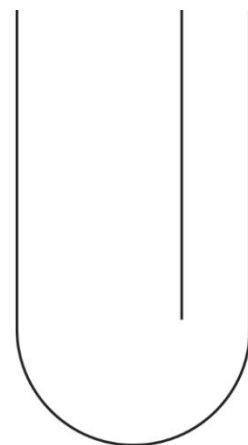# Workshop on language processing in aging

May 23, 2024
VITORIA-GASTEIZ

VENUE:
Micaela Portilla Rechearch Center (UPV / EHU)
Justo Vélez de Elorriaga, 1
01006 Vitoria-Gasteiz (Spain)

BOOK OF ABSTRACTS

GOGO ELEBIDUNA
THE BILINGUAL MIND
LA MENTE BILINGÜE

Organizing Committee
The following members of The Bilingual Mind research group:

Victoria Cano-Sánchez
UPV/EHU

Patricia Fuente-García
UPV/EHU

Irene de la Cruz-Pavía
University of Deusto

Mikel Santesteban
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Technical support

GOGO ELEBIDUNA
THE BILINGUAL MIND
LA MENTE BILINGÜE

The Bilingual Mind Research Group, based in Vitoria-Gasteiz, investigates how humans acquire, represent and organize language in their brain. In order to investigate the universal characteristics of language representation and processing, we make use of behavioral techniques (Reaction Times), electrophysiological measurements (ERPs) and eye-movement recordings. Our three main lines of research are:

1. Language learning and processing. We study the mechanisms of control and change of languages, the learning processes of lexicon and syntax, the effects of cross-linguistic influence, and the impact of grammatical structure on linguistic processing. One of the main goals of our research team is to investigate these matters with a special focus on bilingualism, given the linguistic reality of our speech community. We pay special attention to the Basque language, as well as to the different ages of acquisition and degrees of linguistic competence of bi/multilingual Basque/Spanish/English/French speaker populations.

2. Linguistic processing in aging. A growing body of work shows that our linguistic abilities do not remain stable throughout adulthood. And yet, the study of language processing to date has focused mainly on young adult populations. In order to fully understand how humans process language, we examine younger and older adults in parallel, using the same techniques for linguistic research. Given that a decline of certain linguistic abilities can be an early indicator of various neurodegenerative disorders, our research allows us to tease apart normal from pathological decline, as well as to determine if, how and when bilingualism may offer a cognitive protection against said decline.

3. Linguistic variation. Basque is typologically different from its better known, extensively studied Indo-European neighbors. For this reason, another main objective in our research group is to describe and analyze Basque in its synchronic dimension, focusing on its contemporary dialectal variations.

Scientific Committee
The following members of The Bilingual Mind research group:

Victoria Cano-Sánchez
UPV/EHU

Patricia Fuente-García
UPV/EHU

Irene de la Cruz-Pavía
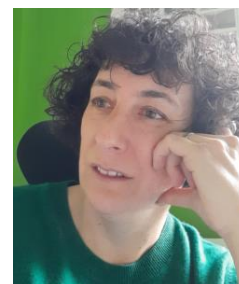University of Deusto

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Principal Investigator
The Bilingual Mind Research Group

WORKSHOP PROGRAM
(Room 0.8 talks & Room 0.12 posters)

|	
9:30-9:40	Opening remarks
9:40-10:30	Keynote 1: Jana Reifegerste (Georgetown University) "Sentence processing in aging: What changes, what doesn't, and why?"
10:30-11:00	Coffee break
11:00-11:50	Keynote 2: Sven Mattys (University of York) "Age-related changes in cognitive recruitment during listening in adverse conditions"
11:50-12:40	Keynote 3: Marco Calabria (Universitat Oberta de Catalunya) "Granularity and modularity of language: insights into lexical retrieval deficits"
12:40-15:00	Lunch break
15:00-15:50	Poster session
15:50-17:20	Oral session: The Bilingual Mind/Gogo Elebiduna research group
15:50-16:20	Miren Arantzeta "Aging, Bilingualism, and the Computational Lens: Exploring Semantic Processing Decline"
16:20-16:50	Patricia Fuente-García "Word segmentation abilities remain stable across the lifespan: A comparative study of young and older bilinguals"
16:50-17:20	Victoria Cano-Sánchez "Aging effects in prediction and agreement processing"
17:20-17:30	Closing remarks
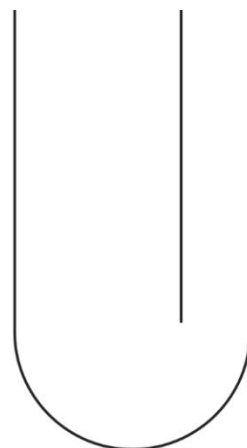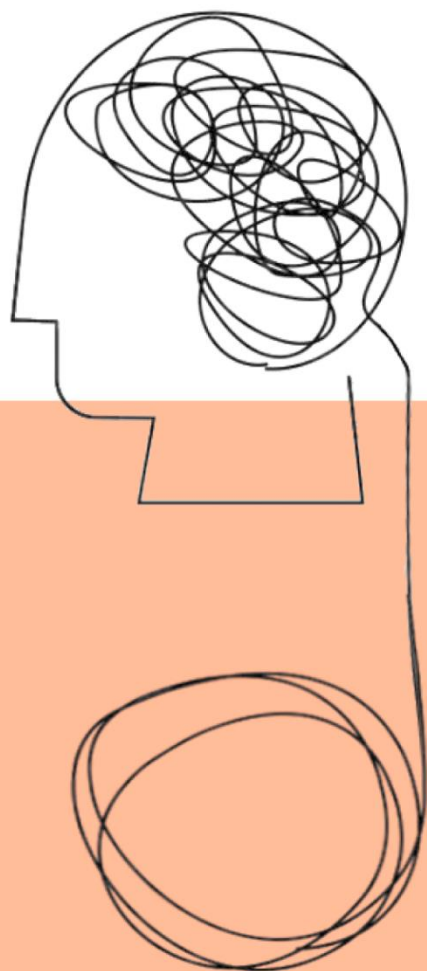
KEYNOTE SPEAKERS

KEYNOTE 1   **9:40-10:30**

Jana Reifegerste - Georgetown University

After obtaining her Bachelor of Arts in Psychology at McGill University in 2010, she moved to the Netherlands to carry out her PhD studies at Radboud University—Max Planck Institute for Psycholinguistics—from 2010-2013. Upon completion, she became a postdoctoral researcher at the University of Potsdam (2013-2017) and then at the University of Munich (2018-2019). She was also a visiting researcher at Georgetown University (2018-2021) and held an adjunct professor position at the Free University of Berlin (2021-2022). In 2023, she returned to Georgetown University as an assistant professor, where she currently leads the Aging Brain & Cognition (ABC) Lab.

Dr. Reifegerste's work focuses on the psychology of language and the (neuro-)cognitive correlates of first- and second-language acquisition and processing. Of particular interest to her research is the question of how, when, and why aging affects language processing, both in healthy participants as well as populations with neurodegenerative disorders.

Talk - *Sentence processing in aging: What changes, what doesn't, and why?*

Over the last century, the average human lifespan has nearly doubled, rendering the effects of aging on cognition, including language, an increasingly vital research topic. Yet, the study of the developmental trajectory of language processing has largely focused on comparing linguistic abilities between children and young adults. Research into how language processing evolves from early adulthood to older age remains sparse, especially regarding sentence processing, which has received even less attention than other linguistic domains. This is noteworthy, given that understanding the changes in language processing with age can offer insights into the broader (neuro)cognitive mechanisms of language.

In this talk, I will present research on sentence-level processing across the lifespan, focusing on the computation of dependencies between sentence constituents, as is found, for example, during agreement computation and pronoun resolution. This work suggests that some aspects of syntactic processing can remain largely immune to aging. In contrast, when grammatical processing involves cognitive functions that are themselves affected by aging (e.g., working memory, processing speed), age-related declines in grammar processing emerge. On the flip side, some recent work suggests the potential for improvements with increasing age, likely as a consequence of lifelong exposure.

In conclusion, I will present evidence indicating that age differences in sentence processing may be at least partly explained by age-related changes in other aspects of cognition.

KEYNOTE 2	**11:00-11:50**

Sven Mattys – University of York

After graduating from the Université Libre de Bruxelles in 1993, he moved to the USA to carry out his PhD studies at the State University of New York at Stony Brook (1997). He remained in America as a postdoctoral researcher at the Johns Hopkins University (1997-1999) and then at the House Ear Institute in Los Angeles (1999-2000), before moving to the University of Bristol in 2001.He joined the University of York in 2012.

With a background is in experimental psycholinguistics, Dr. Mattys is particularly interested in the perceptual, cognitive, and physiological mechanisms underlying speech recognition. Although the populations he has investigated so far (normal-hearing adults, hearing-impaired adults, and infants) vary widely in their quantitative and qualitative exposure to the spoken language, a number of research questions apply to all of them: How are novel spoken words learned? What is the time-course of speech processing? How is speech segmentation carried out? How are words represented in the lexicon? How do we recognise speech in adverse conditions?

Talk - *Age-related changes in cognitive recruitment during listening in adverse conditions*

Cognitive decline is a dominant feature of aging. In this presentation, I will discuss the effect of cognitive decline on three facets of language processing: statistical learning, phoneme perception, and near-threshold sound detection. The ability to use statistical regularities in the soundscape to segment words from connected speech is observed in infancy and is thought to be largely automatic. Indeed, we found that statistical learning is remarkably stable across the lifespan, confirming the relative resilience of implicit learning to the aging process. However, an age effect appeared when statistical learning was measured under cognitive pressure (divided attention), highlighting age-related changes not so much in language processing itself but in the top-down cognitive control of linguistic functions. This observation was confirmed in a series of experiments showing that older listeners have difficulty inhibiting task-irrelevant lexical knowledge when performing a phoneme identification task (did you hear /g/ or /k/?); again, inhibition deficits were especially pronounced under divided attention. Age-related deficits in attention control were observed even in a task presumed to be encapsulated from cognition, namely a hearing test. Older participants' audiometric thresholds were raised by approximately 3 dB when performing a hearing test under divided attention, whereas younger participants' thresholds were largely unaffected. Taken together, our studies show that age-related changes in language and speech processing must be examined within a cognitive listening framework, with cognitive control, resources, and effort as defining constructs rather than linguistic processes per se.

| **KEYNOTE 3** | **11:50-12:40** |

Marco Calabria - Universitat Oberta de Catalunya

He got a degree in Psychology in 2002 at the University of Padua (Italy). In 2003, he joined the Cognitive Neuroscience Laboratory in Brescia (Italy) where he worked as a clinical neuropsychologist and, at the same time, collaborating on projects that investigated language deficits in patients with Frontotemporal dementia and the use of brain stimulation as a rehabilitation tool for patients with neurodegenerative diseases.

From 2006 to 2009, he carried out his PhD in Psychobiology at the University of Padua (Italy) focusing on the neurophysiological components of semantic and episodic memory in the elderly.

In 2009, he joined the Speech Production and Bilingualism (SPB) at the Center for Brain and Cognition (Pompeu Fabra University). From 2009 on his research interests are focused on the study of word production, non-linguistic control processes in brain-damaged (post-stroke and neurodegenerative diseases) individuals with a special emphasis on bilingual speakers, and on bilingualism as a contributor to cognitive reserve in dementia. In 2010, he was awarded the 'Juan de la Cierva' post-doctoral fellowship and in 2014 the 'Ramón y Cajal' fellowship from the Spanish Government.

Since December 2019, he is an Associate Professor of the Master in Neuropsychology at the Faculty of Health Sciences of the Universitat Oberta de Catalunya and member of Cognitive NeuroLab.

Talk - *Granularity and modularity of language: insights into lexical retrieval deficits*

Language, as a complex system, presents various granularities and modularities that pose both challenges and opportunities in understanding age-related deficits in speech production. In this talk, I will focus on the interplay between granularity and modularity in lexical retrieval deficits, with a particular emphasis on neurodegenerative diseases. I will discuss how comparing different types of diseases can reveal underlying deficits in specific levels of word production, as delineated by psycholinguistic models. Additionally, I will examine the commonalities in word-finding deficits across various brain diseases, which may challenge the predictions of certain language-based models of the brain.

POSTER SESSION

POSTER 1	**11:50-12:40**
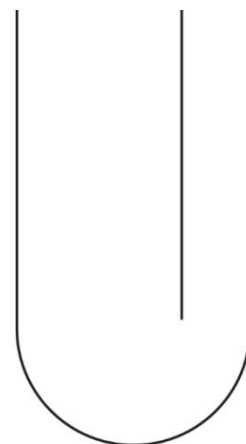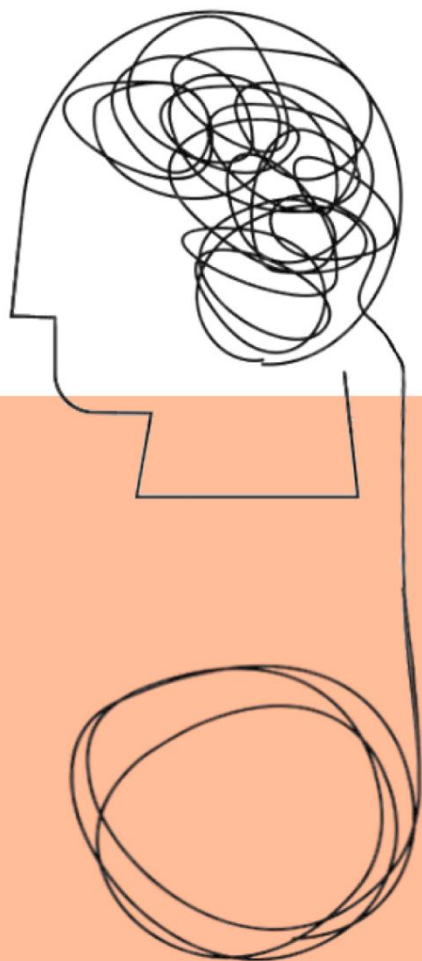
What were you thinking?
Differences in everyday thinking content in young and senior citizens
Chiara Barattieri di San Pietro[1], Valentina Bambini[1], Veronica Mangiaterra[1], Lara Fracassi[2],
Serena Lecce[2] & Elena Cavallini[2]
[1]University School for Advanced Studies IUSS; [2]University of Pavia

Everyday social experiences rely on pragmatic skills, whose disruptions can pose a risk to maintaining relationships and social engagement (Cummings, 2014), whose quantity and quality being associated with better physical and mental health in older adults (Bailey et al., 2008). Despite the relevance of these communication competences in everyday life, their investigation in aging is limited to the assessment in lab setting. To overcome this hurdle, we created a mobile Ecological Momentary Assessment (EMA) protocol.

One hundred and fifty six participants (80 young, 76 senior) answered a set of questions related to communication every day for seven days , five times a day (Fig. 1). From the answers to the question "What were you thinking just before the acoustic signal? We computed the n umber of words, type token ratio, Valence Arousal, and Dominance, Concreteness and Imageability, the number of human referents, and coherence.

Older adults produced shorter answers ($F(1, 3845) = 28.48$, $p < .001$), using words more abstract ($F(1, 3789) = 5.39$, $p = .02 0$)), less imageable ($F(1, 3789) = 5.39$, $p = .02 0$)), and expressing lower control over the content ($F(1, 3830) = 6.96$, $p = .0 08$) than words used by younger adults. In addition, answers by older adults were less coherent ($F(1, 3004) = 10.17$, $p < .001$) than answers by younger adults (Fig.).

The features extracted offers insights on the use of communication skills and on mentalizing processes across the lifespan, with reduced fluency and incoherence possibly related to the known pragmatic difficulties, and the abstract ion of content to differences in Theory of Mind processes in the senior population.

Figure 1. Examples of open and closed questions in the EMA protocol.

Figure 2. Plot of group effects (0 = younger adults, 1 = older adults).
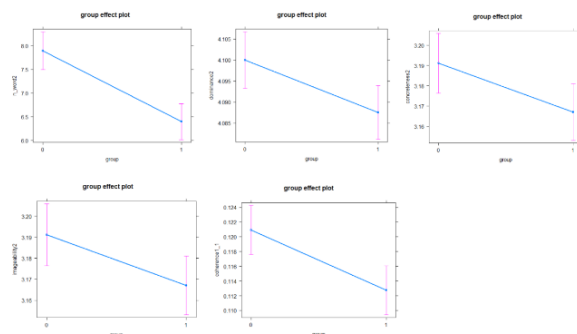
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POSTER 2	**11:50-12:40**

Training older and younger adults to perceive nonnative speech sounds
Sidsel Holm Rasmussen[1], Ocke-Schwen Bohn[1] & Birgitte Poulsen[1]
[1]Aarhus University

Many seniors are mentally healthy, but how flexible are their mental abilities? This is a relevant question in basic research and in the daily lives of seniors who seek intellectually stimulating activities such as language learning. This project examines foreign speech learning in one linguistic domain, i.e., perceptual training of identification accuracy for nonnative speech sounds. In a series of phonetic experiments, we apply well-established methods to a group of participants that has not been studied much in previous L2 perception research as we probe the perceptual flexibilities of healthy seniors.

This presentation summarizes main findings from our first two studies in which we trained younger (age 18-35) and older (age 60-78) listeners, whose first language was Danish, to identify nonnative speech sounds. The target L2 sounds were the English sibilant contrast /s/-/z/ in the first experiment, and the four Mandarin lexical tones in the second experiment. All trainees were first tested on their ability to identify the target items in our lab. They then completed a series of online auditory phonetic training with feedback over the course of three weeks, after which they returned to the lab for a post-training test. Furthermore, delayed post-training test scores were obtained for the trainees who were available two months later.

Findings demonstrate that both age groups obtained higher perceptual accuracy scores after training, and we suggest that the ability for reorganization of phonetic systems remains intact over the entire life span.

POSTER 3	11:50-12:40

Younger adults are quicker at semantic prediction but older adults are better
Leigh B. Fernandez[1], Muzna Shehzad[2], Lauren V. Hadley[2]
[1]University of Kaiserslautern-Landau, [2]University of Nottingham

Semantic prediction is the use of linguistic context to engage in the pre-activation of linguistic information before it is encountered. While evidence for prediction in young adults is relatively clear (Ferreira & Chantavarin, 2018) use of prediction across the lifespan remains contentious (Payne, & Silcox, 2019). In the current study we compare semantic prediction using eye-tracking and the Visual World Paradigm (VWP) with younger monolingual speakers of English (age mean (sd)=20.36(2.02), n=30) and older monolingual speakers of English (age mean (sd)=68.87(5.86), n=30). We tested predictable (semantically constraining) and unpredictable (semantically neutral) sentences while viewing a visual array; see Table 1. Firstly, we tested the timing (using divergence point analysis (Stone et al. 2021)) of looks to the target (guitar) relative to the distractor (strawberry) as a measure of general prediction. Secondly, we tested prediction with semantic competition: the agent (singer) activates two competing images (guitar, microphone), which the verb narrows to a single target (guitar). For general prediction we found that older adults were significantly later (~125ms) to look to the guitar relative to younger adults. However, when faced with semantic competition, older adults were significantly earlier (~275ms) to look to guitar relative to younger adults (see Figure 1). We believe that this supports recent research finding that as we age the attentional network of alerting (i.e., readiness to respond to incoming information) decreases, while orienting (i.e., resource shifting) and inhibitory functioning (i.e., inhibiting information) capacities increase (Veríssimo et al., 2022). We believe this will have interesting implications in the fields of both aging and prediction.

Table 1: Example stimuli and visual array

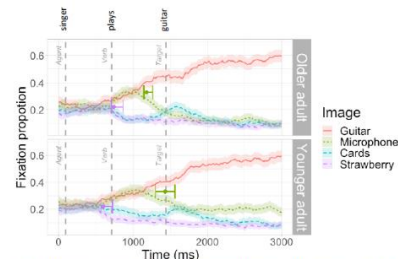|	Example stimuli	
	Sentence	Corresponding visual array
Predictable	The singer plays the <u>guitar</u>.	
Unpredictable	The cousin finds the <u>guitar</u>	

Figure 1: Divergence point and 95% confidence intervals (CIs) superimposed on the fixation proportion of looks to all images in predictable items. The purple CIs represent the general prediction divergence (*guitar* vs. *strawberry*) with older adults diverging significantly later than young adults. The green CIs represent the competition divergence (*guitar* vs. *microphone*) with the older adults diverging significantly earlier than younger adults.

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POSTER 4	11:50-12:40

The impact of word frequency and phonological neighbourhood density in lexical retrieval deficits in Primary Progressive Aphasia

María Sainz-Pardo[1], Marco Calabria[1], Francesco Ciongoli[1], Clara Martin[2,3], Simona Mancini[2,3] Stephanie Grasso[4], Sonia Marqués Kiderle[5,6,7], Juan Fortea[5,6,7], Alberto Lleó[5,6,7], Ignacio Illán-Gala[5,6,7], Miguel Ángel Santos-Santos[5,6,7]

[1]Universitat Oberta de Catalunya; [2]Basque Center on Cognition Brain and Language; [3]Basque Foundation for Science, Ikerbasque; [4]The University of Texas at Austin; [5]Sant Pau Memory Unit – [6]Hospital de la Santa Creu I Sant Pau; [7]Network Center for Biomedical Research in Neurodegenerative Diseases

Primary progressive aphasia (PPA) is a syndrome mainly characterised by the progressive deterioration of linguistic abilities, including lexical retrieval. However, it remains unclear which specific levels of processing are impaired in each variant of PPA and to what extent these deficits differ from those observed in patients with Alzheimer's Disease (AD).

The aim of this study was to examine the impact of lexical and phonological features in word retrieval deficits among patients with PPA and AD. To achieve this, we administered a picture naming task to individuals with AD (n=6) and individuals with PPA (n=23) comparing them in terms of accuracy and error types. Additionally, 11 cognitively healthy participants served as controls. The selected pictures varied in word frequency and phonological neighbourhood density.

Firstly, our findings revealed that in the PPA group, the semantic variant (53% accuracy) and the logopenic variant (59%) exhibited the most pronounced naming performance impairment compared to the non-fluent variant (79%), while AD participants (86%) performed comparably to controls (94%). Secondly, we observed that phonological neighbourhood density did not significantly affect naming performance, whereas word frequency demonstrated an impact on word retrieval.

Results indicate that word retrieval deficits in patients with semantic and logopenic variants of PPA may stem from a lexico-semantic origin, unlike in the non-fluent variant and AD. Further research is required to explore the influence of additional linguistic variables on word retrieval deficits in PPA patients.

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POSTER 5	**11:50-12:40**

*Understanding semantic networks in healthy aging and dementia
through measures of lexical availability*
Olga Ivanova[1], Ariadna Vergés Bonaventura[1] & Juan José García Meilán[1]
[1]University of Salamanca

Lexical-semantic impairment is one of the hallmarks of cognitive decline in Alzheimer's disease (AD). There is strong evidence that lexical-semantic impairment in AD significantly correlates with the severity of dementia (Tchakoute et al., 2017), and is qualitatively different from lexical changes in healthy aging (Ivanova et al., 2020). Psycholinguistic research has showed that features of typicality, age of acquisition, frequency, and propositionality of word-concept relations are crucial to understanding lexical-semantic deterioration in AD (cf. Venneri et al. 2018). Yet, studies on this question have not focused on how the remaining concepts are re-organized in semantic networks in aging.

We approach the re-organization of semantic networks by analyzing indexes of lexical availability for two semantic categories –"animals" and "fruits" – in a sample of Spanish-speaking older adults with AD, MCI, and healthy aging (HA) (n = 416). Data was collected through Semantic Verbal Fluency task. We analyze the lexical items composing both semantic categories by focusing on three parameters: (a.) quantitative and qualitative aspects of preserved semantic networks; (b.) bigram characteristics of preserved semantic networks (directionality, node salience, and distance between items); and (c.) force of connection between preserved lexical-semantic items. In doing so, we base our analysis on the newly developed software LexPro.

Our results allow to observe important differences in the preservation of semantic networks according to both the typology of the group (HA vs. MCI vs. AD) and the semantic category per se. We discuss our results in light of the correlation between cognitive impairment and semantic memory.

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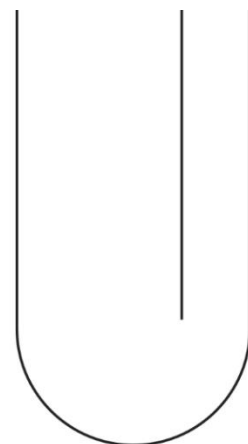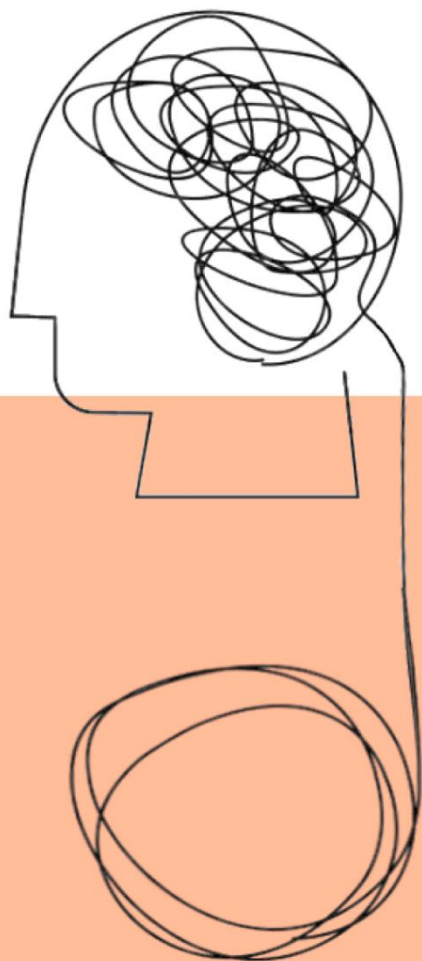
ORAL SESSION:

THE BILINGUAL MIND/GOGO ELEBIDUNA RESEARCH GROUP

TALK 1	15:50-16:20

Aging, Bilingualism, and the Computational Lens: Exploring Semantic Processing Decline
Miren Arantzeta[1], Itziar San Martin[1], Jon Paul Laka[2], Josu Goikoetxea[1]
[1]University of the Basque Country; [2]University of Deusto

Investigating semantic processing and its aging resilience is vital for understanding language processing. This research examines how aging influences the structure of semantic networks and whether bilingualism can mitigate these effects. We selected 180 Basque and Spanish word pairs from a semantic similarity database, computed through word embeddings, in a study involving 256 participants aged 30 80, including monolingual Spanish and highly proficient bilingual Basque Spanish speakers. Participants underwent a semantic judgment task and an unexpected memory recall task in their L1, with their accuracy, reaction times, and recall abilities analyzed through statistical models.

The findings highlight the significant role of semantic similarity in determining judgment accuracy and speed. Aging was shown to raise the threshold for semantic similarity needed to associate concepts, with these effects being more pronounced in monolinguals. Reaction times lengthened with age and were influenced by the semantic similarity between word pairs and the judgment type. Recall performance was linked to verbal fluency and visual working memory capabilities, with monolinguals generally performing worse than bilinguals. Moreover, the effect of semantic closeness on recall likelihood was stronger in younger adults, indicating that older adults have a reduced capacity to utilize semantic memory for recall.

These findings highlight the age-related decline in semantic processing, particularly challenging for monolingual individuals. Our computational approach, utilizing word embeddings for semantic similarity calculation, appears sensitive in detecting age related deterioration in semantic memory, illuminating the complex interplay between aging, bilingualism, and semantic cognition.

TALK 2	**16:20-16:50**

Word segmentation abilities remain stable across the lifespan:
A comparative study of young and older bilinguals

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Breaking down continuous speech into meaningful units is challenging, yet humans—infants and adults—do so effortlessly by integrating multiple cues whose importance and relative weigh changes throughout development (Mattys et al., 2005). Here, we investigate whether adults' segmentation abilities remain constant in healthy aging. In addition, we explore bilinguals' abilities to achieve native-like segmentation of a second language. Viewing bilingualism as a multifaceted construct and a continuum (Dash et al., 2022), our study explores the impact of four key dimensions of bilingualism: age of acquisition, language proficiency, language use and frequency of language switch.

We tested 98 healthy older (≥60) and 124 young (18-35) Spanish-Basque bilinguals that varied greatly in their knowledge, use and age of acquisition of Basque. We assessed these factors using self-report and standardized measures and controlled for fluid intelligence in both groups and cognitive health and cognitive reserve in older bilinguals. Participants completed a segmentation task in Basque, adapted from Sanders and Neville (2000), which comprised 240 sentences of three types: (1) "natural" sentences, i.e. fully grammatical and meaningful; (2) jabberwocky sentences, where content words were replaced with nonsense words, but functors were preserved (i.e., grammatical, but not meaningful); and (3) phonological sentences comprising only nonsense words, but preserving all phonological information (i.e., neither grammatical, nor meaningful). Each sentence contained a target phoneme and participants' task was to indicate whether it occurred word-initially or word-medially.

Multiple regression analysis revealed that the factor age did not improve model fitness, neither as fixed effect nor in interaction with other factors. Conversely, age of acquisition, frequency of language switch, proficiency, and fluid intelligence (all $p≤.01$) predicted segmentation accuracy. Further, proficiency interacted significantly with sentence type ($p<.0001$), as proficiency-related gains were greatest in natural sentences, followed by jabberwocky, and lastly by phonological sentences. Proficiency also interacted significantly with target position ($p≤.001$), as accuracy increases related to proficiency were larger in word-initial targets.

These results evidence thus the stability of our segmentation abilities throughout adulthood, identify the role of specific bilingual dimensions in achieving native-like segmentation of a second language and suggest a particular role of proficiency in modulating word segmentation in older bilinguals.

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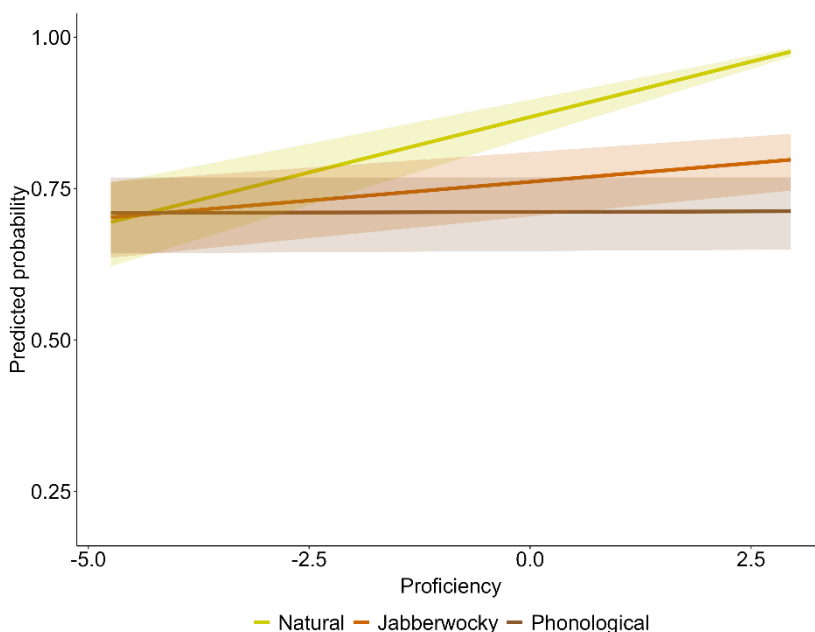
Figure 1. Accuracy as a function of Proficiency by Sentence type computed on estimated marginal means. Accuracy increased with proficiency in all cases, but natural sentences produced the largest proficiency-related gains, followed by jabberwocky and lastly by phonological sentences.

Figure 2. Accuracy as a function of Proficiency by Target position computed on estimated marginal means. Accuracy increases related to proficiency were larger in word-initial targets.
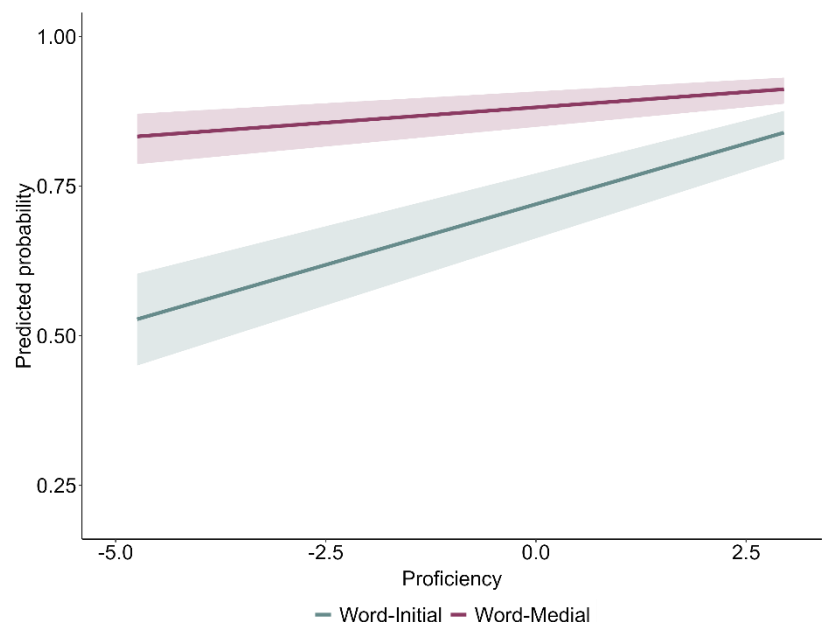
TALK 3	16:50-17:20

Aging effects in prediction and agreement processing
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In aging, prediction is influenced by two competing cognitive forces: cognitive decline and language experience [1]. Accordingly, this study investigates how does age modulate predictability? Two hypotheses were tested: (1) OAs would make better predictions due to greater language experience, and (2) that cognitive decline would hinder prediction abilities in OAs.

The study tracked the eye-movements of 27 YAs (22.96 (3.86)) and 28 OAs healthy native Spanish speakers (61.85 (4.22)) to investigate the effects of aging in lexical put, particularly, on grammatical prediction during comprehension. Participants read sentences for meaning with a Verb+Clitic manipulating semantic predictability (high-cloze vs. low-cloze verbs) and grammaticality (grammatical vs. ungrammatical object-clitic gender agreement). Results revealed robust age-related differences in grammatical prediction, with OAs exhibiting larger effects and higher processing costs compared to younger adults, particularly in the ungrammatical sentences. These findings went in line with previous studies [2, 3] and supported our hypothesis 2, suggesting cognitive decline and a decline in prediction with age.

A follow-up experiment (experiment 2) aimed to replicate this larger grammaticality effects in OAs (prediction 1)[4] by using paradigm of agreement attraction (aim 1), and to further explore OAs' and YA's susceptibility to agreement attraction during sentence comprehension in Spanish (aim 2). Importantly, if these aging effects reflected weaker resources to process agreement, we expected OAs to show stronger agreement attraction effects than YAs (prediction 2) [2]. The study involved eye-tracking 44 YAs (18-34 years; M=28.5, SD= 7.7) and 48 healthy OAs (>65 years; M=64.0 SD= 5.6) Spanish natives participants. They had to read 60 sentences in 4 experimental conditions: with subject noun phrases whose head matched (pl.) or mismatched (sg.) in number with the plural verb (Grammaticality: gramm./ungramm.) and attractor nouns that matched (sg.) or mismatched (pl.) the verb (Attractor: sg./pl.) (Figure 1).

The GLME analyses revealed several interactions indicating how age affects agreement processing. Specifically, OAs showed larger grammaticality effects (confirming prediction 1). Additionally, an interaction between grammaticality and attractor effects was observed at the verb region, with attraction effects being significant only in ungrammatical sentences (grammatical asymmetry) [5]. This latter interaction pattern was also present at the subject and attractor regions. Importantly, a three-way interaction at Total Time Durations at the verb region showed that the grammatical asymmetry of attraction effects was significant only for OAs (confirming prediction 2: see Figure 2) [2].

Overall, these findings suggest that age influences agreement processing, possibly because of challenges in inhibiting interference or due to higher working memory loads. Cognitive measures are currently being analyze to relate them with these eye-tracking patterns.

References

[1] Harada et al., *Clin Geriatr Med*, 2013.

[2] Reifegerste, J., et. al., *Aging Neuropsychol. Cogn*., 2017.

[3] Reifegerste, J. et. al., *J Mem Lang*., 2020.

[4] Cano-Sánchez, V., et.al., *AmLaP*, 2021.

[5] Wagers et al., *J. Mem Lang*., 2009.

Figure 1. *Sample sentences of an item in the four experimental conditions resulting from the manipulation of the attractor number (singular vs. plural) and grammaticality (grammatical vs. ungrammatical sentences). The two elements involved in the attraction relation are bolded across all conditions, and the critical region for analysis (the verb) is framed in squares.*

(i) Grammatical-Mismatch (Plural subject-Singular attractor-Plural verb; PSP):

Los pasteles$_{PL}$ con el dibujo$_{SG}$ nunca ganaron$_{PL}$ *un premio de repostería debido a la calidad de la masa.*

(ii) Grammatical-Match (PPP):

Los pasteles$_{PL}$ con los dibujos$_{PL}$ nunca ganaron$_{PL}$ *un premio de repostería debido a la calidad de la masa.*

(iii) Ungrammatical-Mismatch (SSP):

**El pastel$_{SG}$ con el dibujo$_{SG}$ nunca* ganaron$_{PL}$ *un premio de repostería debido a la calidad de la masa.*

(iv) Ungrammatical-Match (SPP):

**El pastel$_{SG}$ con los dibujos$_{PL}$ nunca* ganaron$_{PL}$ *un premio de repostería debido a la calidad de la masa.*

The cake(s)$_{MASC.SING./PL}$ with the design(s)$_{MASC. SING./PL}$. never won$_{V°PL}$. a price bakery due to quality dough.

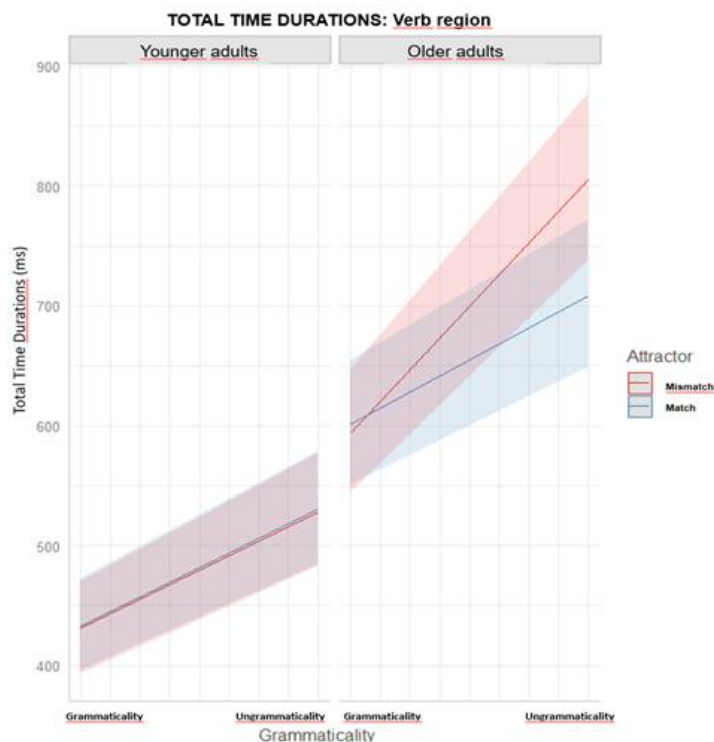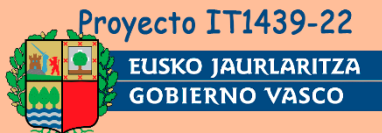**Gloss:** The cake with the designs never won a bakery price due to its dough quality.

Figure 2. *Graph plotting the triple way interaction of grammaticality by attractor by group in Total Time Durations at the verb region with a significant effect of attraction only for the older adults in the ungrammatical-mismatch (SPP) condition.*

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