Workshop on Language Dynamics Across the Lifespan
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FRIAS (Freiburg Institute for Advances Studies)
University of Freiburg

Workshop topic
Over the last years, cognitive aging has attracted a great deal of scholarly attention, partly due to the global demographic trend towards aging populations and the economic, medical and social challenges this poses. While cognitive aging research has mostly focused on age-related deficits, it has also been acknowledged that certain cognitive functions might be preserved or even improve as a function of age. A possible candidate for a cognitive ability that might remain largely intact across the life span is language comprehension. Efficient language comprehension is essential for successful social interactions for both young and older adults. The acquisition and maintenance of linguistic skills is, however, strongly modulated by cognitive and perceptual factors. Moreover, linguistic skills and cognitive abilities change over the life span. The aim of this workshop is to explore the dynamics of language comprehension across the life span, starting with adolescents and up to older adults.

By its very nature, cognitive aging research is fragmented across multiple disciplines (psychology, neurology, linguistics, cognitive sciences, among others), making it hard to arrive at an integrated understanding of the dynamics of language comprehension across the life span. As a result, many questions around the presumed resilience of language comprehension to aging still await interdisciplinary treatment: Are all aspects of language comprehension (phonological, morphological, syntactic, semantic, pragmatic levels of processing) equally spared across the (adult) life span? Does broadly similar behavioral performance between age groups in comprehension tasks result from similar neuro-functional processes, or does the performance of elderly people rest on compensatory reorganization of the language comprehension system? How do the dynamics between language and other cognitive functions (executive control, working memory) develop with age? How do sensory deficits affect language comprehension? How do typical experimental tasks (e.g., button-press tasks under time pressure, tasks with high working memory load) affect, and maybe even bias, the outcome of cognitive experiments in general comparing younger and older subjects? And finally, how does age interact with other demographic variables such as gender and socio-economic background? Our research objective is to gain a more systematic and comprehensive understanding of these issues, with a special focus on differentiating the effects of age on different levels of language processing.

Organizers: JProf.Dr. Adriana Hanulíková, Dr. Alice Blumenthal-Dramé, Prof.Dr. Evelyn Ferstl

Programme

9:00-9:30	Registration
9:30-10:00	**Welcome**
10:00-11:00	**Michele T. Diaz (Pennsylvania State University)** Effects of task difficulty on semantic and phonological aspects of language comprehension and production in younger and older adults
11:00-11:20	Coffee break
11:20-12:20	**Katinka Dijkstra (Erasmus University Rotterdam)** Situation model updating in younger and older adults
12:20-13:00	**Evie Malaia (FRIAS and Purdue University)** Interaction of language comprehension and working memory: Cross-sectional analysis
13:00-14:00	**LUNCH**
14:00-15:00	**Deniz Başkent (University of Groningen)** Perception of voice and speaking styles in cochlear-implant users: a case study of individual differences
15:00-15:30	**Adriana Hanulíková (University of Freiburg and University of Konstanz)** Advantage accented? How talker identity affects speech processing across the life span
15:30-16:00	Coffee break
16:00-17:00	**Antje Heinrich (University of Manchester)** On the role of cognition for speech intelligibility in younger and older listeners in a range of listening situations
18:30	**WORKSHOP DINNER**

9:30-10:30	**Fermín Moscoso del Prado Martín (University of California, Santa Barbara)** The potential of corpus analyses for studying language in aging.
10:30-11:15	**Catherine McBride (FRIAS and Chinese University of Hong Kong)** Speed matters for higher order literacy skills
11:15-11:45	Coffee break
11:45-12:45	**Joana Acha (University of the Basque Country UPV/EHU)** Cognitive markers of language development in primary school children
12:45-13:45	**LUNCH**
13:45-14:15	**Evelyn C. Ferstl (University of Freiburg)** Comprehension of pragmatic language in older adults: The case of verbal humour
14:15-15:15	**Debra Titone (McGill University)** How does bilingual experience over the lifespan impact natural reading and enduring changes in cognition?
15:15-15:45	Coffee break
15.45-16:30	**Final Discussion: Challenges and future of lifespan and aging studies**
18:00	**WORKSHOP DINNER**

Cognitive markers of language development in primary school children

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Aim: Non-modular accounts of SLI suggest that impaired basic cognitive processes might be possible causal mechanisms of language disabilities. Concretely, deficits in several core processes that start developing early in childhood such as sustained attention, speed of processing and working memory have been suggested to play a potential role on SLI. This fact could explain the relative overlap among language and reading disorders (Pennington & Bishop, 2009). However, previous works have studied these processes separately in different clinical samples. The aim of this study was to examine the causal role of these three processes on language attainment in a big non-clinical sample of pre-readers.

Method: A longitudinal study was run to 116 children in 1st grade (aged 6 to 6.5), who were also recruited one year later (in 2nd grade). Children were tested on processing speed, visual attention (WISC Symbol search) and verbal working memory (WISC digit span backwards) as well as on linguistic abilities: CELF-4 receptive and expressive vocabulary, phonological short term memory, receptive grammar and phonological awareness (a key precursor of reading). Regression analyses were conducted to test whether these three key processes predicted language outcomes.

Results: Measures of visual attention predicted verbal working memory, and phonological short term memory. In turn, phonological short term memory explained the greatest source of variance on both receptive and expressive vocabulary and receptive grammar. Attentional resources were also implicated in nonverbal IQ measures. Interestingly, executive processes in Time 1 (attention and working memory) predicted language outcomes in Time 2.

Conclusions: Our results provide clear evidence for the role of executive function abilities such as attentional control and verbal monitoring in the developmental pathway of language, suggesting that lack of executive resources might be potential early at risk factors of language difficulties. Additionally, our predictive model reflects that attention, verbal monitoring and short term memory represent three different but interrelated abilities that may boost acquisition of linguistic skills, suggesting a cascaded cognitive model of language development. These findings support a non-modular approach to understand language development and pose important challenges for evaluation and intervention strategies not only in childhood but across the lifespan. Broader implications will be discussed and several areas of investigation that derive from this perspective will be proposed.

Perception of voice and speaking styles in cochlear-implant users; a case study of individual differences

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Speech communication is essential for humans, yet, in can be hindered by hearing impairment. Especially in vulnerable populations, such as children and elderly, this can lead to devastating effects, such as delays in child development or isolation of the elderly.

While linguistic content per se (what they said) is an essential component of communication, another very important component of speech is the speaker's voice (who said it). Voice information can significantly contribute to communication, such as in conveying crucial details about the talker's identity, background, and emotional state, in adapting to a speaker's style to subsequently increase the intelligibility of their speech, or in enhancing speech segregation and comprehension in cocktail-party listening. These are also the situations where hearing-impaired individuals with cochlear implants report to have difficulties.

Cochlear implants, prosthetic hearing devices that directly and electrically stimulate the auditory nerve, have been successful in helping the users regain hearing function. Yet, due to a number of factors related to nerve health, etiology of deafness, electric stimulation, and device settings, the speech signal delivered is heavily degraded in spectro-temporal details[1]. Added to this that many implant users are children or elderly, with variations in current age or age of deafness/implantation, hearing experience, and cognitive compensation for degraded speech[2]. All these factors combined, the implant users make a study population that is inherently and widely heterogeneous[3], emphasizing the importance of focusing on individual differences[4].

Despite the importance of voice and speaking styles for speech communication, and the observations of implant users having difficulties in related tasks, our knowledge of voice processing and its role in speech comprehension in cochlear implant users generally remained limited. Some of this limitation came from the technical aspects, as the voice and linguistic content are closely related to each other in a speech signal. Some of the limitation came from the heterogeneous structure of the population. In our recent work, which will be presented in this talk, we aim to tackle both aspects. For technical limitations, we use signal processing techniques that allow us to change voice parameters in an isolated and systematic manner[5]. For individual differences, in addition to analyses of behavioural data for individual differences[6], we use techniques such as eye tracking, which reveal further details of time course of speech comprehension[7]. With such systematic approach, we aim to not only gain more scientific knowledge on speech comprehension, with or without hearing impairment and across the lifespan, but also potentially improve solutions to hearing-impaired clinical populations.

References
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Effects of task difficulty on semantic and phonological aspects of language comprehension and production in younger and older adults

Michele T. Diaz

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Although decline in cognitive function is often observed with aging, language reveals patterns of both spared and impaired performance. Semantic processes are well maintained throughout adulthood with older adults having larger and more varied vocabularies and knowledge. However, older adults often complain about frustrating and increasingly frequent problems with language production, particularly with phonological aspects, as seen in more tip-of-the-tongue incidences and more pauses during speech. This asymmetric pattern suggests a fundamental difference in the cognitive and neural organization of these language abilities. Importantly, the differences between semantic and phonological processes may also depend on task difficulty, and difficulty may vary between comprehension and production. I will discuss the results of two fMRI experiments in which difficulty varied in comprehension and production tasks. In the first experiment, we investigated the neural underpinnings of phonological and semantic retrieval with rhyme and semantic judgment tasks. Behaviorally, all participants responded faster and more accurately during the rhyme task, and older adults were more accurate than younger adults during the semantic task. The neuroimaging results revealed an Age Group × Task interaction in left inferior frontal gyrus (IFG), with older adults produced greater activation than younger adults during the semantic condition. These results showed that during the easier phonological task, older and younger adults engaged similar neural networks, and as task difficulty increased during the semantic task, older adults relied more heavily on largely left hemisphere language regions to maintain performance during comprehension. These results are consistent with the stability of language comprehension across the lifespan and suggest that the preservation of semantic representations with age may aid performance under conditions of increased difficulty. In our second experiment, we examined how task demands influence speech production using a phonological Go-No Go picture naming task. Naming (language production) and inhibition (withholding naming) demands were manipulated by altering the number of naming (Go) and withholding (No-Go) trials per run. Behaviorally, we found that all adults named pictures more slowly as task difficulty increased and that older adults only named more slowly than younger adults in the more difficult naming conditions. fMRI showed that all adults had increased activation as a function of naming difficulty in both language-related regions such as bilateral IFG and insula, as well as cognitive control regions such as right superior and middle frontal gyri. Moreover, age-related increases in activation were associated with faster reaction times, suggesting that the increases may be compensatory. These results illustrate how both language and cognitive control regions may help maintain speech production under increased difficulty. Collectively, these findings highlight the important influence of task difficulty on behavioral and fMRI patterns of activation and suggest that the nature of age-related increases in fMRI activation may depend on the nature of the task at hand.

Situation model updating in younger and older adults

Katinka Dijkstra

Erasmus University Rotterdam

Cognitive aging research has been developing as a discipline in its own right since the past four decades or so. Initially, the focus of research was geared towards age-related deficits in cognitive functions and processing speed (Salthouse, 1996) demonstrating how older adults performed worse and more slowly on cognitive tasks that placed heavy demands on cognitive resources compared to their younger counterparts.

More recently, there has been a shift in research towards preserved skills in cognitive aging processes. For example, the socio-emotional selectivity theory described better emotion regulation in older than in younger adults and a better processing and memory of positive rather than negative stimuli (Carstensen, 2006). Preserved abilities in aging have also been demonstrated in language comprehension tasks. Several studies have shown that even though age-related declines in language comprehension appear at the level of the surface form (verbatim words and syntax) and text base (propositional content) of the text, these age differences do not apply to the creation and updating of situation models (state of affairs represented in a text), for which older and younger adults show similar performance (Radvansky & Dijkstra, 2007). On the one hand, older adults may have more difficulty to maintain information from earlier sections in a text because of their slower processing speed compare to younger adults, which coupled with a decline in working memory capacity, may impair their ability to remember verbatim information and manage larger amounts of information (Zacks, Hasher, & Li, 2000). On the other hand, more extensive reading experience and a higher ability in gist-based processing among older adults, relative to younger adults, may facilitate the creation and updating of situation models of a text. This preservation of language comprehension skills at the level of situation models has been demonstrated in different language comprehension and memory tasks and for different types of texts, such as sentences (Dijkstra, Yaxley, Madden, & Zwaan, 2004, Madden & Dijkstra, 2010) and stories (Radvansky, Copeland, & Zwaan, 2003). In several studies, older readers appeared to be even more sensitive to manipulations in language comprehension tasks than younger readers. For example, older adults showed a stronger mismatch effect when processing sentences when responding to pictures of objects that did not match the implied shape of the objective in the preceding sentence (Dijkstra et al., 2004). They also displayed stronger updating effects of changes in the situation model than younger adults (Radvansky, Copeland, Berish, & Dijkstra, 2003).

Overall, older readers may have more unitized representations of text because of their lifelong reading experience that enables them to have more effective reading strategies and a stronger reliance on context in language comprehension tasks. This may compensate for deficits in cognitive capacity but results there does not appear to be a direct relationship between reading span, language comprehension and age (Madden & Dijkstra, 2010; Radvansky & Dijkstra, 2007). Factors that may be responsible for this resilience in language comprehension in older age will be discussed and explored further in this presentation.

Comprehension of pragmatic language in older adults: the case of verbal humour

Evelyn C. Ferstl

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Pragmatic language comprehension, such as the comprehension of metaphors, idioms, indirect requests or verbal humour, relies on two rather distinct types of subprocesses. On one hand, all of these types of language require good social knowledge and a rich vocabulary, as the basis for entertaining alternative interpretations of ambiguous words, phrases or situations. Knowledge based processes of this type have been shown to be preserved, or even improved in older readers and listeners. On the other hand, most of these types of non-literal language require flexibility of processing and the ability to quickly and effortlessly shift between alternative interpretations. This latter type of processes is more prone to decline or slowing throughout the lifespan.

In this talk I will review empirical literature on age related changes in the comprehension of pragmatic language with a particular focus on jokes and verbal humour. In addition, I will present pilot data from a currently conducted study. Using materials developed for neuropsychological patient studies, we attempt to disentangle linguistic revision processes, - necessary for reinterpreting initially misleading context information -, from affective reactions and socio-communicative processes involved during joke comprehension. Reading times and evaluation of jokes and control texts are compared in a group of older (75 years and older) and younger (around 35 years) adults.

Advantage accented? How talker identity affects speech processing across the life span

Adriana Hanulíková

University of Freiburg, University of Konstanz

Speech and faces provide a rich source of information about a talker identity. In a face-to face conversation, listeners combine not only linguistic information but also information about who is speaking and how a message is communicated. Previous research suggests that perceived racial identity may alter comprehension and interpretation of native-accented and foreign-accented speech. Following expectation-based accounts, perceiving a specific ethnicity may result in expectations about a talker's accent and hence increase intelligibility of foreign-accented speech. In contrast, bias-based accounts predict comprehension difficulties even for native-accented speech, because a perceived foreign ethnicity of the ostensible speaker activates certain stereotypes or biases. In this talk I will focus on two questions: 1) Under what conditions is comprehension of native-accented and foreign-accented speech facilitated as a function of speaker identity? 2) Do effects of speaker identity on language comprehension change across the life span? I will present results from several studies with distinct populations (school children, college students, young adults, and preliminary results from older adults) and show that ease of language comprehension depends on the specific combination of accented speech and talker identity on one hand, and listener background on the other hand.

On the role of cognition for speech intelligibility in younger and older listeners in a range of listening situations

Antje Heinrich

University of Manchester

Correctly perceiving speech in a noisy environment is difficult for everyone, but particularly so for older listeners. Age-related hearing loss explains some but not all of the difficulties, and considerable individual differences in listening success remain between listeners with comparable hearing profiles. The suggestion of cognitive involvement in speech perception has received a lot of attention in recent years as an additional factor to understand, on the one hand, individual differences between older listeners with similar hearing profiles, but also to understand differences in listening between young and old adults. In my talk I will discuss how a number of different cognitive abilities, including working memory, attention and linguistic knowledge, contribute to listening in a variety of situations and how their contributions are affected by both age and hearing loss. I will show data that suggest that younger and older listeners achieve the same level of intelligibility with the support of very different cognitive skills. I will also discuss how the employment of cognitive skills differs depending on the nature of the to-be-perceived speech signal and the amount of hearing loss of the listener. Overall I will argue that often younger and older listeners appear to be using very different listening strategies to achieve the same goal - good speech intelligibility in a noisy situation, and that these differences in strategy may go some towards explaining why older listeners often find listening in noise much more effortful and tiring than their younger counterparts.

Interaction of language comprehension and working memory: Cross-sectional analysis

Evie Malaia

FRIAS and Purdue University

Multiple studies attest to a relationship between working memory capacity (WMC) and language processing ability; however, the exact nature of the relationship is not yet clear. For example, individual differences in WMC correlate with success in reading comprehension, but only for complex reading tasks, which require manipulation of the WMC contents, rather than simple storage. While most research examining the relationship between language and working memory has focused on the verbal WM system, the language may interact with the visuo-spatial and episodic (long-term) memory buffers as well.

We examine the relationship between working memory and linguistic processing by considering evidence from several populations using multi-method framework: 1) neurophysiological and neuroimaging evidence from adult readers of complex sentences, who differed in WMC measures; 2) a pilot investigation aimed at improving reading comprehension for complex sentences in 5th graders; and 3) analysis of working memory interaction with sign language processing, and WMC relationship with visuo-spatial processing in signers and speakers.

Overall, neurophysiological evidence suggests that adult readers with high WMC appear to generate an event representation of the sentence they are reading early, and revise it multiple times in the process of reading, which aids in comprehension. 5th graders, when trained to apply a similar strategy to reading complex sentences, showed, first, an increase in automaticity of memory access, indicated by higher accuracy of sentence content recall, and second, the shift in allocation of executive attention from working memory manipulation to retrieval, as evidenced by decreased performance on Backward Digit Span task. Thus, while strategy-based reading intervention did improve participants' reading comprehension, it also trained participants to allocate executive function resource to maintenance and recall, as opposed to working memory manipulation, due to competition in resource allocation within individual's executive function.

The question of apparent discrepancies in short-term memory capacity for sign language and speech has long presented difficulties for the models of verbal working memory. While short-term memory capacity for spoken language spans up to 7±2 items, the verbal working memory capacity for sign languages appears to be lower at 5±2. The assumption that both auditory and visual communication (sign language) rely on the same memory buffers led to the claims of impairment of STM buffers in sign language users. However, comparative review of methods used to assess WMC in signers and speakers indicates that common neural resources recruited for sequential rehearsal and spatial representation preclude the signers from utilizing an 'overflow' strategy (phonological loop), which speakers rely on to extend their WMC. This model offers a parsimonious explanation for the conflict between spatial and linguistic processing in spoken language alone, as well as the differences observed in WMC for sign and speech.

Speed matters for higher order literacy skills

Catherine McBride

FRIAS and Chinese University of Hong Kong

In this talk, I will primarily review some data we have analyzed over the years on correlates and predictors of reading comprehension and writing composition, higher order language comprehension skills in literacy. Many cognitive-linguistic skills are associated with both abilities. Among these are vocabulary knowledge, morphological skills, and word reading or spelling themselves. At a broader level, home literacy environment, motivation, gender, and socio-economic status are also associated with better skills and probably interact. Perhaps the one variable that stands out most strongly across studies, however, is speed of processing. Proxies for speed of processing continue to develop over childhood and adolescence, are often independently associated with reading and writing apart from other cognitive-linguistic skills, and may be influenced by culture or genetics. In our own work on literacy skills across a first and foreign language, those who are particularly slow in speed of processing tasks tend to be the most impaired. One important issue for researchers and clinicians, then, is to what extent speed of processing can be trained and enhanced across adolescence and early adulthood. Enhancing fluency could potentially improve written language comprehension in both a first and a foreign language.

The potential of corpus analyses for studying language in aging

Fermín Moscoso del Prado Martín

University of California, Santa Barbara

Understanding the changes in our language abilities along the lifespan is a crucial step for understanding the aging process both in normal and in abnormal circumstances. Besides controlled experiments, it is equally crucial to investigate linguistic corpora, as they offer rich information from "natural experiments". I will present two corpus analyses investigating the effects of aging in naturalistic corpora. The first study investigates a large cross-sectional sample of dyadic conversations, revealing important differences in the aging process for women and men, seemingly pointing to an earlier deterioration of linguistic abilities in mean (beginning as early as 43 years of age in average). In the second study, I will investigate longitudinal written corpora (of novels and of letters) revealing early indicators of Alzheimer's disease, that could potentially be exploited for early diagnosis and monitoring of the progress of dementias. In addition, I will introduce a set of information-theoretical measures suitable for measuring linguistic performance along the lifespan that address some of the sample-size confounds that arise in other frequently used measures.

How does bilingual experience over the lifespan impact natural reading and enduring changes in cognition?

Debra Titone

McGill University

A wealth of research has investigated the ways in which healthy aging impacts language processing, however, much of this work has focused on monolingual speakers, or first language (L1) comprehension and production. Consequently, there is much to be discovered about how language processing varies over the lifespan for bilingual individuals when they engage in second language (L2) processing, and also how the impact of bilingual language experience on processing may lead to enduring changes in linked cognitive capacities (e.g., executive control). In this talk, I will highlight two ongoing streams of research in my laboratory that pertain to these questions about bilingual language experience over the lifespan. In a first line of work, we investigate L1 and L2 bilingual reading in healthy younger and older adults using eye movement measures of comprehension, and how natural reading patterns relate to individual differences in bilingual experience (e.g., the likelihood of currently using ones L2 in daily life). In a second line of work, we investigate how similar individual differences in bilingual experience link to enduring changes in domain-general executive control performance in healthy younger and older adults. Taken together, these interdependent streams of research suggest that the heterogeneous nature of people's bilingual experiencemust be considered to understand how language function changes over the lifespan, both in the context of L1 and L2 language processing.