline Mahé (SCALab)

2016-2019 Principal Investigator for the project entitled "The nature of representations and neurocognitive processes involved in agreement processing", grant from the Institute of Human and Social Science (INSHS-CNRS), 99,360 euro

Oct. 2017-Oct. 2022 Getting an award for student and research project supervision (prime d'encadrement doctoral et de recherche, PEDR)

Sept. 2017-Feb. 2018 Getting a permission for not giving teaching activities during this period (congé pour recherches ou conversions thématiques, CRCT)

2015-2016 Principal Investigator for the project entitled "Integration of visual information in spoken communication", grant from University of Lille 3, 5,000 euro

2015-2016 Participation in the project entitled "Speech Segmentation in aphasia", grant from Maison européenne des sciences de l'homme et de la société Nord-France, principal investigator: Dr. Anahita Basirat (SCALab)

2015 6 month-stay funded by Universidad de Granada for a PhD student, Alba Casado (Universidad de Granada)

2014-2015 Principal Investigator for the project entitled "Processing and Representations in agreement processing", grant from University of Lille 3, international collaboration with NYU (New York University), 2,000 euro

2014-2015 Co-Investigator for the project entitled "Contribution of pictures in verbal communication" with Pr. Séverine Casalis (SCALab), grant from University of Lille 3, 7,000 euro

2013-2014 Co-Investigator for the project entitled "Studying interactions between visual contents and language processing" with Pr. Séverine Casalis (SCALab), grant from Interdisciplinary Cluster for the

Advancement of Visual Studies, scientific support of Irdive platform (Innovation-research in Digital and Interactive Visual Environments, certified Equipements d'Excellence), 12,800 euro

March 2014-Dec. 2014 Co-Investigator for the project entitled "Impact of visual content in spoken communication" with Pr. Séverine Casalis, grant from University of Lille 3, 5,500 euro

Nov. 2013-Dec. 2013 Principal Investigator for the project entitled "Studying multimodal prosody", grant from Bonus Qualité Recherche-Lille Métropole Communauté Urbaine, 5,700 euro

March 2013-Dec. 2013 Principal Investigator for the project entitled "Brain correlates of on-line predictions in speech processing", grant from University of Lille 3, in collaboration with Pr. Salvador Soto-Faraco (Center for Brain and Cognition), 1,600 euro

March 2013-Dec. 2013 Co-Investigator for the project entitled "Speech and Languages Sciences: a Ghent-Rijsel Cooperation" with Dr. Anahita Basirat (SCALab), grant from University of Lille 3, 1,000 euro

2011-2013 Postdoctoral funding from Generalitat de Catalunya declined – Program Beatriu de Pinós

2011 Participation in the project entitled "Brainglot Project", grant from Consolider-Ingenio 2010 Scheme, Spanish Ministry of Science and Education, principal investigator: Pr. Nuria Sebastian-Gallès (Center for Brain and Cognition)

2009-2010 Participation in the project entitled "Imitation in Speech: From sensory-motor integration to the dynamics of conversational interaction" (ANR-08-BLAN-0276-01), principal investigator: Pr. Noël Nguyen (Laboratoire Parole et Langage, UMR6057 CNRS & Université de Provence)

Nov. 2005-Mai 2009 Getting two Swiss grants (FNS 105314-109987, FNS 100014-120353) on studying agreement processing, 150,000 CHF

2008 Travel award of Academic Society of Geneva for participating to CNS2008, San Francisco, April

2006 Travel award of Association Francophone de la Communication Parlée for participating to JEP2006, Dinard, June

2004-2005 Master Scolarship from the Ministère de l'Education Nationale

Collaborations

- Pr. Alec Marantz (Morphology Lab, New York University)
- Pr. Salvador Soto-Faraco (Center for Brain and Cognition, Universitat Pompeu Fabra)
- Dr. Sophie Dufour (Laboratoire Parole et Langage, UMR6057 CNRS & Université de Provence)
- Dr. Jean-Baptiste Van der Henst (Institut des Sciences Cognitives – Marc Jeannerod, UMR5304 CNRS & Université de Lyon 1)
- Dr. Pascal Denis (Centre de Recherche en Informatique, Signal et Automatique de Lille, UMR9189 & Université de Lille)
- Dr. Cyril Auran, Dr. Laurence Delrue, Dr. Cédric Patin (Laboratoire Savoirs, Texte, Langage, UMR8163 CNRS & Université de Lille)
- Dr. Anahita Basirat, Dr. Isabelle Bonnotte, Dr. Jérémie Jozefowiez, Dr. Dominique Knutsen, Dr. Laetitia Perre (SCALab)

Research Stays

2017 New York University, Morphology Lab, 8 days

2015 Universitat Pompeu Fabra, Center for Brain and Cognition, 15 days

2015 New York University, Morphology Lab & David Poeppel Lab, 8 days

Scientific Expertise

- Expertise for Associate Professor Committees

2014 Reporter of two Associate Professor Committees in psychology of language (University of Lille 2 & Université de Reims Champagne-Ardennes)

2015 & 2017 Vice-president of Associate Professor Committee in psychology of language (University of Lille 3)

- Expertise for scientific projects

National Science Foundation, Innoviris Brussels, Netherlands Organisation for Scientific Research, National Research French Agency

- Expertise for scientific journals

Biological Psychology, Brain and Language, Neuropsychologia, Human Brain Mapping, Brain and Cognition, Brain Research, International Journal of Psychophysiology, Journal of Experimental Psychology: Human Perception and Performance, Journal of Experimental Psychology: Learning, memory and Cognition, Frontiers in Psychology, Language, Cognition & Neuroscience, Cognition and Emotion, Language Learning, Neuroscience Letters, Journal of Neurolinguistics

Supervisions

- PhD student

2016-in progress Principal supervisor, University of Lille (co-supervisor: Pr. Séverine Casalis, SCALab)
Jane Aristia: « La nature des représentations et des processus neurocognitifs impliqués dans le traitement de l'accord grammatical » ("The nature of representations and neurocognitive processes involved in agreement processing")

March 2015-August 2015 Supervision of a Phd student from Universidad de Granada during 6 months, Alba Casado: "The influence of voice speaker during gender processing"

- 2nd year of MSc student

2018 M2 européen de psychologie: psychologie des processus neurocognitifs et sciences affectives, University of Lille, Emmanuel Farce: "The influence of expressive prosody on prediction mechanisms during auditory sentence processing"

2017 M2 MIASHS Sciences Cognitives pour l'Entreprise, University of Lille 3, Chloé Monnier : « Influence de la prosodie expressive sur les processus anticipatoires du langage oral »

2015 M2 européen de psychologie : psychologie des processus neurocognitifs et sciences affectives, University of Lille 3, Adèle Delalleau : « Parole audiovisuelle et compréhension de la phrase : étude en potentiels évoqués »

- 1rst year of MSc student

2018 M1 MIASHS Sciences Cognitives pour l'Entreprise, University of Lille, Eva Carru : « La propagation de l'activation au sein d'une catégorie sémantique à travers la typicalité »

2017 M1 de psychologie, University of Lille 3, Emmanuel Farce : « L'influence de la typicalité sur la reconnaissance des mots écrits »

2016 M1 MIASHS Sciences Cognitives pour l'Entreprise, University of Lille 3, Chloé Monnier : « Influence de la prosodie expressive sur les processus anticipatoires du langage oral »

2016 M1 de psychologie, University of Lille 3, Jordan Alves : « L'influence de la présentation audiovisuelle sur le traitement de la parole »

2016 M1 de psychologie, University of Lille 3, Aleksandar Ivkovic : « Etude de la perception de phonèmes et de mots en Nord de France »

2015 M1 de psychologie, University of Lille 3, Laure Grosz : « Etude électrophysiologique de l'influence de la parole visuelle sur la segmentation lexicale pour l'apprenant d'une seconde langue » (co-supervisor : Anahita Basirat, SCALab)

2015 M1 de psychologie, University of Lille 3, Apolline Delobeau : « Apport des mouvements des lèvres dans les mécanismes prédictifs du langage oral »

2014 M1 de psychologie, University of Lille 3, Adèle Delalleau : « L'influence de l'emphase sur la compréhension de la phrase parlée : étude en potentiels évoqués »

- Bachelor's degree, Internships & Assistants

6 student in 3rd year of Bachelor of Psychology, University of Lille, 5 students in 3rd year of Bachelor in Cognitive Science, University of Lille

Research internships: 1 Phd student in Psychology from Universitat Pompeu Fabra, 1 MSc student in Neuroscience from Universitat Pompeu Fabra, 1 student in 3rd year of Bachelor in Biology, University of Tours, 7 MSc students in Psychology, University of Lille, 6 students in speech therapy, University of Lille

Research assistants: 3 MSc students in modern languages, 5 MSc students in Psychology

- PhD follow-up

Follow-up of 5 PhD students in Psychology as being a member of their PhD committee, University of Lille (Noelia Do Carmo: 2013-2016, Gary Boddaert: 2015-in progress, Camille Cornut: 2017- in progress, Florian Salomé: 2017- in progress, Ségolène Guérin: 2019-in progress)

Outreach initiatives

2017 Performing open-access videos about the research studying on language processing and on the evolution and diversity of languages (projets UOH, Université Ouverte des Humanités :"Cité-langage : trajets dans les sciences du langage")

Teaching and administrative activities

- Teaching activities

Since Sept. 2011, my teaching has averaged 210 hours per year. As can be seen in the table below, the content of these courses concerns the psychology of language, research methodology, biology and neuroscience at different levels (Bachelor, Master) and in the programs of Psychology, Cognitive Science and Examination training for Speech therapy. My teaching therefore presents a diversity of topics, training courses and levels provided. I have taken care to be organized in my teaching such that it allows me to have a good match between my initial training, my research activities, and a general multidisciplinary culture around cognition.

Heading of course	Training courses	Level	Size	Number of hours
Psycholinguistics	Bachelor in Psychology	2nd	670	16h L
Psycholinguistics	Bachelor in Psychology	3rd	60	4h L 8h S
Psycholinguistics	Bachelor in Cognitive Science	2nd	20	16h L 32h S
Psycholinguistics	Master in Psychology	2nd	30	3h L
Neurocognition of language	Master in Psychology	1rst	60	4h L 6h S
Cognitive Neuroscience	Bachelor in Psychology	3rd	450	20h S
Neuroscience	Bachelor in Cognitive Science	1rst	50	4h L 8h S
Cognitive Neuroscience	Bachelor in Cognitive Science	1rst	50	8h L 16h S
Biology and Neuroscience	Examination training for Speech therapy	1rst	30	4h L 8h S
Neuroimaging techniques	Master in Psychology	1rst	60	6h S
Research methodology	Bachelor in Psychology	3rd	450	32h S
Research methodology	Master in Psychology	1rst	60	6h S

L: Lecture, S: Seminar

In all my teaching activities, I have endeavored to offer courses in the most appropriate way for the subjects taught and the receptivity of students. I build my teaching by pursuing a double goal, namely the acquisition of knowledge and skills targeted by the subject taught, but also the construction of a disciplinary representation linking the contents taught with the other courses of the training and with vocational guidance. This approach to teaching therefore leads me to regularly modify not only the content and organization of the subjects I teach, but also and above all to propose and coordinate the organization of content with other teachers as head of many teaching units. All my lessons are based on concrete examples

and practical application of the content provided by carrying out exercises and presentations, and using the peer-reviewing method. I strive to build lessons that allow a high degree of interactivity with students to compare their understandings with the targeted content and reverse pedagogy is often used.

Another very particular focus of my teaching activity is my involvement in research methodology. Indeed, I am keen that a university education can be an opportunity to develop both general skills based on a scientific approach and skills on reflection and synthesis. Similarly, the construction of research methodology teaching is geared towards introducing students to research in a fun and creative way, without falling into simplicity, and above all by highlighting the concrete applications of research, the challenges of tomorrow and the possible links between the research professions and the vocational training targeted. In this sense, I coordinate two teaching units on research methodology, leading to the management of 12,600 hours provided.

- Administrative activities

From 2020, co-manager of Language team in SCALab and representative for ERASMUS in the department of Psychology

2014-in progress Head of teaching in biology and experimental methodology (Bachelor in Cognitive Science-University of Lille), in research methodology (Bachelor in Psychology-University of Lille) and member of validation panel for the diploma of Bachelor in Psychology

2011-in progress Member of ethic committee-University of Lille

2014-2019 Head of teaching in Biology and member of admission and validation panel (One year preparing entrance diploma of Speech Therapy University of Lille)

2015-2018 Head of teaching in psychology of language (Bachelor in Cognitive Science-University of Lille)

2015-2017 Member of department committee in biology-University of Lille 3

2013-2019 Elected member of scientific committee of SCALab

2011-2018 Head of EEG rooms and materials

PUBLICATIONS ET COMMUNICATIONS

- Articles in international peer-reviewed journals

21 accepted papers, 14 as first author, 2 as last author
* the co-authors are master or PhD students supervised by myself

1. Basirat, A., Allart, E., **Brunellière, A.**, & Martin, Y. (accepted). Audiovisual speech segmentation in post-stroke aphasia: a pilot study. *Topics in Stroke Rehabilitation*.

2. **Brunellière, A.**, Delrue, L., & Auran, C. (in press). The contribution of audiovisual speech to lexical-semantic processing in natural spoken sentences. *Language, Cognition & Neuroscience*. https://doi.org/10.1080/23273798.2019.1641612

3. **Brunellière, A.**, Auran, C., & Delrue, L. (2019). Does the prosodic emphasis of sentential context cause deeper lexical-semantic processing? *Language, Cognition & Neuroscience*, *34*, 29-42. https://doi.org/10.1080/23273798.2018.1499945

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5. Basirat, A., **Brunellière, A.**, & Hartsuiker, R. (2018). The role of audiovisual speech in the early stages of lexical processing as revealed by ERP word repetition effect. *Language Learning*, *68*, 80-101. https://doi.org/ 10.1111/lang.12265

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1. **Brunellière, A.**, & Dufour, S. (2013). Electrophysiological evidence for benefits of imitation during the processing of spoken words embedded in sentential contexts. *In Proceedings of Interspeech,* Lyons, 25-29 August, 1345-1349.

2. **Brunellière, A.**, Dufour, S., & Nguyen, N. (2010). Y a-t-il un impact de l'imitation sur la reconnaissance des mots parlés dans un accent régional non-natif. *Journées d'Etudes sur la Parole*, Mons, 25-28 May, 321-324.

3. Dodane, C., & **Brunellière, A.** (2006). Lecture silencieuse et oralisée des phrases relatives : le rôle de la prosodie, *Journées d'Etudes sur la Parole*, Dinard, 12-16 June, 117-120.

- Posters

22 accepted posters, 15 as first author, 3 as last author

1. **Brunellière, A.**, & Delrue, L. (2019). Predicting while comprehending spoken sentences: the influence of speakers' communicative intentions on predictions. *European Society for Cognitive Psychology*, 25-28 September, Tenerife.

2. **Brunellière, A.**, & Delrue, L. (2019). The role of prosodic emphasis in speaker's communicative intention and in listeners' word prediction during spoken-language comprehension. *Architectures and Mechanisms for Language Processing*, 6-8 September, Moscow.

3. Knutsen, D., Col, G., & Brunellière, A. (2019). How do dialogue partners jointly manage mental load to navigate the interaction? Architectures and Mechanisms for Language Processing, 6-8 September, Moscow.

4. **Brunellière, A.**, & Delrue, L. (2019). The robustness of prediction effects based on article-elicited negativity in spoken language comprehension depends on the communicative intentions of listeners and speakers. *Society for the Neurobiology of Language*, 20-22 August, Helsinki.

5. Aristia, J.*, **Brunellière, A.**, & Marantz, A. (2019). Tracking brain prediction based on associative representations in subject-verb agreement, *Cognitive Neuroscience Society,* 23-26 March, San Francisco.

6. **Brunellière, A.**, & Delrue, L. (2017). When the expressive prosody meets word prediction in spoken-language comprehension. *Society for the Neurobiology of Language*, 7-11 November, Baltimore.

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8. **Brunellière, A.**, Farce, E.*, & Bonnotte, I. (2017). Typicality effects in a lexical decision task and in a categorization task. Classical or renewed interpretation. *Architectures and Mechanisms for Language Processing*, 7-9 September, Lancaster.

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11. **Brunellière, A.**, Delrue, L., Soto-Faraco, S., & Foucart, A. (2016). Audiovisual speech speeds up on-line language processes during spoken sentence comprehension. *Workshop on audiovisual speech processing and language learning*, 28-29 November, Barcelona.

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17. **Brunellière, A.**, & Frauenfelder, U.H. (2008). Morpho-syntactic priming effects in spoken language processing. *Annual Conference on Architectures and Mechanisms for Language Processing*, 4-6 September, Cambridge.

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19. **Brunellière, A.**, & Frauenfelder, U.H. (2008). Morpho-syntactic context effects in spoken language processing: An ERP study. *Brain talk: Discourse with and in the Brain: the impact of the context on language processing*, 2-3 June, Lund.

20. **Brunellière, A.**, & Dominey, P.F. (2008). Between LAN and P300: markers for dissociable aspects of rule processing. *Cognitive Neuroscience Society*, 12-15 April, San Francisco.

21. **Brunellière, A.**, Franck, J., & Frauenfelder, U.H. (2007). Is mismatch negativity sensitive to morphosyntactic violations? *Lemanic-Neurosciences Annual Meeting*, 14-15 September, Diablerets.

22. **Brunellière, A.**, Ludwig, C., Franck, J., & Frauenfelder, U.H. (2006). Early and automatic morpho-syntactic processing of person agreement: An ERP study. *Lemanic-Neurosciences Annual Meeting*, 8-9 September, Diablerets.

- Invited talks

3 Sept. 2015 *Universitat Pompeu Fabra* (Barcelona, Spain)

19-20 Sept. 2013 *Universitat Pompeu Fabra* (Barcelona, Spain)

19 Feb. 2011 *Laboratoire Parole et Langage* (Aix-en-France, France)

9 Aug. 2010 *Universitat Pompeu Fabra* (Barcelona, Spain)

RESEARCH REPORT

Preface

Spoken language is the modality from which humans acquire the ability to interact with others. Remarkably, this modality insures both quick, spontaneous conversational interactions and long communicative debates. Yet the question remains as to how listeners decode and understand the message from the flow of speech uttered by speakers. Processing spoken language indeed requires a complex series of processing stages to map speech sounds into meaning. This complex series of processing stages has been described separately by the models of sentence processing and those of spoken-word recognition. In particular, cognitive and neurocognitive models of sentence processing (e.g., Forster, 1979; Frazier, 1979; Hagoort, 2003; Friederici, 2002) have discussed how and when one particular linguistic level of information (e.g. syntactic information and semantic information) contributes to the construction of meaning of a sentence. For instance, both the primacy of syntactic processing and the serial aspect of information processing (that is, in what order and when a specific linguistic information such as syntactic or semantic information is processed) have been studied. At present, the consensual and accepted view is that "the different information types (lexical, syntactic, phonological, pragmatic) are processed in parallel and influence the interpretation process incrementally, that is, as soon as the relevant pieces of information are available" (see Hagoort, 2003).

In contrast to such models of sentence processing, models of spoken-word recognition (e.g., Marslen-Wilson, 1984; McCelland and Elman, 1986; Norris, 1994) have described how the decoding of the message is achieved by mapping the auditory information in the speech input onto stored representations of words in the mental lexicon. Interestingly, the current models of spoken-word recognition differ in terms of the activation flow between levels of the processing system from low-level acoustic–phonetic processing to higher stages involving the lexicon and the nature of representations encoded into the lexicon (for a recent review, see Weber & Scharenborg, 2012). In terms of the activation flow between levels of the processing system, while the interactive models of spoken-word recognition assume that the activation flow spreads from lower to higher levels and also from higher to lower levels, the autonomous models of spoken-word recognition propose only a bottom-up flow of activation from speech sounds to higher levels (until a lexical level).

Links between both kinds of models in spoken-word recognition and sentence processing can be made based on the idea that top-down influence from higher to lower levels may include constraints driven by sentential context. This top-down influence therefore requires us to consider a connection between mechanisms described by the models of spoken-word recognition and those of sentence processing. According to a top-down influence from higher to lower levels, the constraints driven by sentential context are the result of the building of meaning based on the previously recognized words and have consequences on the recognition of incoming words. Following this consideration, I have attempted to investigate how the construction of meaning based on previously recognized words can constrain the recognition of incoming words in spoken language. As for in written language comprehension, I used the traditional cloze procedure first described by Taylor in 1953 in which participants are asked to complete sentence fragments with the first word that comes to mind. I created sentence fragments providing high or low semantic constraints.

Such a top-down influence from the constraints driven by sentential context is in fact in line with recent proposals regarding the role of prediction in language comprehension (for reviews, see Huettig, 2015; Kuperberg & Jaeger, 2016). According to the predictive coding framework (Friston and Kiebel, 2009), the brain continuously infers the probabilities of sensory input across the hierarchy of multi-level representations to be able to predict upcoming input. In spoken language comprehension, Pickering and Garrod (2007) assume that top-down predictions occur at different linguistic levels (phonological, lexical, syntactic, semantic) about the upcoming input. Such top-down predictions in the processing of sentences are considered to be probabilistic systems mirroring the statistics of the linguistic environment (Kuperberg, & Jaeger, 2016; Levy, 2008). For instance, after a listener extracts semantic and syntactic information driven by a sentential context, it is assumed that the unification of semantic and syntactic information is used to elaborate the meaning of the message and that this unification can constrain the processing of incoming word, such that the more probable upcoming words might be pre-activated based on Bayesian computing.

The notion of prediction goes hand in hand with the incrementality of sentence processing (processing information as soon as its use is available); however, it highlights before anything else the computational architecture required to achieve language processing in real time in which higher level representations predictively pre-activate lower level representations. Therefore, the notion of prediction is fully in line with classical interactive models of spoken-word recognition (e.g., McCelland and Elman, 1986) and emphasizes more strongly than these models the fact that the

sentential context may act by pre-activating lower-level representations, such as at the lexical level. The first studies arguing for predictive mechanisms in spoken language comprehension have been conducted using the "visual world paradigm" (e.g., Altmann and Kamide, 1999). In this paradigm, participants see a small number of pictures among which one is related to the predicted word before they listen to sentential context. Eye movements towards pictures that are or not related to the predicted word are measured, while participants are listening to constraining spoken sentences. Although eye movements toward the picture related to the predicted word are found before the target word is spoken, the presentation of pictures which is done before the listening of sentential context can explain the pre-activation of upcoming word which tends to begin stronger and stronger during the unfolding of the sentence. To date, few studies have provided clear evidence for word prediction in spoken language comprehension (Brunellière, & Delrue, 2017; Foucart, Ruiz-Tada & Costa, 2015; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005; Wicha, Bates, Moreno, & Kutas, 2003). Moreover, it has recently been suggested that predictive mechanisms may not be systematically involved during language processing (Huettig, & Mani, 2016). Although the rapidity of natural speech in everyday communication could cause listeners to become more likely to generate top-down predictions, the role of predictive mechanisms is not clearly established in spoken-language comprehension. The findings described in the following parts will be discussed in light of a predictive view of spoken language comprehension. These findings will thus provide a better understanding of the role of predictive mechanisms in spoken language comprehension.

It is important to note that sentential contexts in ecological situations can provide information of different kinds. These include semantic and syntactic information, but also phonological information related to the speaker, such as a regional accent. Beyond the fact that speech is fast and remarkably continuous, the way speakers produce speech sounds is highly variable depending on where the speakers grew up, their gender and their social status. Moreover, the variability in speech productions also can depend on a speaker's intention and motivation to communicate a message. Another aspect of spoken language is the notion that auditory signals are usually accompanied by speakers' visible articulatory gestures, such as lip movements. An unresolved question is whether these different kinds of information in the sentential context affect the processing of incoming word and, if they do, how they do so.

It is in this context that I have developed several lines of research to study how the semantic constraints driven by the sentence context as well as phonological information related to the speaker act upon spoken-word recognition. In line with the properties of speech signals, I have

studied separately three sources of phonological information related to the identity of speakers: regional accent, intention to communicate and visible articulatory gestures. To date, the models for spoken-word recognition and models for sentence processing have not taken into account the phonological information related to the identity of speakers. The first reason lies in the fact that most models of spoken-word recognition (except for the Minerva model, Goldinger, 1998) posit that the perceptual system normalizes speech sounds by removing any acoustic variation. The second reason is that the great interest in how speech is segmented has resulted in the communicative aspect of spoken language being somewhat neglected. The third reason stems from the fact that the models of spoken-word recognition and the models of sentence processing have looked at the stages of processing from an auditory input and not from multimodal signals such as in face-to-face interactions. Therefore, studying these three sources of phonological information has the advantage of enabling the tracking of processes involved in spoken language comprehension taking into account the identity of speakers. It provides further evidence for the understanding of processes involved in spoken language comprehension in its communicative aspect. The communicative aspect of spoken language comprehension here refers to the indexical information conveyed by speakers.

In the following parts, I will present my different lines of research on the interplay between the semantic constraints driven by the sentence context and the phonological information related to the speaker (regional accent, intention and visible articulatory gestures) on spoken-word recognition. For each line, I will briefly describe a reflective starting point, the background and the main findings. Along these research lines, the methodological approach that I employed usually consisted of recording electrical brain activity by electroencephalography. Additionally, I decided to mainly use tasks simply requiring participants to focus on the meaning of a sentence. All studies related to these research lines have been conducted using adult listeners in Catalan, French, and Spanish and have been carried out from 2008 to now. It is important to note that the studies that I had previously conducted during my doctoral research aimed to explore the processes involved in subject-verb agreement in spoken language. All of my work therefore concerns studying the cognitive and neurocognitive processes involved in spoken language comprehension. It should also be noted that since my PhD, I have developed a great interest in the study of lexical level during spoken language comprehension. This is because the word level has the advantage of being situated at the interface between the lower and higher levels of processing. According to my view, the interactive flow between the different levels of processing is at the core of the processes involved in spoken language comprehension.

Studying the impact of semantic constraints in spoken language comprehension on word recognition has further led me to develop an interest in the organization of semantic representations in memory. I will present two experiments that I conducted in collaboration with colleagues from the language team of my current laboratory (SCALab, Laboratoire Sciences Cognitives et Sciences Affectives), although these experiments were conducted in visual semantic priming. The findings about the nature of semantic representations will be discussed in line with the literature of phonological representations and will provide interesting perspectives about linguistic representations in spoken language comprehension.

After presenting my different lines of research on the interplay between the semantic constraints driven by the sentence context and the phonological information related to the speaker and on the nature of semantic representations in memory, I will propose new perspectives about the processes of spoken language comprehension, taking into account the communicative aspect of spoken language and predictive mechanisms. I will discuss the notion of linguistic representations and their adaptations in spoken language comprehension as well as in spoken language communication.

Part I: Studies on the interplay between the semantic constraints driven by the sentence context and the regional accent of speakers on spoken-word recognition

My interest in the impact of regional accent during the processing of spoken language has its initial roots in a scientific collaboration with Dr. Sophie Dufour and Pr. Noël Nguyen (Laboratoire Parole et Langage, UMR6057 CNRS & Université de Provence). This interest continued in Barcelona and even in Lille. It should be pointed out that the phonology of every language shows substantial variation across space between different regional accents. Interestingly, listeners' ability to perceive speech sounds greatly depends on the phoneme inventory of their native language (Best, McRoberts, & Sithole, 1988; Flege, 1995). The two models that are most frequently used to explain this phenomenon are the Perceptual Assimilation Model (PAM: Best, McRoberts, & Sithole, 1988) and the Speech Learning Model (SLM: Flege, 1995). According to the SLM, perceptual space is described as being warped as a function of learning about the phonological organization of the native language. More specifically, the PAM introduced the notion of assimilation such that the sounds in the incoming speech are perceptually assimilated to the phonemic categories of the native language. In the case of non-native sounds, they are perceived with respect to their similarities and differences to the phonemic inventory of the native language. In line with this literature, my immediate interest was to understand how the phonological variation due to regional accent within a language affects sub-lexical and lexical processing in adults (Brunellière, Dufour, & Nguyen, 2011; Brunellière, Dufour, Nguyen, & Frauenfelder, 2009). At that time, few studies had addressed this question, and the few that had provided conflicting results (Conrey, Potts, & Niedzielski, 2005; Cutler, Smits, & Cooper, 2005; Dufour, Nguyen, & Frauenfelder, 2007; Evans & Iverson, 2004). I will present below the first studies that I conducted in line with my immediate interest. I will then mention the studies that I undertook concerning the impact of imitation on the adaptation of listeners' perception to regional accents. Finally, I will describe in greater detail the studies that I have developed on the interplay between the sentential constraints and the regional accent of speakers on spoken-word recognition.

I first focused on accent-related variation associated with vowel mergers. A vowel merger refers to a case in which two vowels are not, or are no longer, distinguished in pronunciation in one regional accent but remain contrastive in another accent of the same language (Brunellière, Dufour, Nguyen, & Frauenfelder, 2009). The goal was to determine whether exposure to a merged variety can affect the listener's vowel perception in their unmerged native variety. An example of a vowel merger in French is provided by the /e/–/ɛ/ contrast. Whereas Standard French is

traditionally said to establish a contrastive distinction between /e/ and /ɛ/ in word-final open syllables (e.g., épée "sword" /epe/ vs. épais "thick" /epɛ/), this distinction does not exist in Southern French, which only has close-mid /e/ in that position (Fagyal, Kibbee, & Jenkins, 2006). Thus, both *épée* and *épais* are pronounced /epe/ in this regional variety. As seen in Figure 1A, we compared the event-related potential (ERP) responses to the perception of the /e/–/ɛ/ contrast, which is subject to regional variations in French-speaking regions, with that of the /ø/–/y/ contrast, a stable phonemic contrast in French (e.g., jeu "game" /ʒø/ vs. jus "juice" /ʒy/).

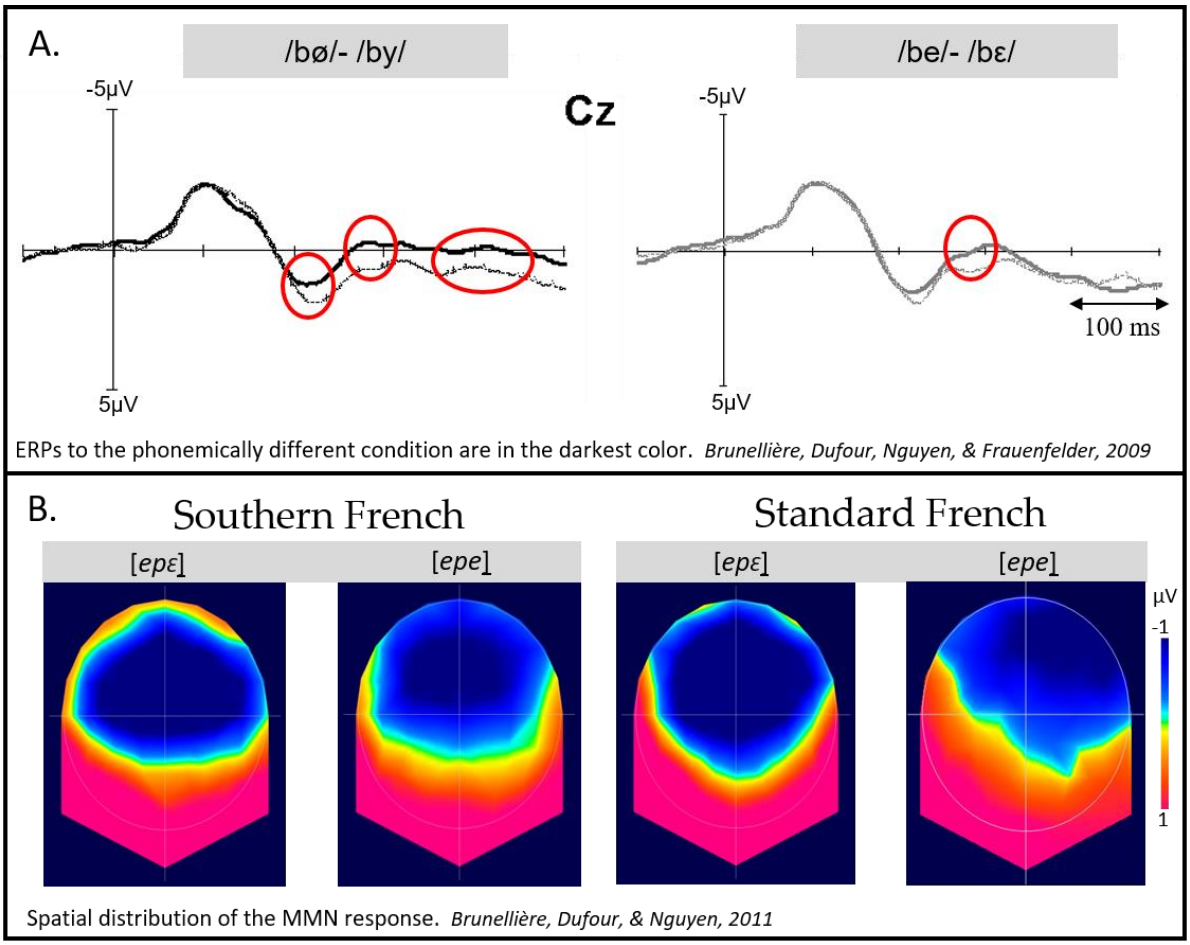

Figure 1. Adapted illustrations from papers by Brunellière, Dufour, Nguyen, & Frauenfelder (2009) shown in (A) and by Brunellière, Dufour, & Nguyen (2011) displayed in (B).

The /ø/–/y/ contrast was chosen as a basis of comparison because, as is the case for the /e/–/ɛ/ contrast, the pair of vowels in question differs by only one phonetic feature (i.e., vowel height). Furthermore, it was verified that the acoustic distance was equal. Standard French listeners first heard four phonemically identical but acoustically different syllables (e.g., /be/–/be/–/be/–/be/), which were produced by four different female speakers, and then heard the test syllable

which was produced by a male speaker and which was either phonemically identical (/be/) or phonemically different (/bɛ/) from the preceding context stimuli. The variability introduced by mixing speakers forced the listener to rely on more abstract representations and therefore enabled us to examine phonological processing. Listeners were asked to indicate whether the test syllable was or was not identical to the preceding context stimuli. As seen in Figure 1A, a negative wave with stronger amplitude from 300 ms was observed for the phonemically different condition during the processing of the unstable /e/–/ɛ/ contrast. The electrophysiological differences due to the phonemically different condition were found starting earlier at 200 ms and persisted later during the processing of the /ø/–/y/ contrast (see Figure 1A). These findings were in line with the behavioral results on the phonemically different condition in which responses were slower and more error-prone for the /e/–/ɛ/ contrast than for the /ø/–/y/ contrast. In other words, the discrimination of the merged contrast was more difficult than the unmerged contrast. To summarize, the great variability of the /e/–/ɛ/ contrast appears to affect the phonemic memory traces of Standard listeners such that they would be close together in the phonemotopic map, thus making their discrimination more difficult (Brunellière, Dufour, Nguyen, & Frauenfelder, 2009).

While the question of whether exposure to a merged variety can affect the listener's vowel perception in their unmerged native variety was explored in our previous study, another question concerns whether exposure to a merged variety can affect the encoding of lexical forms in the listeners of this merged native variety (Brunellière, Dufour, & Nguyen, 2011). For instance, due to the merging contrast between /e/ and /ɛ/ in Southern French, listeners in this variety could have encoded a single phonological form of lexical representation, namely /epe/. To study this question, I examined semantic access triggered by the word forms [epe] and [epɛ] in Standard French and Southern French listeners through the topography of the Mismatch Negativity response (MMN). It has previously been established that concrete words evince a larger right lateralized negative response than abstract words (Dhond, Witzel, Dale, & Halgren, 2007; Kounios, & Holcomb, 1994; Pulvermüller, Shtyrov, Kujala, & Näätänen, 2004). Since *épée* and *épais* differ in terms of concreteness (respectively "sword" and "thick" in English), we thus compared the topography of MMN responses for [epe] and [epɛ] when they occasionally occurred after the repeatedly presented word [epi] "cob". Listeners' attention was disengaged from the auditory stimulus such that they were asked to focus their attention on a silent movie while ignoring any auditory stimulus. A MMN response is usually observed when a stimulus interrupts the repetition of another stimulus. The topography of the MMN response (i.e., the spatial distribution across all EEG channels) was lateralized to the right side after the listening of [epe] contrary to that of [epɛ] in Standard French listeners (see Figure 1B). In contrast, the same topography of the MMN response was found after

the listening of [epe] and [epɛ] in Southern French listeners with no right lateralization. These findings suggest that Southern French but not Standard French listeners treat words ending in [e] and [ɛ] as homophonous. Contrary to what was observed in the /e/-/ɛ/ contrast, it is important to note that Southern French listeners distinctly perceive the /o/-/ɔ/ word-form pairs produced by several speakers in a same-different task when behavioral and ERP data were recorded (Dufour, Brunellière, & Nguyen, 2013). In fact, whereas Standard French is traditionally said to establish a contrastive distinction between /o/ and /ɔ/ in word-final closed syllables (e.g., côte "hill" /cot/ vs. cotte "dungarees" /cɔt/), this distinction does not exist in Southern French, which only has close-mid /ɔ/ in that position. However, although the/o/-/ɔ/ contrast in word-final closed syllables is merging in the Southern French, this contrast is very stable in Standard French when speakers produced word closed syllables.

It thus appears that brain networks encoding word units and phonemic representations are shaped by the linguistic exposures within a speaker's own regional accent and in the different regional varieties of one's native language (Dufour, Brunellière, & Nguyen, 2013; Brunellière, Dufour, & Nguyen, 2011; Brunellière, Dufour, Nguyen, & Frauenfelder, 2009). In that case, an intriguing question arises: how does the adaptation of listeners' perception to a regional accent occur? Especially in a society where geographical mobility is high and where people can live far from their place of employment during adulthood, the question of adaptation to accent regional seems very relevant. The adaptation to the phonetic and phonological realizations of one's interlocutor manifests itself in dialogic settings. One interesting phenomenon is the observance that people tend to imitate each other in social conversation. More exactly, convergence effects have been shown under many different forms, which include posture (e.g., Shockley, Santana, & Fowler, 2003), head movements and facial expressions (e.g., Estow, Jamieson, & Yates, 2007; Sato and Yoshikawa, 2007) and, as regards speech, vocal intensity (Natale, 1975), pitch curve (Gregory, Webster, & Huang 1993; Bosshardt Sappok, Knipschild, & Hölscher, 1997), and rate of speech (Giles, Coupland, & Coupland, 1991). Such convergence effects are usually associated with the notion of alignment mechanisms (Garrod and Pickering, 2004). Linguistic representations at different levels between partners are shared in order that these partners have a better joint understanding of what they are talking about.

Some authors have explored whether the imitation of a novel accent can later improve spoken language comprehension under adverse listening situations (e.g., Adank, Hagoort, & Bekkering, 2010). Speech comprehension assessed by the signal-to-noise ratio (SNR) at which listeners can repeat 50% of the key words in a sentence was improved only for participants who

had imitated the novel accent during the listening of sentences. In the same vein, we studied whether imitating words in a non-native accent facilitates the later recognition of words spoken in that accent (Nguyen, Dufour, & Brunellière, 2012). Before a lexical decision task, Standard French speakers performed either a repetition task or a semantic-categorization task. They had to repeat each word after having heard it (repetition task) or to indicate whether the heard word belonged to a pre-specified semantic category (e.g., the category 'animal' in a semantic-categorization task). All words were produced by a Southern French speaker. In the repetition task, a clear convergence by Standard French speakers toward the Southern French speaker was found, such that they produced words with a more open vowel in the /o/-/ɔ/ contrast. However, the phonetic imitation did not result in an impact on later word recognition. The recognition of non-native word forms with the /ɔ/ open vowel in word-final closed syllables took longer than the processing of native word forms with the /ɔ/ open vowel even after the convergence effect. Contrary to Adank, Hagoort, & Bekkering (2010), imitation does not play a role in spoken word recognition. Moreover, the greater difficulty in processing non-native word forms reflects the word frequency of occurrence. The frequency of non-native word forms with the /ɔ/ open vowel in word-final closed syllables in Southern accent remains low, even though our participants were regularly exposed to Standard French in their daily life. This is completely in line with the theoretical framework postulated by Connine, Rambon, & Patterson (2008). Their research revealed that a word can be encoded as several phonological forms at the lexical level and that word memory traces depend on their frequency of use. Our data are also consistent with the view that there may be a decoupling between changes in production and changes in perception (Kraljic, Brennan, & Samuel, 2008).

What then is the role of imitation? For instance, the previously cited study by Adank, Hagoort, & Bekkering (2010) and our study differ in many aspects. These include the level of processing (sentence processing versus word recognition), the novelty of accent (novel accent versus unfamiliar regional accent) and the type of speech (speech in noise versus clear speech). Since Adank, Hagoort, & Bekkering (2010) demonstrated that imitation of a novel accent can improve spoken language comprehension, we performed a preliminary ERP study in sentence processing and presented a completely novel accent to listeners to which they had never been exposed (Brunellière, & Dufour, 2013). We chose to measure their abilities in spoken-language comprehension using the cloze probability effect, which reflects the ease with which a word embedded in a sentential context is recognized. A word's cloze probability is related to the proportion of individuals who provide it to complete a given sentence fragment and is used as a measure of the level of predictability of the word. The ERP cloze probability effect in two groups of Southern French speakers was evaluated after they had either listened to or imitated sentences

spoken by a Belgian French speaker. Both groups showed a cloze probability effect on the N400, which is an ERP component known to be associated with lexical and semantic processing (Lau, Phillips, & Poeppel, 2008). Speakers who did not imitate the novel accent showed a cloze probability effect over an early stage of processing of around 200 ms, while those who did imitate the accent showed no effect of cloze probability on this timing. More precisely, low cloze probability words elicited a stronger negativity in the group of speakers that did not imitate than in the group of speakers who had to imitate the novel accent at around 200 ms. We interpreted this finding as reflecting an improvement in acoustic/phonological processing due to imitation when listeners treated the low cloze probability words. Although this finding is particularly interesting regarding the impact of imitation on adaptive mechanisms of listeners' perception, our study suffers serious limits related to the onset of spoken words from which ERP were time-locked. Because of coarticulation phenomena in speech, the onsets of spoken words were in fact not sufficiently clear and prominent. More work is therefore needed to examine the role of imitation in the processing of spoken language. More exactly, further studies should attempt to determine to which linguistic levels imitation can affect, both immediately and later, the processing of spoken language. In particular, it is important to know whether the role of imitation is mainly coupled with the process of speech segmentation by inferring the temporal envelop of speech. Another goal concerning the adaptive mechanisms to accent regional is to understand listeners' ability to exploit the identity of speakers and to use other information crucial to spoken language comprehension (such as semantic information) at the same time.

To a have better understanding of the adaptive mechanisms to regional accents in spoken language comprehension, it seems relevant to know how listeners use the semantic constraints of sentence context and the regional accent of speakers when they know the rule of phonological variation within their native language (Brunellière, & Soto-Faraco, 2013, 2015). In that case, it could be hypothesized that listeners would predict phonological word forms of expected words according to context thanks to both the information of semantic constraints and that of regional accent in sentence context. To this aim, I capitalized on the rule of vowel reduction in Catalan during my collaboration with Pr. Salvador Soto-Faraco (Center for Brain and Cognition, Universitat Pompeu Fabra). Specifically, Eastern Catalan (spoken in Barcelona) applies vowel reduction (e.g., /a/ and /e/ segments become a schwa sound /ə/ in unstressed syllables) whereas Western Catalan (spoken in Lleida, for example) does not apply vowel reduction. That is, the rule of vowel reduction in unstressed syllables leads to vowel neutralizations in Eastern Catalan (Alarcos, 1953). For example, the word 'third' in Catalan is pronounced /tersé/ in a Western Catalan accent, whereas it is produced /tərsé/ in Eastern Catalan. In a similar fashion, /o/ and /ɔ/ are reduced to /u/ in

unstressed syllables, so that the word 'chocolates' is pronounced /bombóns/ in Western Catalan whereas it is produced /bumbóns/ in Eastern Catalan. In this study, native Eastern Catalan speakers were exposed to semantically constraining sentences produced either in their native regional accent (Experiment 1) or in the alternative non-native regional accent (i.e. Western Catalan, Experiment 2) in separate groups. The semantic constraints were assessed by a cloze probability test. To make sure that we could track the temporal dynamics of spoken word recognition, we selected words beginning with a clear acoustic onset (such as a plosive). In each experiment, there were three critical conditions (see Figure 2).

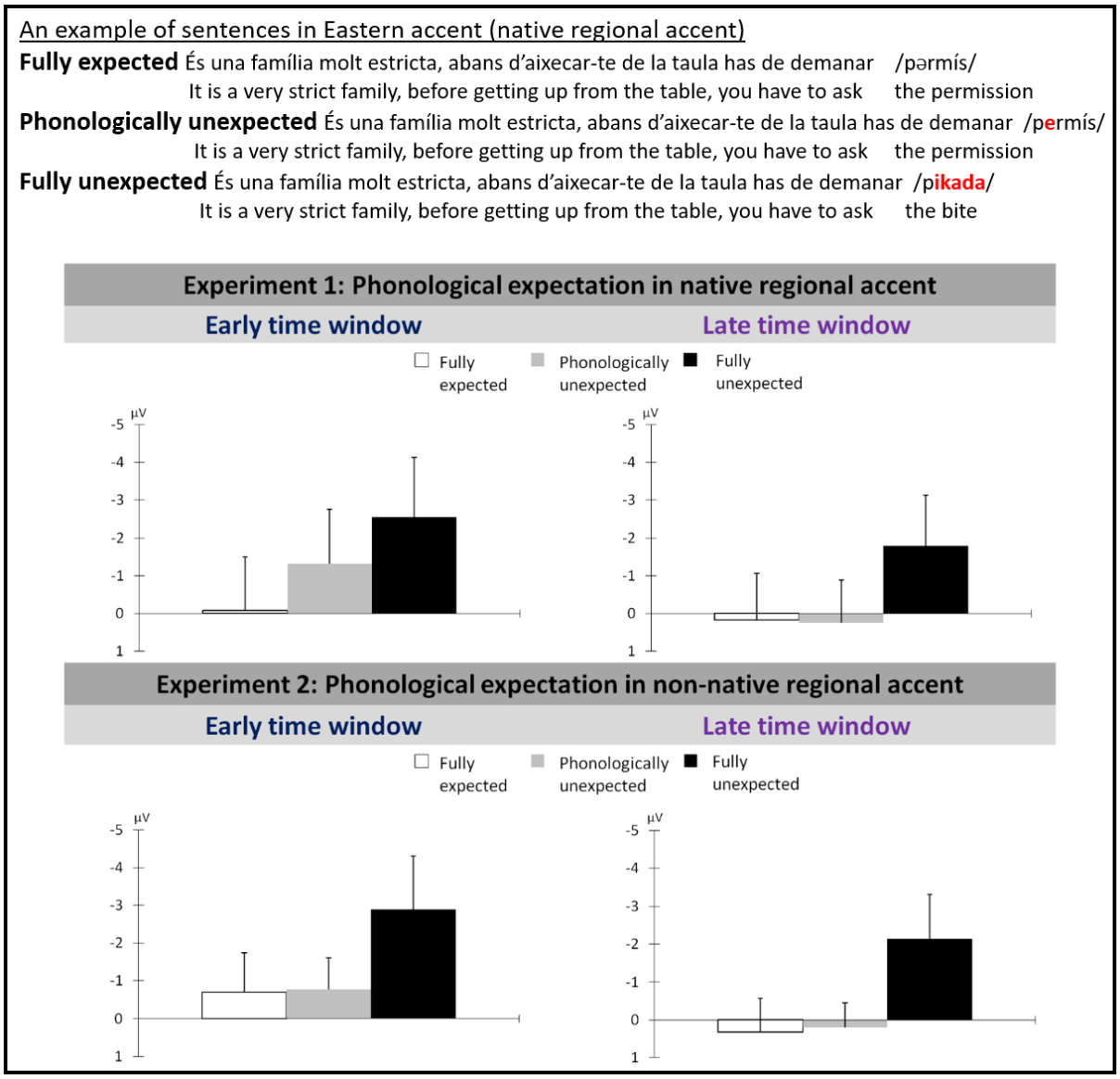

Figure 2. Adapted illustrations from the paper written by Brunellière, & Soto-Faraco (2013). Mean ERP amplitude over early and late time windows (respectively, 285-335 ms, 350-600 ms).

In fully expected condition, the final word was the most expected word provided the prior semantic context and the phonological form was expected from the regional accent of the sentence context. In phonologically unexpected condition, the final word was the most expected word but the

phonological form was unexpected with respect to the regional accent in the sentence context. In fully unexpected condition, the final word was a semantically incongruent word to the prior context (e.g., */pikada/* "bite" in the following sentence context *És una família molt estricta, abans d'aixecarte de la taula has de demanar* "It is a very strict family, before getting up from the table, you have to ask"). Exposure to a semantically incongruent word in the prior context was used to insure that listeners effectively treated the speech input and accurately interpreted the sentence meaning whatever the regional accent in the sentence context. This condition thus gave us the opportunity to explore to what extent the listeners' ability to process the sentence meaning did not depend on the regional accent presented in the sentence context (native versus non-native regional). The moment at which listeners could detect that the speech input differed in the semantic or/and phonological constraints of the sentence context was always placed at the second phoneme of the final word (see Figure 2). Listeners were simply asked to listen to the auditory sentences and focus on sentence meaning.

When the carrier context sentence was spoken in the listener's native accent (Eastern Catalan, Experiment 1 at the top of Figure 2) or in the alternative non-native regional accent (Experiment 2 at the bottom of Figure 2), a long-lasting negative shift (N400) started at 250 ms after the listening of the semantically incongruent word compared to the listening of the semantically and phonologically expected word, thus reflecting a phonological as well as a semantic mismatch to the prior context. Interestingly, as shown over the two time windows in Figure 2, this shift did not vary as a function of the accent regional of speakers provided by the carrier context sentence. This suggests that listeners understood the meaning of the carrier context sentence with the same degree of analysis and treated the speech input with the same effectiveness.

In line with the aim of this study, when the carrier context sentence was spoken in the listener's native accent (Eastern Catalan, Experiment), the ERPs revealed evidence for early detection of a phonological mismatch, that is, a negative shift around 250 ms, after the unexpected phonologically form with respect to the expected regional word form (see Figure 2). It must be noted that the early detection of phonological mismatch did not persist later. Crucially, the early ERP modulation observed in the listener's native accent did not appear when the carrier context sentence was spoken in the non-native regional accent of the listeners (Western Catalan). Since the sentence context and the final word were produced by only one speaker in each experiment but not by the same one between two experiments (a native Eastern Catalan speaker in Experiment 1 versus a speaker who was native Western Catalan in Experiment 2), we evaluated the native Eastern Catalan listeners' ability to categorize the critical phonemes in an isolated presentation of the target

words during a new behavioral experiment. These listeners had not taken part in Experiments 1 and 2. It appeared that their abilities to categorize the critical phonemes from the stimuli in Experiment 1 and 2 did not differ. Therefore, the differential ERP response to phonological mismatch according to the regional accent in sentence contexts could not be explained by an advantage in discriminating the critical phonemes in Experiment 1 with respect to those Experiment 2.

Taken together, our results suggest that the phonological context (i.e., native vs. nonnative regional accent) tuned the sensitivity to phonological mismatch when the sentential context was semantically constraining. However, the contrasting pattern of results between native and non-native context is somewhat unsupportive of a strong version of any of the two models, either exemplar-based or abstract representation (Goldinger, 1998; Johnson, 1997; Marslen-Wilson, 1984; Morton, 1979; Norris, McQueen, & Cutler, 2003). According to an exemplar-based representation, it is assumed that word representations are stored with a high level of detail concerning sound shape, such as the speaker's voice, and that words are encoded in memory as exemplar-based representations of fine-grained phonological cues present in the auditory input. In stark contrast to this framework, some authors have argued that words are represented as abstract phonological codes (e.g. Marslen-Wilson, 1984; Morton, 1979; Norris, McQueen, & Cutler, 2003). In this kind of abstract representations model, variability in the speech input (e.g., inter-speaker variability in voice, speech rate, dialect-dependent phonological and phonetic realizations) is treated as irrelevant variation and removed in the activation and selection of lexical candidates. According to this account, this is accomplished using a filter that can match the incoming signal to abstract representations in the lexicon, via a normalization process.

Therefore, an account that encompasses the present results as a whole must resort to a more flexible representational model. Along these lines, some recent models of spoken word representation, referred to as hybrid models (such as for example, the frequency-based model (Connine, Rambon, & Patterson, 2008) have been proposed. As previously mentioned, Connine et al. (2008) proposed that main phonological variants of a word are jointly stored in the mental lexicon. In line with the frequency-based model, the weak sensitivity to phonological mismatch occurring in a phonologically unfamiliar accent context could be explained by the low frequency of unfamiliar word forms but phonologically expected in the sentence context (i.e., fully expected condition) in contrast to the high frequency of familiar word forms but phonologically unexpected in the sentence context (i.e., phonologically unexpected condition). Hence, listeners could have expected both the likely but unfamiliar word forms and the phonologically unexpected but familiar

word forms to a similar extent. A plausible alternative hypothesis for the present results would be a flexible predictive mechanism that adapts the level of specification according to prior knowledge. In particular, when the context is phonologically familiar, the mechanism can draw upon detailed phonological knowledge to project highly specified phonological expectations. In contrast, when the context is phonologically unfamiliar, predictions cannot be fine-tuned to a detailed form because the priors for prediction are less precise. In this case the system would default to a less specified prediction mode. Therefore, we have proposed two main possible mechanisms that could account for this pattern of findings: on the one hand, hybrid representational models where variants of the lexical item are weighted by their frequency of occurrence; on the other hand, a flexible predictive coding model wherein word forms predictions are only as detailed as it is allowed by the degree of precision to which the context can be parsed.

To further characterize the role of sentence-level context from the semantic constraints on the phonological tuning related to the regional accent, I studied the interplay between the degree of semantic constraint (high or low cloze probability) and the phonological form of target word (congruent vs. incongruent) regarding the regional accent of context (Brunellière, & Soto-Faraco, 2015). Indeed, we did not know what the influence was of semantic constraints in our previous study (Brunellière, & Soto-Faraco, 2013), since the semantic constraints were always strong. In this new experiment, native Eastern Catalan speakers were only exposed to sentences produced in their native regional accent. The final word was embedded in strongly or weakly semantically constraining sentence frames and was phonologically expected or not from the regional accent of the context (see Figure 3).

Similar to Brunellière & Soto-Faraco, (2013), listeners were simply asked to listen to the auditory sentences and focus on the sentence meaning. The phonological form differed from the phonologically expected word only in its second phoneme in the incongruent phonological word form conditions, which always indicated that the word was produced in the non-native Western accent. In this new experiment, we again showed the negative shift following phonological mismatch around 250 ms (target pronunciation incongruent with respect to sentence regional accent) when the sentence context provided by the semantic information was highly constraining (see Figure 3). In contrast, when the sentence context was less constraining, the phonological mismatch brain response was stronger such that the response started sooner with an early expression around 100 ms and persisted later over the time (from 300 ms to 600 ms, see Figure 3). Therefore, brain responses to phonological mismatch in the form of a negative shift depended on

expectancy arising from semantic context. Moreover, phonological mismatch was resolved more rapidly when the word benefited from a strong semantically predictive context.

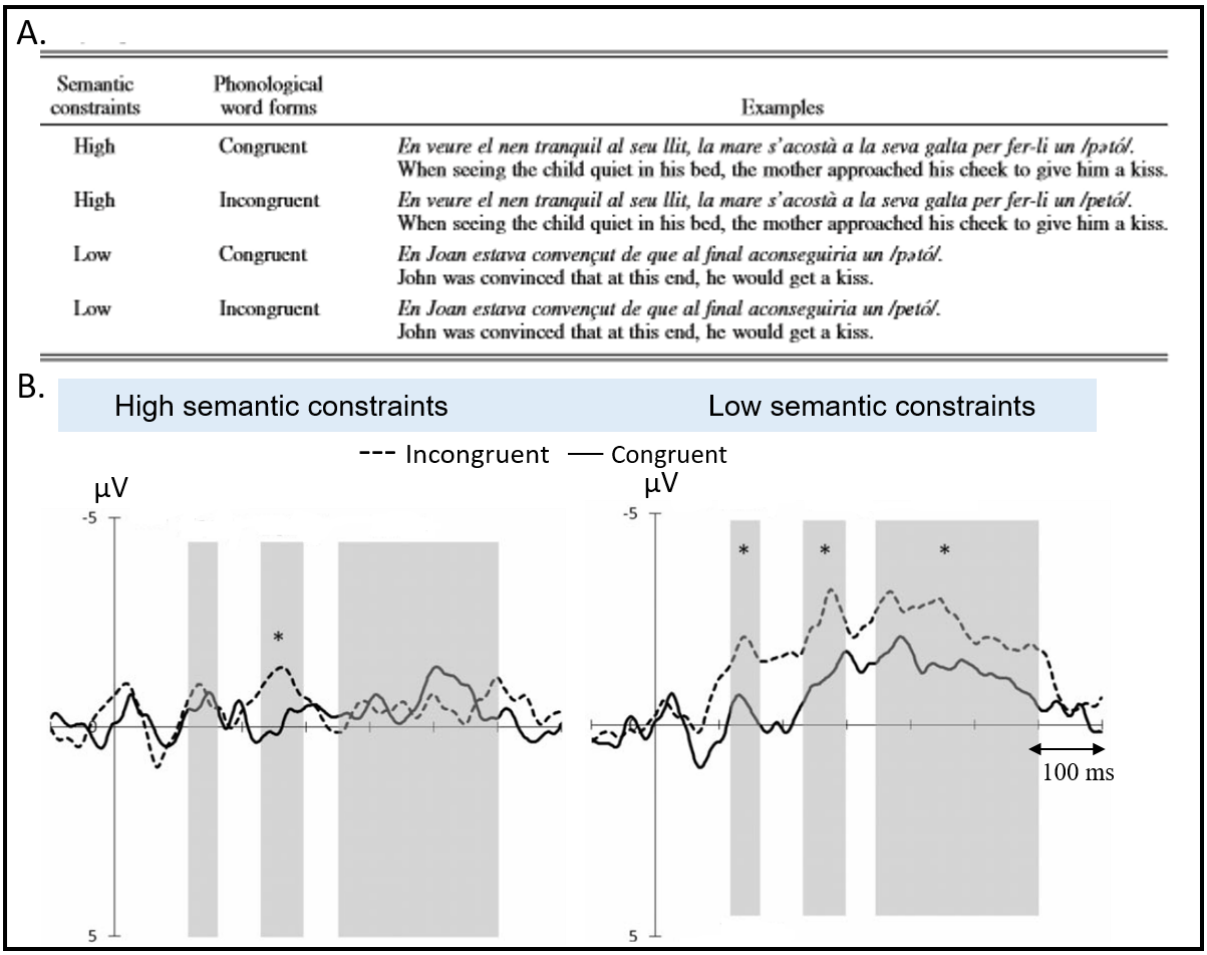

Figure 3. Adapted illustrations from Brunellière, & Soto-Faraco (2015). (A) Examples of sentence materials, (B) Grand-average waveform over Cz for final words embedded in strongly and weakly constraining sentence contexts according to the phonological form. * indicate if the ERP response significantly differed between incongruent and congruent phonological forms (p<.05).

Since we manipulated the semantic constraints in sentence context, we interpret the effects of high-level semantic constraints imposed by sentence context as reflecting mechanisms of lexical top-down predictions. Interestingly, there was an early impact of top-down predictions related to the semantic constraints within the classic time window of the N100 component. This component is known to reflect the bottom-up processes operating at the sublexical level and to be an index of perceptual processing of auditory input and phonological processing (Krumbholz, Patterson, Seither-Preisler, Lammertmann, & Lütkenhöner, 2003; Näätänen, 2001; Obleser, Scott, & Eulitz, 2006). Therefore, our findings suggest a fast influence of the semantic constraints and an interplay between them and bottom-up processes at the sub-lexical level. Crucial to our study, the critical

vowel that we used to create the phonological mismatch did not differ in duration, intensity or fundamental frequency (F0) between low and high semantic constraining contexts. In addition, the Euclidean distance in the F1-F2 plane between the matching and the mismatching vowel in each sentence at the acoustic midpoint of the vowel did not vary as a function of the level of semantic constraint. Consequently, the earlier detection of the phonological mismatch in low semantic constraining contexts cannot result from the differential acoustic realization of the critical vowels in low semantic constraining contexts compared to high semantic constraining contexts.

It thus appeared that when the semantic constraints are low, the system is more sensitive to the input, leading to an earlier detection of phonological mismatches as compared to contexts with high semantic constraints. In contrast, the lexical top-down predictions from the high semantic constraints affected the processing at sub-lexical levels, which prevented an early detection of phonological mismatches regarding the accent of speaker during the processing of the initial phoneme. This account is compatible with a fully interactive framework of spoken-word recognition models (e.g., TRACE model, McClelland, & Elman, 1986) assuming that the lexical activation induced by contextual information can exert an influence at early stages of word recognition, such as the perceptual analysis. The findings over the N100 are consistent with predictive mechanisms based on the pre-activation of a word form and even affecting the sub-lexical level by spreading. In line with the functionality of the N400, the ERP responses over the time window from 300 ms to 600 ms might reflect the subsequent processing stages when the lexical candidates are activated from the input. Over this window, the lexical top-down predictions based on the prior semantic context facilitated the processing of the incoming word after the detection of phonological mismatch.

For the first time, it was found that the two different linguistic constraints imposed by sentence context —phonological and high-level semantic constraints— interacted at sublexical and lexical levels of incoming words. Overall, it seemed that listeners adjust their probability model, taking into account speaker's characteristics and semantic constraints during spoken language comprehension (Brunellière & Soto-Faraco, 2013, 2015). This suggests that the predictive mechanisms in spoken language comprehension play a key role in the flexibility of accessing on listeners' representations and potentially in the updating of listeners' representations. Further studies are needed to a have better understanding of how words are represented in the mental lexicon by focusing on either phonetic or phonological variations in pronunciation embedded in sentence context and their interactions with other sentential information such as semantic constraints.

Highlights

The linguistic exposures within own regional accent and in the different regional varieties of native language (Dufour, Brunellière, & Nguyen, 2013; Brunellière, Dufour, & Nguyen, 2011; Brunellière, Dufour, Nguyen, & Frauenfelder, 2009) affect word units and phonemic representations.

The speaker's accent shapes the listeners' phonological predictions. Whereas phonologically precise predictions operate over native input, phonologically less specified predictions act in a non-native regional accent (Brunellière, & Soto-Faraco, 2013).

The two different linguistic constraints— speaker's accent and high-level semantic constraints—imposed by sentence context interacted together in word recognition at sublexical and lexical levels (Brunellière, & Soto-Faraco, 2015). This view is consistent with interactive models of spoken-word recognition and a predictive view of spoken language comprehension.

Part II: Studies on the interplay between the semantic constraints driven by the sentence context and the intention of speakers on spoken-word recognition

During conversations, listeners take care to decode the message, understand why the message is uttered and who is saying the message. The studies described in the previous part highlighted the notion that listeners can finely use the phonological information related to the speaker, such as the regional accent. More than regional accent, the identity of speakers traditionally refers to the indexical information of the speech signal, including regional and economic background, emotional state, age and gender. In the following part, I will present studies in which I examined two other types of information related to the identity of speakers: the speaker's gender and speaker's intention. After a quick report on the study focusing on the speaker's gender, I will describe more specially the research line addressing the interplay between the semantic constraints driven by the sentence context and the intention of speakers on spoken-word recognition. All studies that I will present in this part have been conducted at the University of Lille.

If listeners can exploit the speaker's accent, another kind of information related to the speaker, namely, the speaker's gender, also could affect the way words are processed. We have attempted to explore this hypothesis with Alba Casado, a PhD student from the University of Granada. To address this hypothesis, female listeners were only exposed to two semantic gendered words in French (*chanteuse* "female speaker" or *chanteur* "male speaker"). Crucial to the aim of this study (Casado, & Brunellière, 2016), the gender of the speakers was kept stable in each block and either five males or five females produced the two semantic gendered words (*chanteuse* "female speaker" or *chanteur* "male speaker"). In that manner, we expected that the gender of speakers might play a role of a priming context. In this experiment, we used a design similar to our study by Brunellière, Dufour, & Nguyen (2011) and we looked at the amplitude of MMN component. For instance, in one block, while the masculine word was frequently repeated, the feminine word was rarely repeated (and inversely). In all the designs, there were four different blocks: rarely repeated feminine word in the context of female voices, rarely repeated feminine word in the context of male voices, rarely repeated masculine word in the context of female voices, rarely repeated masculine word in the context of male voices. Participants had to focus attention on a silent movie while ignoring any auditory stimulus. We found that the indexical information about the gender of the speakers influenced the processing of semantically gendered spoken words. First, the amplitude of MMN response was more pronounced when the gender of the speaker matched with that of the word around 100 ms from the second syllable of the critical word. Thereafter, after 250 ms

from the second syllable, an enhancement of MMN response was elicited by the incongruence between the gender information related to the speakers and that of the word. The increased MMN response when the gender of the speaker matched with the gender of the word suggests that the word is more activated in that case. It thus seems that the listeners use the speaker's gender to preactivate the corresponding gendered word. Then, at higher-level processing, access to the grammatical gender feature triggered the incongruence reaction. These findings are in line with previous behavioral studies showing that the speakers' gender influenced word recognition and grammatical processing (e.g., Vitevitch, Sereno, Jongman, & Golstein, 2013). However, contrary to our study, Vitevitch, Sereno, Jongman, & Golstein (2013) had employed explicit tasks, which forced the processing on the voice or on the gender information. Taken together, such findings argue in favor of exemplar models of the mental lexicon (Goldinger, 1998) or at least for a storage of fine-grained information contained in the indexical portion of speech. These findings also provide theoretical contributions in how the gendered conceptual referents are represented. The Grounded theory (Barsalou, 1999) posits that concepts are flexible context-dependent representations by which the referred perceptions and the actions occurring in the same situational contexts are encoded together. Following this view, gendered conceptual referents may incorporate the perception of indexical information related to the speaker as well as the use of corresponding linguistic information. In everyday life, when a female speaks about her own experiences, she uses feminine words. Hence, the Grounded theory easily explains that the listeners might use the gender of the speaker to preactivate the corresponding gendered word. Moreover, this study raises questions about how words and gendered conceptual referents are stored and represented in the mental lexicon. For instance, it will be interesting to examine whether the processing of purely arbitrary gendered words (e.g., *table* "table" is a feminine word in French) might also be shaped by the gender of speakers because of mental organization of semantic gender. Additionally, one can ask how the gendered conceptual referents are accessed in generic gender and interact with the gender of speakers. In French, the masculine forms in semantic gender may refer to the female and male biological identities and such forms thus represent a generic gender.

It is important to bear in mind that the main purpose of spoken language is to insure communication between individuals in dialogic settings. In the view of several authors (Bühler, 1934; Grice, 1975), language is an intentional action by which the message can be understood. According to pragmatic accounts of language comprehension (Grice, 1975), meaning inferred from word meanings and grammatical structure is in fact an incomplete representation of the meaning of an utterance. Similarly, speech act theories (Austin, 1962 and Searle, 1969) considered two levels of information for access to the meaning of an utterance: the content carrying the lexical meaning

of what is said, and the illocutionary function representing the action and speaker's intention. In line with this theoretical distinction, neuroimaging and neuropsychological studies have demonstrated a specialized neural substrate for the pragmatic comprehension of a speaker's intended meaning, including the medial prefrontal cortex (MPFC), the precuneus, the bilateral posterior superior temporal sulcus (pSTS) and adjacent temporoparietal junctions (for a review, Bara, Enrici, & Adenzato, 2016). Interestingly, whereas patients with lexico-semantic impairments performed well on pragmatic tasks and were able to communicate their intention, patients with brain damage to the medial prefrontal cortex but with no other linguistic impairments showed deficits in inferring a speaker's intentions. Recent studies have investigated the effectiveness of prosodic cues in conveying intentions (Hellbernd, & Sammler, 2016) and their neuronal correlates (Bašnáková, Weber, Petersson, Van Berkum, & Hagoort, 2014; Hellbernd, & Sammler, 2016). Hellbernd, & Sammler (2016) in particular concluded that "prosody is a signal that is able to convey a broad communicative concept on its own but becomes cognitively interlinked and specified with complementary contextual information, if available". Similarly to Bara, Enrici, & Adenzato, (2016), the functional magnetic resonance study (Bašnáková, Weber, Petersson, Van Berkum, & Hagoort, 2014) showed that the neuronal correlates of inferring a speaker's meaning differ from those usually involved in sensory-motor simulations generated by the language production system. Moreover, Hellbernd, & Sammler (2016) highlighted that intentional vocal prosodic signaling in speech illustrates the interface between auditory and social cognition along a large network, including the ventral auditory stream for the abstract encoding of acoustic profiles, mentalizing areas to infer the speaker's mental state and areas associated with controlled decision-making processes.

Although the speaker's expressivity to address a message informs that speaker's intended meaning, few studies examining the interplay between the semantic constraints and the speaker's expressivity have been conducted in spoken language comprehension. Accordingly, when speakers wish to share a message and convince listeners in ecological settings, they use emphasis on words so that listeners can exploit these expressive cues to build their representation of the utterance. For example, an increased fundamental frequency, intensity and duration were found in French stressed words during emphasis discourse (Jun, & Fougeron, 2002; Lacheret-Dujour, & Beaugendre, 1999; Pasdeloup, 1990; Touati, 1987). Studying the influence of natural prosodic emphasis provides a better understanding of the illocutionary function conveyed by prosody in spoken language comprehension. In this context, I have begun a collaboration with researchers in prosody working at the University of Lille (Laurence Delrue and Cyril Auran, Laboratoire Savoirs, Texte, Langage, UMR8163 CNRS & Université de Lille). We first examined whether emphasizing a sentential context induces consequences of semantic processing in discourse that affect the processing of the

following words (Brunellière, Auran, & Delrue, 2019). To disentangle the perceptual processing of accented speech and the consequences of semantic processing, we used parenthetical structure and grammatical cataphora in French spoken sentences. Grammatical cataphora is the use of a pronoun to refer ahead to another word in a sentence (called, a postcedent). For example, in the sentence « Créer des bonbons : ils ont un beau métier, les confiseurs (Creating sweets: they have a great job, confectioners), the pronoun "ils" appears earlier than "les confiseurs" to which it refers. This grammatical cataphora places the postcedent "les confiseurs" in the position of a parenthetical element (see, Figure 4A). The postcedent is thus isolated from the prosodic structure of the preceding clause, rendering it insensitive to acoustic variations in the expressivity of speakers due to a sentential context (e.g. "Créer des bonbons : ils ont un beau métier").

A.

Conditions	Prosodic emphasis- Sentential context	Semantic congruency- Final word	Examples
NP-Congruous	Neutral prosody (without emphasis)	Congruous	Créer des bonbons : ils ont un beau métier, les **confiseurs**. *Creating sweets, they have a great job, confectioners.*
NP-Incongruous	Neutral prosody (without emphasis)	Incongruous	Créer des bonbons : ils ont un beau métier, les **pisteurs**. *Creating sweets, they have a great job, the members of sky patrol.*
EP-Congruous	Expressive prosody (with emphasis)	Congruous	Créer des bonbons : ils ont un beau métier, les **confiseurs**. *Creating sweets, they have a great job, confectioners.*
EP-Incongruous	Expressive prosody (with emphasis)	Incongruous	Créer des bonbons : ils ont un beau métier, les **pisteurs**. *Creating sweets, they have a great job, the members of sky patrol.*

Note: NP: Neutral prosody, EP: Expressive prosody.

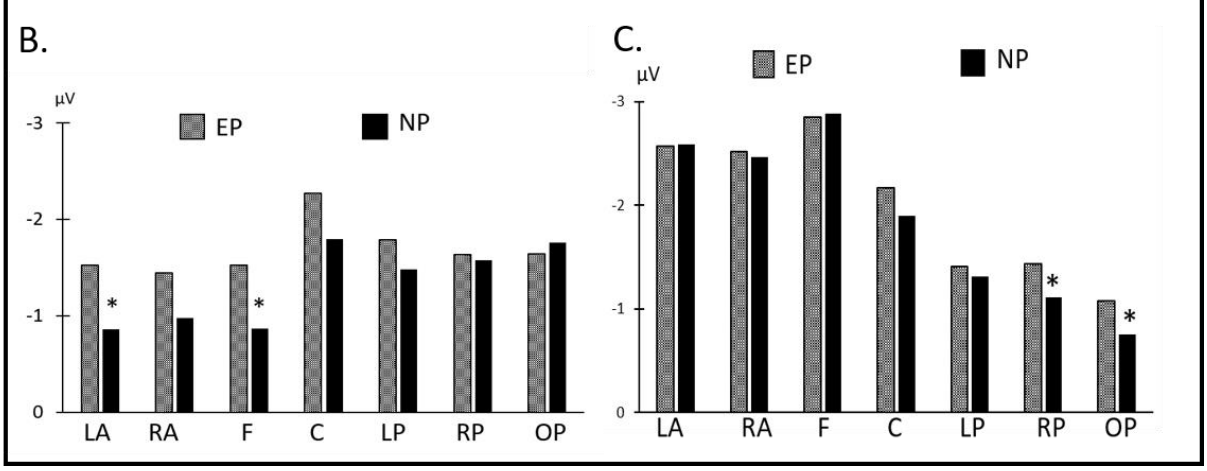

Figure 4. Adapted illustrations from the paper written by Brunellière, Auran, & Delrue (2019). (A) Examples of sentence materials, (B) Mean ERP difference between incongruous and congruous words in early N400 time window across all topographical sites, (C) Mean ERP response for words embedded in the sentential context produced with emphasis or not in a later N400 time window across all topographical sites (LA: Left Anterior, RA: Right Anterior, F: Frontocentral, C: Centroparietal, LP: Left parietal, RP: Right parietal, OP: Occipitoparietal). NP: Neutral prosody, EP: Expressive prosody. *p<.05.

The acoustic cues of the postcedent based on fundamental frequency, intensity and duration did not differ in the expressivity occurring earlier in the sentence (i.e. with emphasis compared to without emphasis). To explore the impact of prosodic emphasis of sentential context on semantics in right dislocated structures in French, we manipulated two factors: the prosodic emphasis of sentential context (without/with emphasis) and the semantic congruency of the final word (congruous/incongruous) (see, Figure 4A). The final word was semantically incongruous or expected from the semantic constraints given by the sentential context. The native French speakers were thus exposed to semantically constraining sentences before the final word. The experimental design did not include any incongruous prosodic patterns and participants were instructed to listen to the spoken sentences to understand their meaning. Acoustic measurements (duration, F0, intensity) confirmed that the sentential contexts were spoken with intended emphasis. Ten native French speakers different from those taking part in the main experiment judged the sentences in the condition with emphasis as being more expressive than those without emphasis. To maintain attention when listening to spoken sentences, participants were informed that they should perform a lexical recognition task after hearing all spoken sentences. During this task, each word was visually presented in the center of the screen in order to probe the memory trace of words while avoiding the familiarity effects associated with acoustic or phonetic properties. This task was conducted immediately after the phase of sentence listening (that is, forty minutes after the listening of the first sentence).

A long-lasting negative shift (N400) started as early as 250 ms after the listening of the semantically incongruous word, as compared to that of the semantically congruous word. The prosodic emphasis of sentential context impacted this negative shift in two different ways. The amplitude of the early negative shift (260-360 ms) was stronger when the sentential context was produced with emphasis than when it was produced without emphasis. As seen in Figure 4B, this effect was observed over the left anterior and frontocentral sites. The increased semantic congruency effect elicited by prosodic emphasis was due to a larger N400 amplitude for incongruous words after emphasized speech. Prosodic emphasis thus increases the sensitivity to detect the semantic anomaly but does not lead to better processing of semantically congruous words. Moreover, prosodic emphasis induced a larger amplitude of the N400 in a later time window (400-500 ms) over the right parietal and occipito-parietal sites, irrespective of the semantic congruency of final words. The prosodic emphasis expressed by the sentential context therefore seemed to encourage listeners to focus attention on the incoming word over the later stages of processing that word. The traditional stages proposed during the processing of spoken words (Frauenfelder, & Tyler, 1987; Marslen-Wilson, & Welsh, 1978) could explain the two different

impacts caused by the prosodic emphasis. From the speech input, lexical candidates are first activated, then a unique lexical candidate is selected. As long as the activated word remains a potential candidate, emphasized speech by triggering a deeper semantic analysis of discourse increases the sensitivity to detect the semantic anomaly. Then, the constraints arising from the sentence representation operate less, when the word is recognized. Regarding the capacities in memory retention, old words occurring in previous sentences during a listening task were more easily recognized when they fitted semantically with the sentence context than those that did not, similar to the study by Neville, Kutas, Chesney, and Schmidt (1986). Although we replicate the findings of Neville et al. (1986), we did not find any impact of prosodic emphasis on memory retention. Therefore, the consequences of semantic processing driven by emphasized sentential context at early stage of word processing do not lead to better memory retention.

The question remains, however, as to which mechanisms can account for the on-line consequences of semantic processing driven by emphasized sentential context. For example, there are a number of proposals for prediction in spoken language comprehension (e.g., Huettig, 2015; Kuperberg & Jaeger, 2016). Despite experimental progress in the area of language predictive mechanisms, evidence pointing to the neural mechanisms underlying top-down predictions which take into account the communicative context is currently lacking. Therefore, we investigated whether listeners integrate the speaker's orally conveyed intention to communicate a message in top-down predictions about upcoming words in the processing of natural spoken sentences (Brunellière, & Delrue, 2017). In other words, we focused on the role played by top-down predictions in the processing of a speaker's meaning by examining the extent to which listeners actively use the speaker's prosodic emphasis to predict lexical items through top-down mechanisms.

To do so, we recorded participants' electrical brain activity as they listened to semantically constraining French sentences that predicted the occurrence of a word. Crucial to the aim of this study, we muted the expected noun and analyzed ERP time-clocked to the article preceding the muted but expected noun as similar to the study by Foucart, Ruiz-Tada & Costa (2015). In our study, the article was (or was not) in agreement with the gender expected (muted) word, and the word expected from the sentential context and never presented was replaced by a brown noise situated at the mean intensity of articles for each sentence fragment. By doing so, we were able to track on-line word predictions and to avoid overlapping effects of the integration of the predicted word in the sentence representation. The speaker's intention to communicate a message was

manipulated by asking a native French speaker to pronounce sentences either with enough emphasis to convince a potential interlocutor or with no emphasis (see Figure 5).

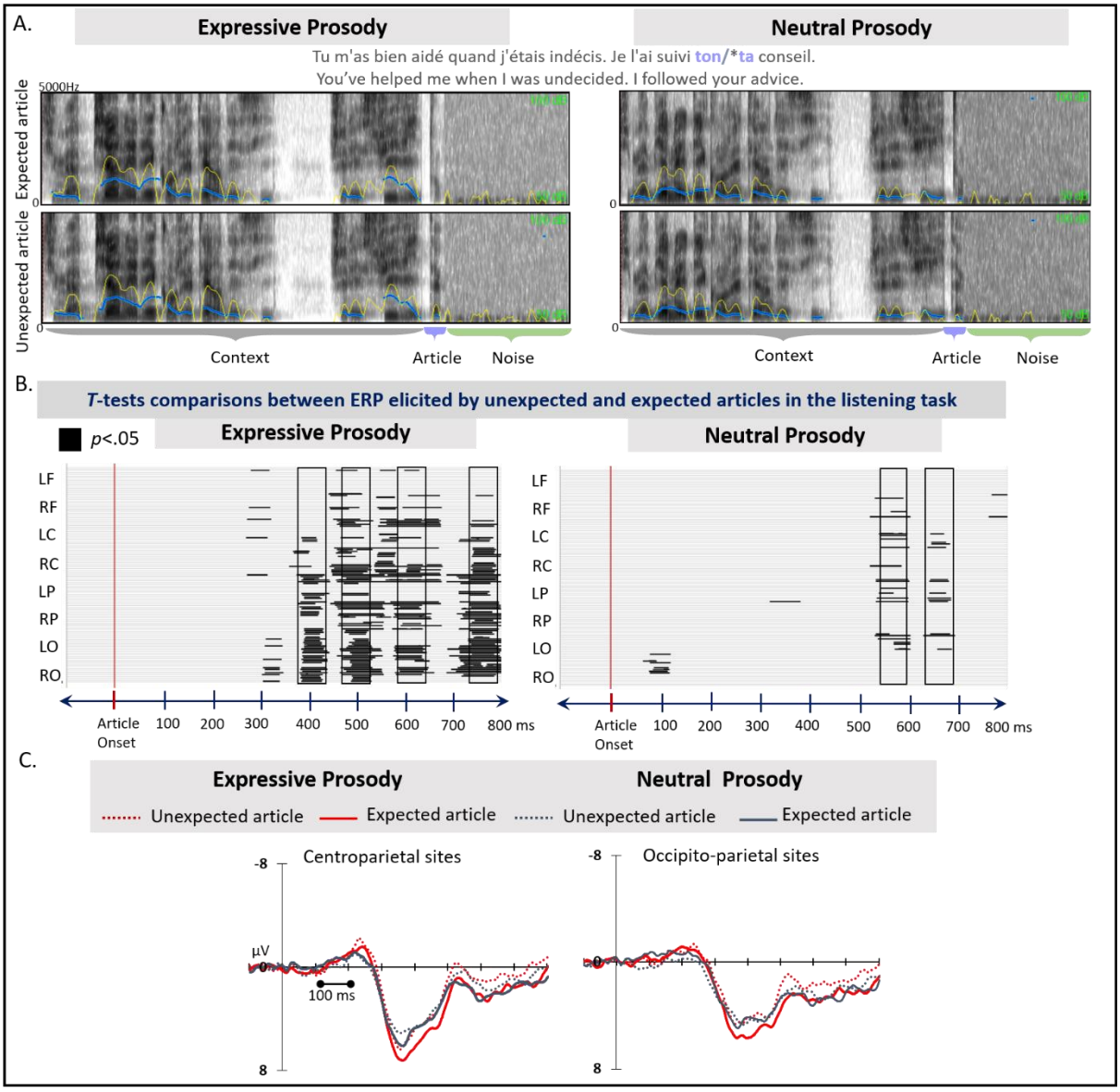

Figure 5. Adapted illustrations from the poster presented by Brunellière, & Delrue (2017). (A) Examples of sentence materials, (B) The scatter plots of paired *t*-tests associated probabilities for ERP comparisons between unexpected and expected articles are shown as a function of the time frame and electrode from -100 to 800 ms after the onset of articles. LF: Left Frontal, RF: Right Frontal, LC: Left Central, RC: Right Central, LP: Left Parietal, RP: Right Parietal, LO: Left Occipital; RO: Right Occipital., (C) Examples of ERP waveforms elicited by unexpected and expected articles at each degree of expressivity over centroparietal and occipito-parietal sites.

As with our previous study (Brunellière, Auran, & Delrue, 2019), participants were instructed to listen to the sentences attentively for comprehension and then performed a lexical recognition task immediately after listening to the sentences. Participants were told that the distortions were just technical interference, as routinely occur on the phone. Duration, intensity

and F0 differed on the critical articles as a function of expressivity but there was no significant difference between the expected and unexpected articles. In line with the functional organization of predictive coding (Friston and Kiebel, 2009), we hypothesized different impacts of a speaker's expressivity. It could increase the sensitivity of processing of the incoming article due to the strength of the prediction of the muted but expected noun on ERP; or later increase the updating of on-line predictions over time after the recognition of articles on ERP; or it could affect the memory trace of the muted but expected noun in lexical recognition task.

We found that the speaker's intention to communicate a message with prosodic emphasis did not increase the processing sensitivity to the incoming article (see Figure 5). The negativity triggered by the processing of the incoming article did not differ as a function of gender agreement between articles and the expected word and of speaker's intention. Instead, the prediction effects reflected by the differential ERP response to unexpected and expected articles occurred earlier and persisted later when words expected from sentence contexts were conveyed with an expressive prosody by the speaker (see Figure 5). Interestingly, these ERP prediction effects occurred from a positive wave whose latency and topography were typical to the P300 component and whose amplitude was stronger when the article was expected than when it was unexpected. Like Foucart, Ruiz-Tada, & Costa (2015), we replicated the ERP prediction effects on positivity, which was associated with the omission of the expected noun.

In line with the functional role of the P300, we interpret that the speaker's expressivity influenced the updating of on-line predictions after the omission of the expected noun. Whereas the earlier ERP prediction effects with emphasis were due to a larger positivity after expected articles with respect to without emphasis, the late impact of the speaker's expressivity on ERP prediction effects was caused by the unexpected article. Therefore, the speaker's intention to communicate a message influenced the updating of the listeners' predictions of the expected noun after they had recognized unexpected/expected articles. In contrast, the long-term memory traces were not influenced by the speaker's expressivity in the lexical recognition task. Long-term memory traces, however, were affected by gender agreement between articles and the expected word, so participants recalled expected words better when articles previously presented agreed with the gender of the expected words. As in Brunellière, Auran, & Delrue (2019), the on-line consequences of semantic processing driven by emphasized sentential context do not lead to better memory retention.

This study shows that the speaker's expressivity conveyed by prosodic emphasis had an impact on the updating of linguistic predictions and rapidly activated neural loops, whose activity

differently affects expected/unexpected information over time. It is important to note that second person articles (/ta/ or /tɔ̃/, 'your' in English) were used in the design to force listeners to be personally involved in the analysis of sentences. Moreover, to avoid the development of focused attention on the critical articles, semantically and grammatically congruent filler sentences were also presented in which one of the two critical articles was introduced either at the beginning or in the middle of a sentence. In the present study, participants were simply asked to listen to auditory sentences for comprehension. Nonetheless, if neuronal top-down predictions are adaptive and dependent upon pragmatic and social contexts, a pragmatic task (e.g. judging whether the speaker addresses a reproach) could cause an earliness of prediction effects associated with the speaker's intention so that they might occur as soon as the eliciting of negativity wave reflecting the processing of incoming articles.

Thanks to the present study, we can conclude that neuronal top-down predictions in spoken sentence processing integrate the speaker's intention by increasing the updating of lexical predictions to minimize prediction errors about the speech input. Prediction errors refer to the differences between inputs and predictions. Hence, neuronal top-down predictions seem to play a role as brain processes that contribute to building a complete representation of the meaning of an utterance. Moreover, word predictability and speaker expressivity should be manipulated in order to better understand linguistic predictions in spoken language comprehension and their interaction with a speaker's expressivity. Further neuroimaging and intracranial studies in spoken language comprehension and communication should also investigate the connectivity of neuronal top-down predictions and neural processing associated with a speaker's meaning. At present, a relatively small number of studies have provided clear evidence for word prediction in spoken language comprehension (Brunellière, & Delrue, 2017; Foucart, Ruiz-Tada & Costa, 2015; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005; Wicha, Bates, Moreno, & Kutas, 2003). All in all, this line of research provides new insights into the debate about the role of top-down predictions in spoken sentence processing by showing the integration of the speaker's intention.

Highlights

The indexical information of the speech signal such as the speaker's gender and intention affects the on-line processing of following words (Casado, & Brunellière, 2016; Brunellière, Auran, & Delrue, 2019).

Emphasizing a sentential context induces consequences of semantic processing in discourse that affect the processing of the following words (Brunellière, Auran, & Delrue, 2019).

Neuronal top-down predictions based on semantic constraints in spoken sentence processing integrate the speaker's intention by increasing the updating of lexical predictions to minimize prediction errors about the speech input. Hence, neuronal top-down predictions play a role as brain processes that contribute to building a complete representation of the meaning of an utterance (Brunellière, & Delrue, 2017).

Part III: Studies on the interplay between the semantic constraints driven by the sentence context and the visible articulatory gestures of speakers on spoken-word recognition

The three main lines of research that I present in this document are about the impact of phonological information related to the speaker on spoken-word recognition and particularly their interactions with semantic constraints provided by a sentential context. I previously presented studies examining three different sources of phonological information related to the speaker (regional accent, gender and intention). Another source of phonological information related to the speaker comes from the visible articulatory gestures. In natural face-to-face communication, visual information from the speaker such as lip movements and hand gestures effectively contributes to speech processing (McNeill, 1992; Biau and Soto-Faraco, 2013; Sumby and Pollack, 1954; McGurk and Macdonald, 1976). Indeed, it has been well established that visual articulatory information is combined with auditory information during speech perception. For example, in the McGurk effect (McGurk and Macdonald, 1976), the perceptual fusion between incongruent auditory (i.e. /ba/) and visual (i.e. [ga]) information often produces the illusory perception of a new, intermediate sound (i.e. /da/). In normal, everyday conditions, where auditory signals are strongly correlated with visual articulations, speech perception benefits from integrating cues across sensory modalities, especially when the processing of auditory information is difficult (such as in noisy contexts, Ma, Zhou, Ross, Foxe, & Parra, 2009; Ross, Saint-Amour, Leavitt, Javitt, & Foxe, 2007; Sumby and Pollack, 1954, or while perceiving non-native languages, Navarra and Soto-Faraco, 2007).

In particular, speakers' orofacial movements provide some reliable markers of phonological information, leading up to the notion of visual phonemes or visemes (Fisher, 1968). In other terms, visible speech gestures can be produced in a visual distinctive opposition from other phonemes (for example, /p/ and /b/ versus /f/ and /v/). Since speakers' orofacial movements provide some reliable markers of phonological information, numerous questions come up about their contribution on spoken word recognition in the processing of natural sentences and their interaction with semantic constraints. In this context, I investigated three main questions: (1) whether the salience of visual cues affects the processing of words in sentence context; (2) whether the audiovisual speech can affect the word memory traces after word repetition in sentence context;

and (3) whether audiovisual speech contributes to lexical-semantic processing in natural spoken sentences.

The speakers' orofacial movements particularly indicate lip movements (Benoit, Guiard-Marigny, Le Goff, & Adjoudani, 1996) and somewhat movements of the teeth and tongue (Badin, Tarabalka, Elisei, & Bailly, 2010; McGrath, 1985). However, they do not provide the same degree of information. For instance, the phoneme /p/ is highly visually salient with the lips' closure and release, whereas the phoneme /k/ provides visually more ambiguous, less salient information. By measuring event-related potentials during the processing of spoken syllables (/pa/, /ta/, /ka/), van Wassenhove, Grant, & Poeppel (2005) reported a reduction in amplitude and a latency shortening of the N1/P2 complex when the auditory syllable was accompanied by the sight of the corresponding visual articulatory information. Interestingly, the size of latency shift depended on the degree of visual salience related to the phoneme. Compared to audio-alone presentation, the audiovisual syllable /pa/ (for which the initial phoneme is highly visually salient) elicited a larger latency shift of the N1/P2 response than the audiovisual syllable /ka/ (for which the initial phoneme provides visually less salient information).

Using a novel approach, we examined the constraints that the salience of visual speech might exert during the recognition of words embedded in a sentence context and those provided by the prior semantic context (Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013). This study was conducted in collaboration with Pr. Salvador Soto-Faraco and his students. In a first experiment, strong and weak semantically constraining Spanish sentences were presented audiovisually and were ended by either a target word beginning with a salient visual articulatory cue, corresponding to the phoneme /p/, or a target word beginning with an ambiguous visual articulatory cue, corresponding to the phoneme /k/. This design made it possible to probe interactions between sentence-level and visually-driven constrains (see Figure 6A). The visual articulatory constraints elicited an increase in amplitude for the high visual salience relative to the low one over all ERP components found (i.e. N100, N200, N400, late N400). The sentence-level and visually-driven constraints interacted at the late period of the N400 component. It appeared that the effect of sentence-level constraints reflected by a long-lasting N400 after weakly predictable words compared to strongly predictable words was stronger and more spatially distributed across the scalp when the visual salience was high (see Figure 6B).

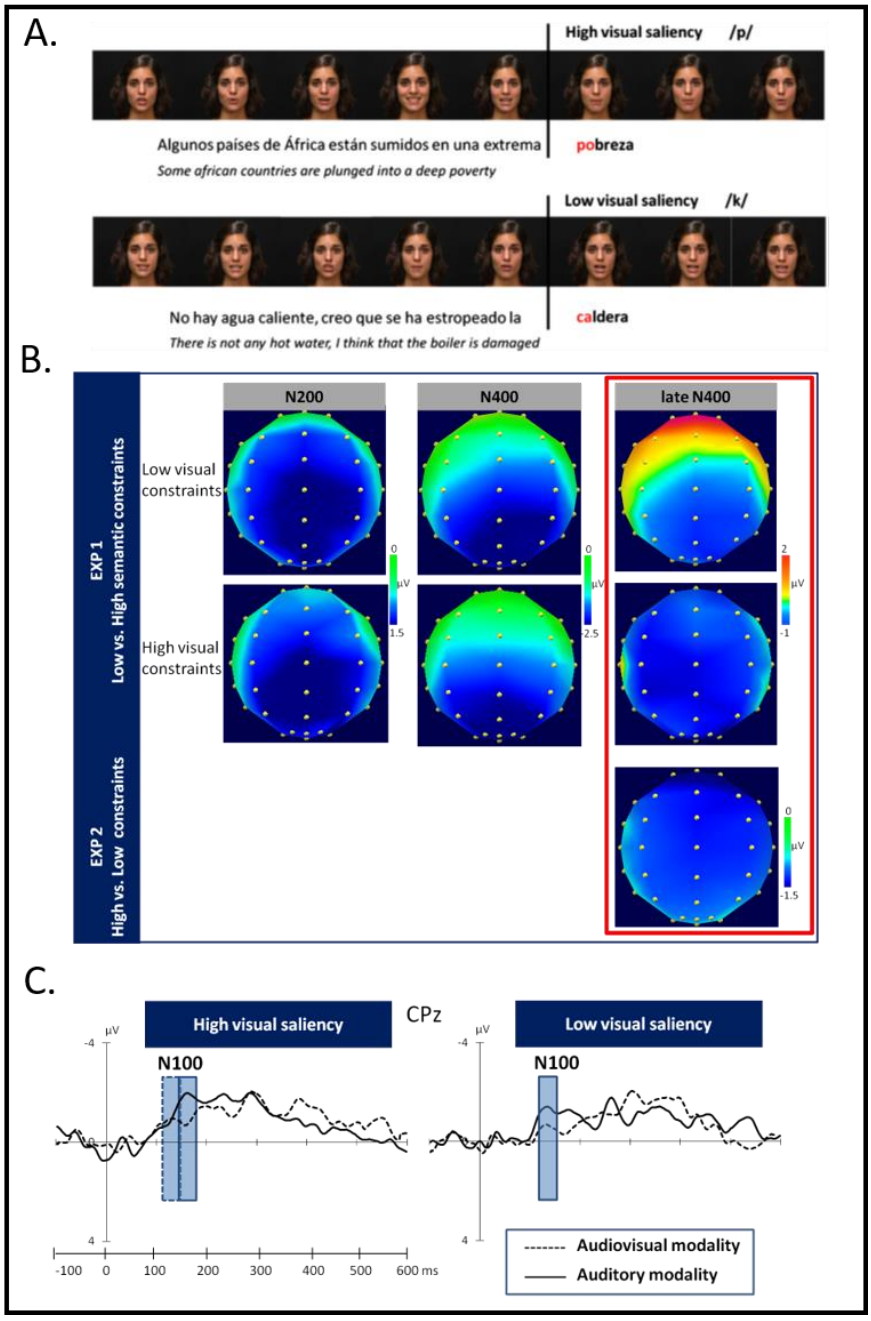

Figure 6. Adapted illustrations from the paper written by Brunellière, Sánchez-García, Ikumi, & Soto-Faraco (2013). (A) Examples of sentence materials, (B) Subtraction maps illustrating the ERP difference between low and high semantic constraints at each level of visual articulatory constraints in Experiment 1 and the visual ERP benefit between high and low visual saliency over late stages in Experiment 2, (C) Grand-average waveforms over CPz for target words in audiovisual and auditory-only modalities within each level of visual articulatory constraints (high and low visual saliency) in Experiment 2.

In order to ascertain the nature of audiovisual contribution, the sentences were then presented audiovisually or in an auditory-alone modality in a second experiment. In the same way as in the previous study, the initial phoneme of final word differed from their degree of visual

articulatory constraints (/p/ versus /k/). In these two experiments, the task of participants was to attentively listen to the sentences and look at the speaker's face on the screen. As in the study by van Wassenhove, Grant, & Poeppel (2005), we found the typical amplitude-reduction effect over the auditory-evoked N100 response in the audiovisual modality with respect to an auditory-only modality (see Figure 6C). Additionally, there was a temporal facilitation of the auditory-evoked N100 response triggered by audiovisual presentation in sentence context when the visual salience is high (see Figure 6C).

Thereafter, the audiovisual modality modulated late processing stages over the late N400 part, producing an amplitude-increase effect for the high visual salient targets. We interpreted this finding as reflecting the contribution of visual speech to lexical selection. The increase of late N400 amplitude for the highly salient visual cue (/p/) with respect to the less salient visual cue (/k/) would reflect the stronger difficulty for rejection of inadequate lexical candidates (Figure 6B). The highly salient visual cue (/p/) might tend to keep activated lexical candidates sharing the same visual onset for a longer time, producing more lexical competition and then a cost for the lexical selection. Therefore, our findings highlight a role of visually salient cues at the moment of word retrieval from the lexicon in natural speech comprehension. Moreover, we replicated the well-known early effects of visual articulatory information in sentence contexts although they had been investigated only during the processing of isolated phonemes or syllables until now. To sum up, the salience of visual articulatory information, like semantic constraints, can exert an early and late influence on word recognition with an interaction between them only over late stages.

The precocity of visual articulatory information in advance of speech sounds and the complementary of audio-visual signals are two sources of explanations for the contribution of audiovisual speech. Visible articulatory movements have been described to precede by tenths or even hundredths of milliseconds the occurrence of corresponding speech sounds in preparatory sequences or the start of a speech utterance (Chandrasekaran, Trubanova, Stillittano, Caplier, & Ghazanfar, 2009). However, Schwartz and Savariaux (2014) showed that the temporal relationship between auditory cues and visible articulatory movements is more complex and highly variable depending on the different phonemes and on their position within an utterance, including a range of audiovisual asynchronies varying from small auditory lead (50 ms) to large visual lead (200 ms). Since visual motion onset preceded auditory burst in plosives, with at least a 50 ms lead in our study, both the precocity of visual articulatory information and the complementary of audio-visual signals can explain the benefits of audiovisual speech that we found in this study.

As in our present study (Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013), there is a growing body of evidence suggesting that visible articulatory gestures of speakers contribute to word recognition and lexical access, but they have been found in isolated word recognition (Buchwald, Winters, & Pisoni, 2009; Fort, Kandel, Chipot, Savariaux, Granjon, & Spinelli, 2013; Mattys, Bernstein, & Auer, 2002; Tye-Murray, Sommers, & Spehar, 2007). In line with these findings, it would be interesting to provide insights into whether or not audiovisual speech plays a role in lexical processing by which the weight of word memory traces might be affected. To this aim, we examined two-word repetition conditions (Basirat, Brunellière, & Hartsuiker, 2018): (1) word repetition in isolation, and (2) word repetition in sentence contexts. In the condition of word repetition in isolation, each block began with the presentation of an isolated word eight times. In the word repetition in sentence contexts, there were four sentences containing a familiarized word and four other sentences containing a novel word. This experiment was conducted in Lille in collaboration with Dr. Anahita Basirat and Pr. Robert Hartsuiker. During this experiment, participants were asked to listen to the French sentences through headphones and to watch the computer screen. The word repetition in isolation triggered a positive shift after the second presentation of a critical word as compared to the first presentation of that word over a time window between 170 and 280 milliseconds. This word repetition effect in isolation was observed only with the auditory-alone modality. The first presentation of an audiovisual word in isolation elicited a less positive wave than that of a word presented in the auditory-alone modality. Over the time window of the N400, the word repetition effect in isolation was then obtained regardless of the modality of presentation. Moreover, a word repetition effect in sentence contexts was observed, but this effect was not affected by the modality of presentation. Although the word repetition in isolation shows an influence of audiovisual speech on the first stages of contact with the lexicon, there was not any impact of audiovisual speech in the processing of sentences.

This study has numerous limits related to a weak sample of trials and the use of stimuli without a clear auditory onset. For instance, in this study, the N100, associated with the perceptual processing, was not observable. Despite these limits, this study suggests that audiovisual speech can influence the first stages of contact with the lexicon during the processing of isolated words, leading to affect their retrieval in memory after word repetition. To determine the precise processing locus of audiovisual speech in the recognition of isolated words, further studies should examine the impact of audiovisual speech on word-frequency and neighborhood density effects in auditory word recognition. It is interesting to note that the nature of neighborhood density effects in auditory word recognition is different across time (Dufour, Brunellière, & Frauenfelder, 2013). Whereas a first effect of neighborhood density reflects the ease with which words are treated at a

phonemic level (i.e. a facilitation effect for neighborhood density), a later effect of neighborhood density reflects the ease with which words are selected (e.g., greater negativities for words residing in dense neighborhoods, in comparison with words residing in sparse neighborhoods).

Beyond the question of the extent to which audiovisual speech contributes to spoken-word recognition, another challenge is to better understand how continuous speech is perceived and then analyzed to build the meaning of a sentence from different sensory modalities. In the same vein as in our previous study (Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013), we explored how sentence-level processes interacted with audiovisual speech. This new experiment was conducted in collaboration with Dr. Laurence Delrue and Dr. Cyril Auran. Remarkably, the processing of natural spoken sentences depends on the interconnection between sub-lexical, lexical, and sentence-level processes. An intriguing question is to know whether audiovisual speech can exert an influence on the interplay between processes involved at the different levels (sub-lexical, lexical, sentence level) in natural spoken sentences. In other words, to what extend does audiovisual speech play a role in the linguistic encoding of an utterance until access to meaning, such that semantic violations would be more quickly detected in the audiovisual modality of presentation compared to the auditory-only modality?

In the present study (Brunellière, Delrue, & Auran, in press), we used event-related potentials (ERPs) to study brain processes in real time with high temporal resolution after semantic anomalies (see Figure 7). More specifically, when participants had to listen passively to natural spoken French sentences which were presented either in audiovisual or auditory-only modality, we recorded ERPs elicited by contextually expected and semantically incongruous words (see Figure 7A). As in Brunellière, Sánchez-García, Ikumi, & Soto-Faraco (2013), we selected words beginning with a clear acoustic onset (such as a plosive) from which we recorded ERPs. The native French speakers were exposed to semantically constraining sentences before the listening of the final critical word. Participants then performed a lexical recognition task after hearing the spoken sentences. During this task, each word was visually presented in the center of the screen in order to probe the memory trace of words while avoiding the familiarity effects associated with acoustic and phonetic properties.

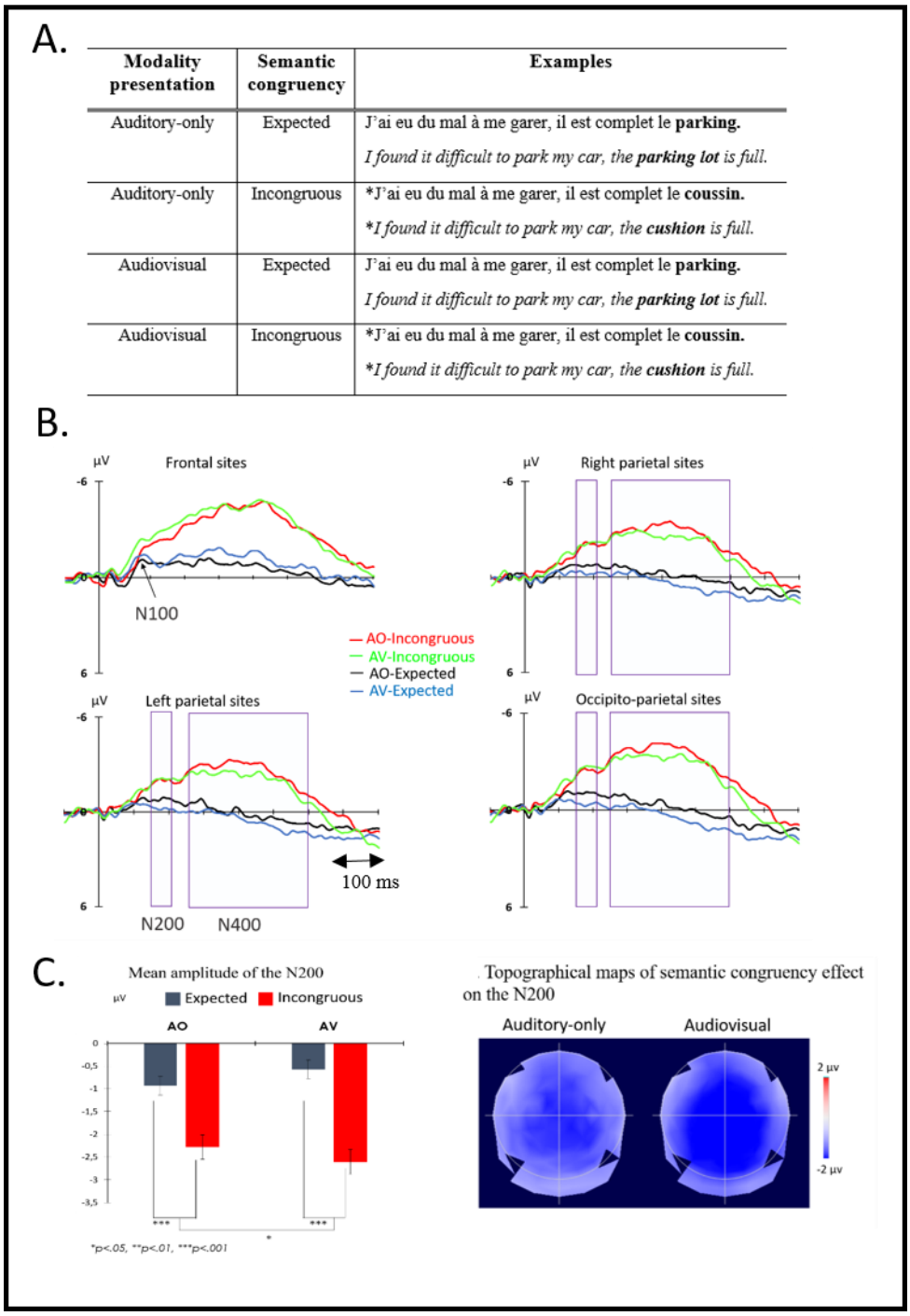

Figure 7. Adapted illustrations from the paper written by Brunellière, Delrue, & Auran (in press). (A) Examples of sentence materials, (B) Grand-average waveforms over critical sites on which the modality of presentation (AO: Auditory-only, AV: Audiovisual) strongly affected the processing of target words (C) Interactive effects between the modality of presentation and the semantic congruency over the N200 component. . *p<.05.

As seen in Figure 7, the N100 associated with perceptual processing was affected by the semantic congruency and the modality of presentation. We found the amplitude-increase effect over the auditory-evoked N100 response in the audiovisual modality with respect to an auditory-only modality, over frontal sites (see Figure 7B). There was also an amplitude-increase effect over

the N100 response after the semantically incongruous words compared to the congruous words. In line with the goal of the present study, the effect of semantic congruency was stronger over the N200 component known to index phonological processing in contact with the lexical- and sentence-level processes, when words were presented in the audiovisual modality than in the auditory-modality alone (see Figure 7C). In contrast, the semantic congruency effect did not vary as a function of the modality of presentation over the N400. Audiovisually presented words elicited a reduced amplitude of the N400 wave over left, right and occipito-parietal sites (see Figure 7B). In the lexical recognition task, words were more easily recalled when they had been previously presented in audiovisual trials than in an auditory-only modality. This facilitated recovery of episodic memory representations associated with final words was found independently of the semantic congruency.

The traditional stages proposed during the processing of spoken words (Frauenfelder, & Tyler, 1987; Marslen-Wilson, & Welsh, 1978) could explain the two different impacts caused by audiovisual speech. When sufficient phonological information about the incoming word has been recognized and the word is selected, audiovisual speech operates independently of the semantic constraints of sentence context. Before the word selection, audiovisual speech contributes to lexical-semantic processing in natural spoken sentences, as revealed in the N200 time window. Therefore, we can argue that audiovisual speech affects the interplay between spoken-word recognition and processing at sentence level by increasing the efficiency of analyzing the incoming word with the contextually-based constraints from the meaning of the utterance. This study thus provides interesting insights into spoken language comprehension by highlighting that audiovisual speech is involved in the encoding of the spoken utterance and not simply in the recognition of phonemes.

As for our previous study (Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013), two sources of information, that is, the precocity of visual articulatory information in advance of speech sounds and the complementary of audio-visual signals, serve to explain the contribution of audiovisual speech. Moreover, it is important to note that the impact of audiovisual speech at perceptual level was found only when we used a clear auditory onset as initial phonemes of target words (Brunellière, Delrue, & Auran, in press; Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013). We replicated the typical amplitude-reduction effect over the auditory-evoked N100 response in the audiovisual modality with respect to an auditory-only modality when we manipulated the salience of visual articulatory cues and employed sentences without linguistic violations (Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013). In contrast, we found an

amplitude-increase effect over the auditory-evoked N100 response in the audiovisual modality when we used in a design in which 33.3% of all presented stimuli were semantically incongruent sentences violations (Brunellière, Delrue, & Auran, in press). The differences in the study design could have caused the divergences of audiovisual speech's impact at the perceptual level. Another possibility is that the divergences of the impact of audiovisual speech over auditory-evoked N100 response stem from the strength of the semantic constraints driven by the sentence context (half of the stimuli are high and low constraining sentence frames by Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013, 2/3 of stimuli are high constraining sentence frames by Brunellière, Delrue, & Auran, in press).

Moreover, Peelle & Sommers (2015) suggested that visual speech can guide phonological and timing predictions with respect to the occurrence of upcoming speech sounds, so that audiovisual speech offers substantial benefits of processing in the encoding of the speech by constraining the number of possible candidates in a spoken utterance. If the timing predictions are the more important factor to obtain N100 amplitude reduction, the precocity of visual articulatory information in advance of speech sounds will be an important factor in the modulations of the auditory-evoked N100 response. Consistent with that, we found an amplitude-reduction effect in the audiovisual modality, when the precocity of visual articulatory information in advance of speech sounds was the strongest among our two studies (respectively, at least 50 ms lead, Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013; mean lead of 35.3 ms, Brunellière, Delrue, & Auran, in press). Moreover, the amplitude-increase effect over the auditory-evoked N100 response can also be explained by the use of sentence structure giving strong predictions about when the critical word will be uttered, as a pause occurs after the sentence context (e.g., after the following context "J'ai eu du mal à me garer, il est complet"). Therefore, the mechanisms underlying temporal attention may be highly involved in that case. Further work will determine the precise aspects of the audiovisual stimulus in natural sentence speech (visual salience, visual precocity, temporal attention, semantic constraints) that are needed for N100 amplitude reduction to occur and for obtaining later effects.

Similar to the study focusing on the intention of speakers (Brunellière, Auran, & Delrue, 2019), audiovisual speech acted on the activation of lexical candidates and interacted at this stage with the contextually-based constraints from the meaning of the utterance (Brunellière, Delrue, & Auran, in press). In light of predictive mechanisms, this effect can be seen as the reflection of lexical top-down predictions from the sentential context interacting with the cues provided by the

audiovisual speech, but also as the reflection of lexical top-down predictions from the sentential context interacting with phonological predictions based on the audiovisual speech.

Highlights

The salience of visual speech can exert an influence over both auditory processing and word recognition at relatively late stages recognition during word selection (Brunellière, Sánchez-García, Ikumi, & Soto-Faraco, 2013).

Audiovisual speech can influence the first stages of contact with the lexicon during the processing of isolated words, leading to affect their retrieval in memory after word repetition (Basirat, Brunellière, & Hartsuiker, 2018).

Audiovisual speech can contribute to the interplay between spoken-word recognition and sentence-level processing and thus plays a role in the encoding of spoken utterance. Nonetheless, its contribution to sentence-level processing is limited to the initial stages of spoken-word recognition (Brunellière, Delrue, & Auran, in press).

Part IV: Other studies: looking towards semantic representations

In addition to the three lines of research previously described, I have developed an active collaboration with colleagues in the language team of SCALab (Dr. Isabelle Bonnotte, Dr. Laetitia Perre) concerning the nature of semantic representations encoded in memory. Studying the impact of semantic constraints in spoken language comprehension led me to ask myself numerous questions about semantic representations. I will present the theoretical background and the methodological approach that we used to investigate the nature of semantic representations encoded in memory. All studies have been conducted in visual semantic priming with word pairs and employed behavioral measures.

The general issue of meaning knowledge concerns how semantic networks are organized in memory and how statistical learning (also called distributional learning) can shape the organization of semantic representations. In recent decades, numerous computational models have attempted to learn semantic representations from statistical regularities in the linguistic environment (for a review, see Jones, Kintsch, & Mewhort, 2006). It has been shown that the complexity required for building semantic representations is available from the occurrence of words in contexts across large language corpora. Typically, computational models represent words in a high-dimensional semantic space based on statistical co-occurrences in text. They reveal semantic relationships between words thanks to the usage of words in similar contexts across large language corpora. A semantic relationship between words can thus exist even though these words have never co-occurred in the same contextual environment. In collaboration with several colleagues in the language team of SCALab, we examined the role that statistical regularities extracted from the linguistic environment still play in semantic networks in young adults (Brunellière, Perre, Tran, & Bonnotte, 2017). The central question was therefore whether lexical co-occurrence frequency is encoded in semantic networks and still contributes to strengthening the purely semantic relation built between words in the cognitive system of young adults. In other words, the encoding of lexical co-occurrence frequency in semantic networks could boost the processing of words sharing a purely semantic relation. To this end, we conducted two experiments to examine the role of co-occurrence frequency in purely semantic priming in masked and unmasked priming conditions in a visual lexical decision priming task. Word co-occurrence frequencies were established from large language corpora of film dialogue which offer a real index to which individuals are exposed daily and best reflects language usage (New, Brysbaert, Veronis, & Pallier, 2007).

The most widely studied effect to explore the organization of semantic representations and the dynamics of spreading activation in semantic memory (for reviews, Hutchison, 2003; Lucas, 2000) is the "semantic priming effect". This effect is measured by comparing performance in two priming contexts: one with semantically related prime–target pairs (e.g., cat–dog), and the other with unrelated prime–target pairs (e.g., glass–dog). The semantic priming effect refers to the observation that a target word is recognized faster when it is preceded by a semantically related prime rather than by an unrelated prime. In the conscious priming presentation (166-ms stimulus-onset asynchrony, SOA), a semantic priming effect was recorded in both related priming contexts, for prime–target pairs with high and low co-occurrence frequency. However, the semantic priming effect was greater with higher co-occurrence frequency (garage–car) in comparison with prime–target pairs rarely co-occurring (traffic–car). In the subliminal priming presentation (66-ms SOA), no significant priming effect was shown, regardless of the related priming context. Although semantic priming effects with conscious exposure are robust, it appears that those with subliminal exposure seem to be unstable and difficult to reproduce (for a similar conclusion, see Dehaene, Changeux, Naccache, Sackur, & Sergent, 2006). Taken together, the low degree of spreading activation across semantic networks induced by the quick presentation of primes, by the interference between the prime and the backward mask, or by the non-relevant task with respect to semantic networks might collectively explain why semantic priming effects are difficult to evidence in some circumstances. This study clearly pointed out a boost in semantic priming due to the co-occurrence frequency established from large language corpora of films in a conscious perception of words.

Although lexical co-occurrence frequency is encoded in semantic networks and still seems to contribute to strengthening the purely semantic relation built between words in the cognitive system of young adults, more abstract knowledge needs to be encoded to organize the whole of semantic networks. For instance, prototype theory (Rosch, 1975) assumes an organization based on semantic categories and describes a particular organization between members within a given category. According to prototype theory (Rosch, 1975), the perceptual and functional features appearing frequently among members of a given category have a high probability of being integrated into its prototype. They are shared features and are distinguished from specific features. For example, the land-based lifestyle is a feature shared by many mammals. In contrast, the aquatic lifestyle is a specific feature of a few members of this category (e.g., whales). Thus, the members of a given category are distributed at greater or lesser distances from its core according to the number of features shared between a given member and the prototype: the members near the core

are typical while the members rather on the periphery are atypical. 'Cat' indicates a typical mammal (as does 'dog') while 'mink' refers to an atypical mammal.

In reference to Rosch's prototype model (1975), Plaut (1996) developed a connectionist simulation to test the hypothesis that the degree of generalization to new words produced by new training should be influenced by the relative typicality of learned words. It was hypothesized that after lesions in an artificial neural network, a new training of the network with words referring to typical concepts should give rise to a greater recovery of memory than the same type of training with words referring to atypical concepts. The results of the simulation were unexpected. In fact, new training on atypical words in their category gave rise to a greater generalization than new training on more typical words. Plaut (1996) concluded that atypical words, as a whole, provide more information about the overall structure of the category due to their specific and shared features. Atypical words include how semantic properties may vary between members of a category and provide a good approximation of the central tendency of the category. Thus, new training on atypical words can produce a generalization on all untrained words, both typical and atypical. On the other hand, new training on typical words is generalized only to other typical words. In the latter case, the performance on the atypical words decreased. The explanation behind this is the fact that atypical words provide a better estimate of both the central tendency and the variation within the category on each semantic dimension, whereas typical words provide only information about the central tendency. Atypical items of their semantic category yield greater generalization than their typical members when relearning in connectionist networks (Plaut, 1996) and in empirical studies with patients with Wernicke's aphasia, young adults, and older adults (Kiran & Thompson, 2003).

It seems therefore that atypical words provide more information about the overall structure of the semantic category due to their specific and shared features. In this view, atypical primes could strongly facilitate the processing of targets compared to typical primes, because typical primes contain little information about the variation between members within a category. While Plaut (1996) and Kiran and Thompson (2003) targeted relearning and retrieving information processes in semantic memory, we investigated how the typicality of members of a given semantic category affects the recognition of other members within the same category in healthy populations (Brunellière, & Bonnotte, 2018). To highlight the impact of the typicality of primes on the recognition of other members within the same category, three experiments included four semantic priming conditions: typical and atypical related priming contexts (e.g., related typical primes conditions, 'cat–dog' and 'cat–jackal' versus related atypical primes conditions, 'mink–dog' and

'mink–jackal') and their respective unrelated priming contexts (e.g., unrelated primes matching with related typical primes, 'scythe–dog' and 'scythe–jackal' versus unrelated primes matching with related atypical primes, 'nut–dog' and 'nut–jackal'). The three experiments with a 166-ms stimulus-onset asynchrony (SOA) were used either in an implicit task (i.e. not forcing participants to focus on semantic information) such as a lexical decision task or in explicit tasks (i.e., forcing participants to focus on semantic information) including a categorization task (i.e., whether the prime and the target belong to 'the same category' vs. 'different categories'), or a semantic judgment task (i.e., whether the prime is semantically related or not with the target). The three semantic priming experiments with a 166-ms stimulus-onset asynchrony (SOA) in visual word recognition showed an advantage with the typical context, but not with the atypical one. Our results do not support the findings about generalization in relearning and suggest that typicality effects in semantic priming mostly come from the activation of representative features of categories and does not benefit on the atypicality of words providing information about the overall structure of the semantic category.

Our two studies (Brunellière, Perre, Tran, & Bonnotte, 2017; Brunellière, & Bonnotte, 2018) raise the two main aspects about the organization of semantic networks in memory. The first aspect is that semantic networks are shaped by statistical regularities. The second aspect concerns the fact that the organization of semantic networks is structured in terms of abstract categories and features within a category. In that case, how does a system from statistical regularities build more abstract concepts such as abstract categories? To attempt to find some answers about this question, it can be investigated how and at what extent computational models, that is, distributional semantic models, can contain the information of typicality and more specially the organization between members within a given category. To this aim, I am beginning a new collaboration with Dr. Pascal Denis (Centre de Recherche en Informatique, Signal et Automatique de Lille, UMR9189 & Université de Lille), who is an expert in computational linguistics.

It is interesting to note that the organization of semantic networks in memory seem to have somewhat similar properties to that of phonological networks. It has been shown that infants are sensitive to the statistical distribution of speech sounds in the input language (Anderson, Margon, & White, 2003; Maye, Weker, & Gerken, 2002) to such an extent that the formation of native-language phonemic categories is biased by the statistical distribution. For instance, non-native contrasts relating to categories of sounds with higher frequencies in the native language are lost earlier than categories of sounds with lower frequencies. Therefore, the decline in discrimination ability of non-native contrasts which is an index of the formation of native-language phonemic categories may be accounted for by the frequency-based theory. Hence, as proposed by

computational models for semantic representations (for a review, see Jones, Kintsch, & Mewhort, 2006), we can consider that the system uses statistical regularities to build more abstract representations, regardless of the nature of linguistic representations.

Highlights

Lexical co-occurrence frequency established from large language corpora of films is encoded in semantic networks and contributes to strengthening the purely semantic relation built between words in the cognitive system of young adults (Brunellière, Perre, Tran, & Bonnotte, 2017).

Typicality effects in semantic priming do not support the findings about generalization in relearning. In semantic priming, there was an advantage with the typical context, suggesting that the semantic priming effect mostly comes from the activation of representative features of categories (Brunellière, & Bonnotte, 2018).

Part V: Interim Conclusion

The research lines that I have described on the interplay between the semantic constraints driven by the sentence context and the phonological information related to the identity of speaker claim in favor of an interactive and dynamic flow between the different sources of information provided by a sentence. The findings show that higher levels such as semantic constraints and the phonological information related to the speaker interacted during spoken-word recognition. Therefore, the models describing the processing from the speech input to the meaning comprehension of sentence must take into account the phonological information related to the identity of speaker. At neuroanatomical level, Belin, Bestelmeyer, Latinus, & Watson (2011) proposed three interacting, but partially dissociable, functional pathways during speech processing. They suggest one pathway for the analysis of linguistic information related to speech sounds, a second pathway for the processing of affective information, and a third pathway for the processing of vocal identity including gender and regional accent from an auditory stream. The same homologous pathways from visual processing of face are proposed to interact with the three pathways activated by the auditory stream. Although this theoretical view assumes an interactive flow between the different kinds of phonological information from the speech input at the sub-lexical level, this view does not integrate the semantic content given by a sentential context and does not describe when and how speakers' regional accent, their intention and their visible articulatory gestures act on spoken-word recognition and whether they are interconnected with the sub-lexical level, lexical level, and sentence-level processes in the processing of spoken sentences.

Following this consideration, our findings highlight the fact that higher-level constraints, such as semantic constraints, and the phonological information related to the speaker interacted during spoken-word recognition but that their interaction did not operate during all the precise stages of word recognition. For example, the intention and visible articulatory gestures related to the speaker interacted with the semantic constraints only when the lexical candidates were activated at the stage of initial contact. In the case of regional accent, the interaction between the semantic constraints and this phonological information occurred even earlier at the perceptual level. This latter finding is compatible with a fully interactive framework of spoken-word recognition models (e.g., TRACE model, McClelland, & Elman, 1986). Interestingly, visible articulatory gestures related to the speaker act on spoken-word recognition at the perceptual level but without interacting with the semantic constraints of sentence. The different impact of three sources related to the identity of speakers on word-spoken recognition can be accounted for their distinctive nature (see Figure 8). For instance, the information related the regional accent carries the phonological

information at the sub-lexical and lexical levels. Additionally, visible articulatory gestures from lip movements can provide phonological information at the sub-lexical level, which thereafter constrains the lexical activation. More than this, visible articulatory gestures can anticipate when the speech sounds will happen in the unfolding speech. In contrast to the two kinds of phonological sources, the intention of speakers to communicate a message conveyed by prosodic cues provide the semantic and pragmatic information, which constrain the lexical activation. Although the intention of speakers has been studied only from the auditory stream in my studies, the intention of speakers can also be conveyed by visual prosody. Through the results of these three sources of phonological sources, the process of spoken language comprehension is seen as mainly based on the interplay between the sentence representation, which triggers semantic constraints, and the lexical level, which is subsequently the interface to the information coming from the input.

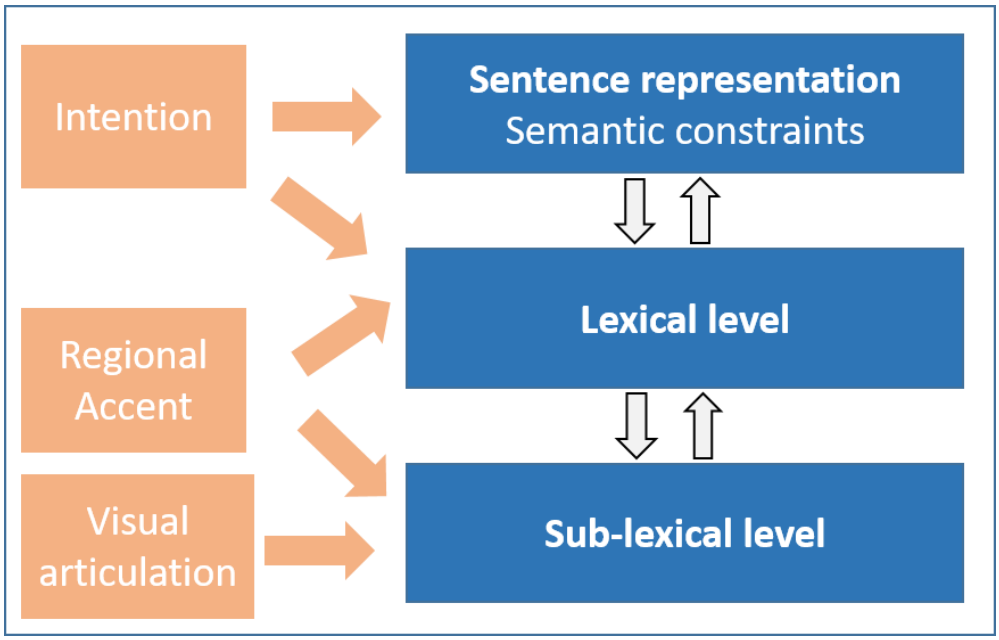

Figure 8. Schema illustrating the level processing impacted by the different phonological sources (regional accent, intention, visual articulation).

In light of predictive mechanisms in spoken language comprehension, our findings suggest that listeners adjust their probability model by taking into account speaker's characteristics such as regional accent and semantic constraints (Brunellière & Soto-Faraco, 2013, 2015). The lexical top-down predictions from semantic constraints also seemed to take into account the speaker's expressivity indicating the intention to communicate a message. The speaker's expressivity increases the updating of lexical predictions to minimize prediction errors about the speech input. Therefore, it appears that top-down predictions in the processing of sentences considered to be probabilistic systems mirroring the statistics of the linguistic environment (Kuperberg, & Jaeger,

2016; Levy, 2008) can also integrate the communicative aspect related to the speaker. Based on this fact, predictive mechanisms in spoken language mechanisms can play an in-depth role in the adaptation to the speaker. A role of predictive mechanisms in the adaptation to the speaker means that the content and the form of predictions depend on the communicative context. This latter point opens new perspectives in the understanding to adaptation of linguistic representations at both the semantic and phonological levels. Moreover, visible articulatory gestures can also be involved in lexical top-down predictions from semantic constraints in the same way as the speaker's expressivity appears to act on them. This source of information could increase the strength of lexical top-down predictions from semantic constraints thanks to a better sentence representation caused by the timing and phonological predictions of audiovisual speech. Such evidence could definitely bring support to the active role of visible articulatory gestures in the encoding of spoken utterance. In the following part, I outline four projects for lines of research about the predictive mechanisms and the adaptation of linguistic representations.

Part VI: New perspectives about spoken language comprehension

The two first lines of research aim at investigating the adaptation of predictive mechanisms and of linguistic representations to the communicative intention of speaker in spoken language comprehension or in spoken communication. The third line of research will examine the predictive mechanisms from visible articulatory gestures of speakers and semantic constraints in spoken language comprehension. While these three areas focus on predictive mechanisms and the phonological information related to the identity of speaker, the fourth research strand will explore the adaptation of predictive mechanisms and of linguistic representations in subject-verb agreement during the listening of spoken language. Studying predictive mechanisms of subject-verb agreement offers the opportunity to examine pre-activation of units smaller than words such as the pre-activation of morphemic units and to look at links between morphemic and phonological levels. Taken together, all these research strands will provide a better understanding of the role of predictive mechanisms and the adaptation of representations in spoken language comprehension.

The first line of research follows on from the previous framework that I conducted concerning the interplay between semantic constraints driven by the sentence context and the intention of speakers. In line with our previous findings showing that the speaker's expressivity increases the updating of lexical predictions to minimize prediction errors about the speech input (Brunellière, & Delrue, 2017), I will explore the adaptation of predicted representations according to an intentional action by which the message can be understood. More specially, the research hypothesis is that the strength of lexical top-down predictions could vary as the function the speaker's expressivity such that they would be tuned more finely in terms of their content and their form. I will therefore focus on incorporating details of semantic content and of interlocutors' pronunciations into word prediction. It may be that this processing is affected by the degree of expressivity given by the interlocutor to communicate a message. Two main scientific goals will be addressed in this line of research: first, whether a speaker's expressivity increases the details on semantic content of predictions; and second, whether a speaker's expressivity increases the details on phonological form of predictions. Details on semantic content of predictions will be examined according to the prior literature of semantic memory. For instance, I will explore whether more details concerning semantic content of predictions implies a higher use of co-occurrence frequency between words or a higher use of abstract content such as atypical and typical features within a semantic category. Regarding details of interlocutors' pronunciations, one might expect that the pre-activation of phonological forms would be adapted to the accent of speakers, regardless of the

listeners' accent. To confirm this hypothesis, I will use the same design as in our previous studies (Brunellière, & Soto-Faraco, 2013, 2015) and manipulate the speaker's expressivity. The project could provide a better understanding of the flexibility on predicted representations and their nature. More than investigating the nature of predicted representations at the phonological and semantic levels, it will be necessary to track the brain networks underlying the adaptation of predictive mechanisms due to the expressivity of speakers from both auditory-only and audiovisual streams. In particular, Pickering and Gambi (2018) argue for an optional role of predictions by production. It may be hypothesized that more detailed representations at the semantic and phonological levels could be guided by predictions by production as a function of the activation of the specialized neural substrate for the pragmatic comprehension of a speaker's intended meaning (Bara, Enrici, & Adenzato, 2016; Hellbernd, & Sammler, 2016).

In the second research line, I will work on linguistic representations adaptation and predictive mechanisms after social interactions in collaboration with a new member in the language team of SCALab, Dr. Dominique Knutsen. This project will investigate whether communicating with someone can influence the adaptation of the linguistic representations at the semantic and phonological levels after the interaction. According to the collaborative approach to dialogue (Clark, 1992, 1996), conversational partners must make sure that they have understood each other correctly every time an utterance is produced before they can progress in the interaction (Clark, & Schaefer, 1989; Clark, & Wilkes-Gibbs, 1986). The expression of mutual comprehension in interaction takes the form of linguistic cues with the production of specific words (for example, in French, "ok" or "voilà"; Knutsen, Col, & Rouet, in press) and also in terms of non-linguistic cues (smiles or head nods). These spontaneous interactive cues are instances of what is called feedback. Past research has suggest that positive feedback is used by conversational partners to indicate that they believe that they have understood each other well enough for current purposes (Clark, & Brennan, 1991) and that they share similar concepts (Brennan, & Clark, 1996; Clark, & Wilkes-Gibbs, 1986). The expression of feedback can be seen as reflecting the adaptation of concept sharedness between partners during interaction. However, the notion of concept sharedness remains to be defined clearly. In this project, we seek to explore this point further by specifying what it actually means – at a representational level – for two conversational partners to share similar concept, and to better understand the role played by feedback in conversation. The research hypothesis is that producing more feedback facilitates the reorganization of semantic and phonological representations during and after interaction. In line with Garrod and Pickering's

(2004) view, we suggest that concept sharedness entails that conversational partners have encoded their partner's semantic and phonological representations and that semantic and phonological representations are more similar to those held by one's partner after the end of the interaction. According to our view, feedback plays a facilitating role in this process. Indeed, without feedback, conversational partners have no way of determining whether or not they have reached mutual comprehension, and hence whether their representations should be updated or not. The updating of representations is believed to be related to predictive mechanisms in language processing such that they could contribute to language learning and inter-speaker coordination (see Huettig, 2015). In other words, the adaptation of mental representations according to those of partners would result from mechanisms predicting the upcoming words in the discourse of partners. In this context, we hypothesize that producing more feedbacks make speakers more likely to predict upcoming words while attempting to comprehend their partner's utterances after the interaction. The adaptation of the linguistic representations at the semantic and phonological levels and the adaptation of prediction will be evaluated by experimental designs either in word recognition or in spoken language comprehension after the interaction. Three main scientific goals will be addressed: first, whether feedback contributes to the adaptation of semantic representations after a dialogue; second, whether feedback contributes to the adaptation of phonological representations after a dialogue; and third, whether feedback facilitates prediction in comprehension after dialogue. To reach these objectives, I have received a financial support to the French National Research Agency.

In the third research line, carried out in collaboration with Pr. Salvador Soto-Faraco (Center for Brain and Cognition, Universitat Pompeu Fabra) and Dr. Marion Vincent (an research engineer at the SCALab), I will examine whether the visible articulatory gestures of speakers can interfere with the word prediction based on semantic constraints in a sentence and, if such interference exists, how it operates. The research line follows from the previous framework that I conducted about the interplay between semantic constraints driven by the sentence context and the visible articulatory gestures of speakers. To address this question, we will analyze ERP time-clocked to the article preceding the muted but expected noun and track the brain oscillations involved in the interplay between semantic constraints driven by the sentence context and the visible articulatory gestures of speakers. The neural oscillations seem to play an important role in speech processing and language comprehension (for a review, Meyer, 2018). Similar to Brunellière & Delrue (2017), the article will (or will not) agree with the gender expected (muted) word and the word expected from the sentential context and never presented will be replaced by a brown noise situated at the

mean intensity of articles for each sentence fragment. The working hypothesis is that the visible articulatory gestures of speakers will reinforce the lexical top-down predictions driven by the sentence context and helps to detect error predictions. To explore this point, we will suggest that brain oscillations associated with word prediction would be reinforced by visible articulatory gestures of speakers and that the cortical entrainment to continuous auditory speech could explain the impact of visible articulatory gestures of speakers on word prediction. Such experimental evidence will reveal an active role of visible articulatory gestures of speakers in spoken language comprehension. This line of research will thus contribute to the understanding on how continuous speech is perceived and then analyzed to build the meaning of a sentence from different sensory modalities. It will open new paths in neural mechanisms involved in spoken language comprehension from multimodal signals.

In the fourth and final line of research I propose, I attempt to explore three themes concerning the adaptation of predictive mechanisms and linguistic representations in subject-verb agreement in collaboration with Pr. Alec Marantz (New York University). To reach these objectives, I have received a Phd grant supported by the Institute of Human and Social Science (CNRS). We focus first on the nature of representation involved in the computation of subject-verb agreement in spoken language. Although the abstract representations are assumed to be used in the computation of subject-verb agreement, the use of associative lexical representations coding the probability between words (Corbett, 1991; Truswell & Tanenhaus, 1994; Seidenberg & MacDonald, 1999; Frost, Monaghan & Christiansen, 2016) in the computation of subject-verb agreement is not clear. In an ERP study, we examine whether the abstract grammatical features and the associative frequency between a pronoun and a verbal inflection are accessed in the computation of subject-verb agreement. Due to the fleeting nature of spoken language, it relies more on temporal memory in the sense that spoken language is processed and conveyed sequentially whereas reading is only processed sequentially (Marslen-Wilson, 1984); the role of associative representations could thus be particularly apparent in spoken language. Moreover, based on the assumption that top-down predictions in the processing of sentences are considered to be probabilistic systems mirroring the statistics of the linguistic environment (Kuperberg, & Jaeger, 2016; Levy, 2008), associative representations can be seen to be related to predictive mechanisms in the computation of subject-verb agreement. By recording magnetoencephalographic activity, we will isolate whether predictive mechanisms based on the associative frequency operate in subject-verb agreement, such that the system preactivates the

upcoming of verbal inflection, producing pre-activation of their associated phonological forms over temporal areas. Finally, we will see whether the nature of predicted representations in the computation of subject-verb agreement can depend on the demands of the task (task focusing at lexical level versus task focusing at grammatical level) by measuring EEG signals in a same design as that previously described for the first objective of this line of research. At present, preliminary findings about the first objective were presented in the international conference Society for the neurobiology of language on November 2017, and a paper to be submitted to an international journal is currently in progress. Preliminary findings about the second objective have been presented at the international conference Cognitive Neuroscience Society on March 2017. This latter research line follows my PhD work and contributes to the understanding of the activation flow between the morphemic and phonological levels during agreement processing. In the longer term, I think that it is necessary to develop a multi-level model including the different linguistic representations (phonological, semantic and morphosyntactic) activated from the speech input.

Part VII: Conclusion

In conclusion, I believe that studying cognitive processes in the comprehension of spoken language requires investigating how the flow spreads across the different levels of representations (sentence representation, lexical representations and sub-lexical representations) and how the phonological information related to the speaker is accessed. In this context, the predictive mechanisms about the upcoming input seem to be a key mechanism in the successful and adaptive comprehension of spoken language. Therefore, a better understanding of mechanisms in spoken language comprehension imposes to study the kind of information related to the speaker, the kind of representations that can be predicted, the sort of situations in which predictive mechanisms are adaptive and which brain networks underlie predictive mechanisms in spoken language comprehension as well as the neural mechanisms at play.

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Part VIII: References

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