

# Dr. Sandra Martin

» I am a cognitive neuroscientist with a focus on computational modeling of brain signals in language and cognition across the adult lifespan. My work integrates fMRI, TMS, and behavioral measures with machine learning and large language models to quantify prediction, semantic control, and executive functions.

I have extensive experience developing and implementing robust analytical workflows in Python and R, and I am particularly interested in bridging neural data and representations from modern NLP models. I am committed to open and reproducible research practices, and strive to implement these principles in my work by sharing data and code, using open-source software, and publishing results in open-access journals.

## METHODS & COMPUTATIONAL SKILLS

<b>Machine learning &amp; statistics</b>	Linear and generalized mixed-effects models for large lifespan datasets; GAM/GAMM approaches for reaction time and reading data; Bayesian hierarchical sequential sampling (HSSM toolbox)
<b>Deep learning &amp; NLP</b>	Use of transformer-based language models (e.g., GPT-2) to derive surprisal, entropy, and contextual embeddings as predictors of behavior and brain activity in naturalistic language tasks; Working with large text corpora and LLM tools (HuggingFace ecosystem, API-based models) for building linguistic predictors and designing language stimuli
<b>Neuroimaging</b>	fMRI acquisition and analysis (GLM, MVPA, seed-based and whole-brain connectivity, network and graph analysis) in large lifespan cohorts; Integration of behavioral, neurostimulation, and physiological measures (e.g., eyetracking, heart-brain coupling); Familiarity with EEG/MEG analysis concepts and their use for connectivity and prediction
<b>Programming</b>	Extensive use of Python (and Matlab) for neuroimaging and machine learning, including data processing (numpy, pandas, scipy), analysis libraries (nilearn, SPM12, HSSM), and deep-learning (PyTorch, HuggingFace transformers); Advanced statistical modeling in R (lme4, mgcv, brms), including development of custom packages for teaching and reproducible analysis workflows; Experience running large-scale analyses on high-performance computing (HPC) systems using SLURM for job scheduling, version-controlled pipelines (Git), and Linux-based, scripted end-to-end workflows (Bash)
<b>Experimental Methods</b>	fMRI; sMRI; eyetracking; TMS; tDCS; PsychoPy

## PROFESSIONAL EXPERIENCE

**Postdoctoral Researcher** since 09/2023  
MPI for Human Cognitive and Brain Sciences, Research Group Cognition and Plasticity  
Project: *Executive and domain-specific processes in predictive language processing across the adult lifespan*

- Lead development of computational models linking GPT-2-based surprisal and behavioral/fMRI measures of language prediction across the adult lifespan.
- Coordinate a multi-site project combining neuroimaging, TMS, and behavioral data; responsible for analysis pipelines and supervision of doctoral and MA students.
- Design and preregister experiments and analysis plans.

**Doctoral Researcher** 2018–2023

MPI for Human Cognitive and Brain Sciences Leipzig & University Hospital Leipzig

Project: *Age-related effects on domain-specific and domain-general neural network interactions in semantic cognition*

**Speech-Language Pathologist** 2015–2017

Median Klinik Berlin Kladow, Clinic for neurological rehabilitation

**Research Intern** 2014–2015

NeuroCure Clinical Research Center, Charité Berlin

**Student Assistant** 2012–2013

Center for Language and Cognition, University of Groningen, The Netherlands

## EDUCATION

**Dr. rer. med. in Cognitive Neuroscience (PhD)** 2018–2023

Medical Faculty, Leipzig University

Supervisors: Prof. Dr. Gesa Hartwigsen & Prof. Dr. Dorothee Saur

Thesis title: *The aging brain in semantic cognition—Insights from fMRI and TMS*

Grade: *Magna cum laude*, Award date: 19/09/2023

**M.Sc. in Neuro- and Clinical Linguistics** 2012–2014

University of Potsdam, Germany, & University of Groningen, Netherlands

Thesis title: *Improving communication in aphasia: A comparison of naming- and discourse-based treatment, both facilitated by transcranial direct current stimulation*

Grade: Excellent (1.1)

**B.A. in Linguistics** 2007–2012

Humboldt-Universität zu Berlin, Germany

Grade: Excellent (1.3)

2009 – 2010 Erasmus exchange student at Université Aix-Marseille, France

## HONORS & AWARDS

**Travel award** 02/2025

Dallas Aging and Cognition Conference (DACC)

**Poster prize** 06/2023

Psychologie und Gehirn (PuG)

**PhD fellowship (80,000 €)** 2018–2022

German Academic Scholarship Foundation (Studienstiftung des deutschen Volkes)

Full stipend for graduate program

**Poster prize** 11/2020

Meeting of the German Society for Clinical Neurophysiology and Functional Imaging (DGKN)

**First prize at Science Slam** 02/2019

20th Annual Meeting of the German Association of Speech-Language Therapy

**Travel grant (1,500 €)** 2014

Erasmus Mundus program

**Erasmus Mundus stipend (24,000 €)**

2012–2014

Erasmus Mundus Program European Union  
Full stipend for Master's studies

**DAAD PROMOS stipend (2,000 €)**

2011

German Academic Exchange Service

**GRANTS & PROPOSALS**

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**Marie Skłodowska-Curie Postdoctoral Fellowship**

submitted 09/2025

Applicant and main PI; full proposal submitted to Horizon Europe MSCA-PF2025 call.

Project on predictive dynamics in language comprehension across the adult lifespan (PREDYNA-AGE).

**DFG Collaborative Research Centre (SFB)**

in preparation

Co-applicant / contributing PI on project module on computational models of language–brain mappings; proposal currently in development for DFG SFB submission.

**MENTORING & SUPERVISION**

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**Co-Supervision of doctoral researchers**

Merle Schuckart (PhD Psychology University of Lübeck, 2022-present), Laura Nieberlein (PhD Psychology Leipzig University, 2021-present), Matteo Ferrante (PhD Psychology Leipzig University, 2022-present)

**Master thesis**

Alina Leiss (M.Sc., 2025-present, Leipzig University), Yulia Guseva (M.Sc., 2024-2025, Mind & Brain, Humboldt University Berlin), Flavia Ercoli (M.Sc., 2024-2025, University of Amsterdam), Pia Siegel (M. Sc., 2023-2024, Leipzig University), Katharina Polsterer (M. A., 2022, University of Groningen), Regine Frieling (M. A., 2021, University of Cologne)

**Interns / Student assistants**

Niklas Kroner-Weigl (Doctoral student, Max Planck School of Cognition), Johannes Kim (M.Sc., 2025, Maastricht University), Jim Krups (M.Sc., 2025, Leipzig University), Alina Leiss (M.Sc., 2025, Leipzig University), Lena Radach (M.Sc., 2024, University of Göttingen), Hanna Weigand (B.Sc., 2024, University of Würzburg), Christian Koblitz (M. Sc., 2023, Leipzig University), Marcel Blumenthal (M. Sc., 2023, Leipzig University), Madeleine Mesgarian (B. Sc., 2023, Freie Universität Berlin), Caroline Duchow (M. A., 2019, University of Erfurt), Annika Dunau (M. A., 2018, Leipzig University)

**TEACHING**

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**Introduction to Advanced Statistical Modeling**

05/2025, 04/2024, 04/2023

MA block seminar on Linear and Non-linear mixed-effects regression, Department of Psychology, Ghent University, Belgium

**Seminar Perception and Action**

since Winter 23/24 every semester

MA program Brain & Behavior, Wilhelm Wundt Institute of Psychology, Leipzig University

**Language and Aging**

05/2023

Guest lecture IMPRS graduate school NeuroCom, Leipzig, Germany

**Workshop: Introduction to Data Analysis in Cognitive Neuroscience**

10/2022

Master's program Cognitive Neuroscience, University of Amsterdam

**Workshop: Data analysis with R**


06/2021

Summer School, German Association of Speech-Language Therapy. I built an R package for the workshop: [gitlab.gwdg.de/sandra.martin/r-workshop-summer-school-2021](https://gitlab.gwdg.de/sandra.martin/r-workshop-summer-school-2021)

**Workshop: Aphasia as a network disorder–Implications for speech-language therapy**

10/2019

German Society for Aphasia Research

Slides for selected lectures and workshops are available on my OSF site:  [osf.io/hvzu2/](https://osf.io/hvzu2/)

## PUBLICATIONS

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- [11] Feng, Z.\*, **Martin, S.\***, Numssen, O., Weise, K., Jing, Y., Gerardos, G., Martin, C., Hartwigsen, G., & Knösche, T. (accepted at *Translational Psychiatry*). Target-specificity and repeatability in neuro-cardiac-guided TMS for heart-brain coupling. *Preprint* doi:10.1101/2025.02.19.638988
- [10] Schuckart, M.\*, **Martin, S.\***, Tune, S., Schmitt, L.-M., Hartwigsen, G., & Obleser, J. (2025). Executive resources shape the effects of language predictability across the adult lifespan. *eLife*, 14. doi:doi.org/10.7554/eLife.108176.1
- [9] **Martin, S.\***, Ferrante, M.\*, Bruera, A., & Hartwigsen, G. (2025). Causal contributions of left inferior and medial frontal cortex to semantic and executive control. *Communications Biology*, 8(1), 1343. doi:10.1038/s42003-025-08848-5
- [8] Nieberlein, L., **Martin, S.**, Williams, K. A., Gussew, A., Cyriaks, S. D., Scheer, M., Rampp, S., Prell, J., & Hartwigsen, G. (2024). Semantic integration demands modulate large-scale network interactions in the brain. *Human Brain Mapping*, 45(18), e70113. doi:10.1002/hbm.70113
- [7] **Martin, S.** & Hartwigsen, G. (2024). The dynamics of neuroplasticity in the recovery from post-stroke aphasia: Commentary on Billot and Kiran. *Brain & Language*, 258, 105479. doi:10.1016/j.bandl.2024.105479
- [6] Numssen, O., **Martin, S.**, Williams, K., Knösche, T., & Hartwigsen, G. (2024). Quantification of subject motion during TMS via pulsewise coil displacement. *Brain Stimulation*, 17(5), 1045-1047. doi:10.1016/j.brs.2024.08.009
- [5] **Martin, S.**, Frieling, R., Saur, D., & Hartwigsen, G. (2023). TMS over the pre-SMA enhances semantic cognition via remote network effects on task-based activity and connectivity. *Brain Stimulation*, 16(5), 1346-1357. doi:10.1016/j.brs.2023.09.009
- [4] **Martin, S.**, Williams, K., Saur, D., & Hartwigsen, G. (2023). Age-related reorganization of functional network architecture in semantic cognition. *Cerebral Cortex*, 33(8), 4886-4903. doi:10.1093/cercor/bhac387
- [3] Kuhnke, P., Chapman, C., Cheung, V., Turker, S., Graessner, A., **Martin, S.**, Williams, K., & Hartwigsen, G. (2022). The role of the angular gyrus in semantic cognition: A synthesis of five functional neuroimaging studies. *Brain Structure and Function*, 228, 273–291. doi:10.1007/s00429-022-02493-y
- [2] **Martin, S.**, Saur, D., & Hartwigsen, G. (2022). Age-dependent contribution of domain-general networks to semantic cognition. *Cerebral Cortex*, 32(4), 870–890. doi:10.1093/cercor/bhab252
- [1] Darkow, R., **Martin, S.**, Burchert, F., Meinzer, M., & Flöel, A. (2015). Effects of tDCS on spontaneous speech in aphasia: A study of naming and discourse treatment [in German]. *Sprache, Stimme, Gehör*, 39, 140-145. doi:10.1055/s-0035-1559656

## BOOK CHAPTERS

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**Martin, S.** & Hartwigsen, G. (2025). Semantic and syntactic networks in the brain. In: Sidiropoulos, K. (eds) *Transcranial Electrical Stimulation in Aphasia and Acquired Language Disorders*. Springer, Berlin, Heidelberg. doi:10.1007/978-3-662-70454-7\_7

Hartwigsen, G. & **Martin, S.** (2025). Plasticity and reorganisation in the language network after stroke. In: Sidiropoulos, K. (eds) *Transcranial Electrical Stimulation in Aphasia and Acquired Language Disorders*. Springer, Berlin, Heidelberg. doi:10.1007/978-3-662-70454-7\_10

## TALKS

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About my research

**Language Testing and Brain Surgery Lab, University of Groningen**

12/2025

*How executive functions shape language processing across the adult lifespan* (Invited)

**Berlin Neuroscience Meeting**

10/2025

*The interplay of semantic memory and executive functions across the adult lifespan: Multimodal perspectives*

- Dynamics of Brain and Language Lab, Geneva University Neurocenter** 07/2025  
*Executive control in language processing across the adult lifespan: Multimodal perspectives*
- Institute Colloquium, Max Planck Institute for Human Cognitive and Brain Sciences** 02/2025  
*The interplay of semantic memory and executive functions across the adult lifespan: Multimodal perspectives*
- Cognitive Aging Lab, University of Geneva** 01/2025  
*The interplay of semantic memory and executive functions across the adult lifespan: Multimodal perspectives* (Invited)
- German Society for Aphasia Rehabilitation (GAB)** 10/2024  
*The neural basis of semantic control: A voxel-based study in chronic aphasia*
- Psychologie und Gehirn (PuG)** 05/2024  
*Beyond motor effects: Repetitive TMS in cognitive control and the impact of protocol selection*  
 Symposium on individualized TMS in cognition (chair)
- German Society for Neurorehabilitation (DGNR)** 12/2023  
*Functional interactions and plasticity in the language network—Insights from young and aging brains*  
 Symposium on neurorehabilitation, plasticity, and learning
- Korea Institute for Advanced Study (KIAS)** 11/2022  
 Center for Artificial Intelligence and Natural Sciences  
*The aging brain in semantic cognition—Insights from fMRI and TMS* (Invited)
- Würzburger Aphasietage** 03/2022  
*Aphasia as neural network disorder*
- German Association of Speech-Language Therapy (dbs e.V.)** 11/2021  
*Non-invasive brain stimulation techniques in language rehabilitation*
- Psychologie und Gehirn (PuG)** 06/2021  
*The role of domain-general networks in semantic processing in the young and the aging brain*  
 Symposium "Cognition and plasticity in the aging brain" (chair)
- German Academic Scholarship Foundation** 03/2021  
*Domain-general networks in semantic processing in the aging brain*  
 Annual meeting for doctoral students of the German Academic Scholarship Foundation (Studienstiftung des deutschen Volkes).
- Clinic Christophsbad, Göppingen, Germany** 04/2019  
*The application of non-invasive brain stimulation techniques in neurorehabilitation* (Invited)
- German Society for Aphasia Rehabilitation (GAB)** 11/2014  
*Expressing your own intentions with aphasia: A comparison of a naming and a discourse treatment, both enhanced by transcranial direct current stimulation*
- About Open Science
- Colloquium at MPI for Human Cognitive and Brain Sciences** 01/2022  
*Advancing the responsible conduct of research at the MPI CBS*  
 Invited talk to present a recommendations paper I wrote together with other researchers from MPI CBS (available here: [osf.io/9n2at/](https://osf.io/9n2at/))
- Research Interactions Symposium by Wiley** 06/2021  
*Trust in science: How early career researchers benefit from open and transparent research practices*  
 Invited talk at symposium organized by Wiley.
- Slides for selected talks are available on my OSF site:  [osf.io/hvzu2/](https://osf.io/hvzu2/)

## CONFERENCE PROCEEDINGS & POSTERS (SELECTED)

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- Martin, S.**, Schuckart, M., Obleser, J., & Hartwigsen, G. 04/2025  
*Robust predictive mechanisms in aging: Insights from behavioral and neuroimaging research*, Cognitive Neuroscience Society, Boston, USA
- Martin, S.**, Schuckart, M., Obleser, J., & Hartwigsen, G. 02/2025  
*Robust predictive mechanisms in aging: Insights from behavioral and neuroimaging research*, Dallas Aging and Cognition Conference, Dallas, USA
- Martin, S.**, Kuhnke, P., Chapman, C., & Hartwigsen, G. 06/2024  
*Aging effects on task-based activity and functional networks during semantic processing and rest*, OHBM, Seoul, South Korea
- Numssen, O., **Martin, S.**, Williams, K., Knösche, T., & Hartwigsen, G. 06/2024  
*A quality metric to assess pulswise coil displacements during TMS*, OHBM, Seoul, South Korea
- Schuckart, M., **Martin, S.**, Tune, S., Schmitt, L.-M., Hartwigsen, G., & Obleser, J. 06/2024  
*No free lunch in language prediction – Limitation of cognitive resources reduces the impact of surprisal at multiple time scales*, HörHanse, Lübeck, Germany
- Ferrante, M., **Martin, S.**, & Hartwigsen, G. 10/2023  
*Probing the functional relevance of pre-SMA and aIFG for controlled semantic processing with transcranial magnetic stimulation*, Society for the Neurobiology of Language (SNL), Marseille, France
- Martin, S.**, Schuckart, M., Obleser, J., & Hartwigsen, G. 10/2023  
*The impact of domain-general cognitive load on language processing in the aging brain*, Society for the Neurobiology of Language (SNL), Marseille, France
- Schuckart, M., Tune, S., Schmitt, L.-M., Hartwigsen, G., **Martin, S.**, & Obleser, J. 07/2023  
*No free lunch in language prediction – Limitation of cognitive resources reduces the impact of surprisal at multiple time scales*, Salzburg Mind and Brain Annual Meeting, Salzburg, Austria
- Martin, S.**, Frieling, R., Saur, D., & Hartwigsen, G. 06/2023  
*Facilitatory stimulation of the pre-SMA enhances semantic cognition via remote network effects in task-based activity and connectivity*, selected for poster flash session with additional talk. Psychologie und Gehirn (PuG), Tübingen, Germany
- Martin, S.**, Frieling, R., Saur, D., & Hartwigsen, G. 03/2023  
*Facilitatory stimulation of the pre-SMA has distinct effects on task-based activity and connectivity networks in healthy aging*, selected as "hot abstract" with talk. Congress for Clinical Neuroscience (DGKN), Hamburg, Germany, Clinical Neurophysiology 148:e5-e6
- Martin, S.**, Frieling, R., Saur, D., & Hartwigsen, G. 02/2023  
*Facilitatory stimulation of the pre-SMA has distinct effects on task-based activity and connectivity*, Brain Stimulation, Lisbon, Portugal
- Martin, S.**, Saur, D., & Hartwigsen, G. 06/2021  
*Age-dependent contribution of domain-general networks to semantic cognition*, OHBM, virtual edition
- Martin, S.**, Saur, D., & Hartwigsen, G. 11/2020  
*The multiple-demand network in language processing of the young and the aging brain*, Congress for Clinical Neuroscience (DGKN), virtual edition, Clinical Neurophysiology 131:e201-e202
- van Scherpenberg, C., **Martin, S.**, Hartwigsen, G., Obrig, H., & Beese, C. 09/2019  
*Age-related decline of semantic inhibition despite the preservation of semantic memory*, PaePsy, Leipzig, Germany
- Martin, S.**, Saur, D., & Hartwigsen, G. 08/2019  
*The multiple-demand network in language processing: Its role in the aging brain*, Society for the Neurobiology of Language (SNL), Helsinki, Finland
- Martin, S.**, Darkow, R., Burcher, F., Meinzer, M., & Flöel, A. 09/2014

*Improving communication in aphasia: A comparison of naming- and discourse based treatment, both facilitated by transcranial direct current stimulation (tDCS)*, Science of Aphasia, Venice, Italy

Darkow, R., Meinzer, M., **Martin, S.**, Würtz, A. & Flöel, A. 12/2013  
*Transcranial direct current stimulation and aphasia*, German Society for Neurorehabilitation, Berlin, Germany

## OPEN SCIENCE

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**fMRI Preregistration template** 2021  
Co-author of widely used template doi:10.23668/psycharchives.5121

**Panelist at discussion on Research Data Management**, Max Planck Digital Library 05/2021

**Open Access Ambassador of the Max Planck Society** 2019-2020

**Doing Good – Scientific Practice under Review** 11/2019  
Organizer of a 2-day symposium on Open Science and Good Scientific Practice at MPI CBS, Leipzig

**Open Science Initiative MPI CBS** since 2018  
Co-founder of the initiative

## OUTREACH

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- *Long Night of Sciences Leipzig*, Tour of TMS lab 2025, 2024, 2023
- Workshop "Introduction to Programming in Neuroscience" at *Girls' and Boys' Day* 2022, 2023
- Article about my research at MDR Wissen (in German), 09/2021: [Link to article](#)
- Co-author on the *Blog Thinky & Brain*, 08/2020: [Link to article](#)
- Guest at the *Orion Open Science Podcast*, 11/2019: [Link to episode](#)

## ACADEMIC SERVICE

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**Ad-hoc-reviewing** Brain, Brain Communications, Brain & Language, Cerebral Cortex, Frontiers in Psychology, Imaging Neuroscience, Journal of Neuroscience, Journal of Gerontology, Nature Human Behaviour, NeuroImage, NeuroImage Clinical

**Professional memberships** Society for the Neurobiology of Language (SNL), Cognitive Neuroscience Society (CNS), Organization for Human Brain Mapping (OHBM)