

# Language Processing and Aging

Vera Demberg

Universität des Saarlandes

– WS 2014/5 –

October 30th, 2014

# Table of Contents

- 1 Administrative remarks
- 2 Organization
- 3 Background
  - Driving and Talking
  - Dialog Systems and Driving
  - Aging
- 4 Giving a good talk

## Requirements for this course

- **A presentation**, ca. 25 min per person; contributes 70% of the grade.
- **participation in the discussion** is graded (15%).
- (If you registered for the seminar for 7 points) write a **term paper** (12-20 pages) at the end of the semester.
- fill in a **peer review form** about each presentation (15%).
- **Attendance**: You can miss ONE meeting without giving an explanation; if you miss more, you have to hand in a critical review for the discussed paper(s).

# Peer Review Forms

WHY peer review forms?

# Peer Review Forms

## WHY peer review forms?

You profit as a reviewer:

- goal: to make you more observant of other's talks
- learn more from presentations given by others
- all comments to the presenter will be ANONYMOUS

# Peer Review Forms

## WHY peer review forms?

You profit as a reviewer:

- goal: to make you more observant of other's talks
- learn more from presentations given by others
- all comments to the presenter will be ANONYMOUS

You profit as a presenter:

- remind you which criteria are important
- **feedback:** you will get lots of *detailed* feedback on your talk

# Peer Review Forms

## WHY peer review forms?

You profit as a reviewer:

- goal: to make you more observant of other's talks
- learn more from presentations given by others
- all comments to the presenter will be ANONYMOUS

You profit as a presenter:

- remind you which criteria are important
- **feedback:** you will get lots of *detailed* feedback on your talk

**Note on grading for review forms:** good grade = thoughtful comments, give *constructive* comments in addition to the box ticking.

# Table of Contents

- 1 Administrative remarks
- 2 Organization**
- 3 Background
  - Driving and Talking
  - Dialog Systems and Driving
  - Aging
- 4 Giving a good talk



# Organization: Topics and Time Slots

Please:

- Send me an email with your top 2-3 preferred topics / question you'd like to work on **by MONDAY**.

EMAIL ADDRESSES: vera at coli.uni-saarland.de

## Time line:

- week 1 assignment of topics
- week 2 lecture on psycholinguistic basics  
start literature search, figure out what methods are mentioned (self-paced reading times, eye-tracking, reaction times, EEG, fMRI etc.)  
decide what method you would like to present about by next meeting
- week 3 lecture on multitasking
- week 4 (I'm travelling); you should in small groups finish up working on the preparation about methods; you can use the seminar room in the normal slot.
- week 5 methods presentations by students
- weeks 6+ topic-related presentations by students.

# Motivation: Why language processing and aging?

- 1 Talking and Driving Safety
- 2 Aging
- 3 Dialog Systems

# Table of Contents

- 1 Administrative remarks
- 2 Organization
- 3 Background
  - Driving and Talking
  - Dialog Systems and Driving
  - Aging
- 4 Giving a good talk

# Table of Contents

- 1 Administrative remarks
- 2 Organization
- 3 Background
  - Driving and Talking
  - Dialog Systems and Driving
  - Aging
- 4 Giving a good talk

# Dialog Systems and Road Safety



Three observations:

# Dialog Systems and Road Safety



Three observations:

- Dialog systems are getting integrated into cars

# Dialog Systems and Road Safety



Three observations:

- Dialog systems are getting integrated into cars
- People will do all kinds of tasks during driving



# Dialog Systems and Road Safety



Three observations:

- Dialog systems are getting integrated into cars
- People will do all kinds of tasks during driving
- We live in an aging population, aging decline in multi-tasking

# Background: Language and Driving

Research on driving and language:

- mobile phone usage  
→ negative effect on driving
- hands-free speaking system  
How does it compare to cell-phone?
- 



# Experiment on Driving and Hands-free driving



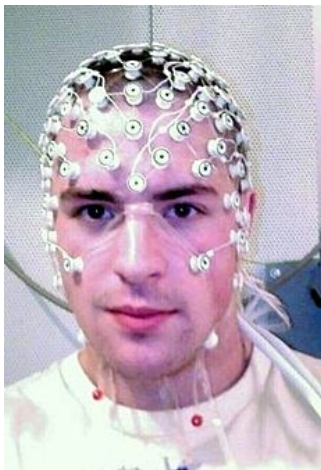
Strayer & Drews 2007

Task-relevant objects appear on side of road.

Experiment 1: Recognition memory test

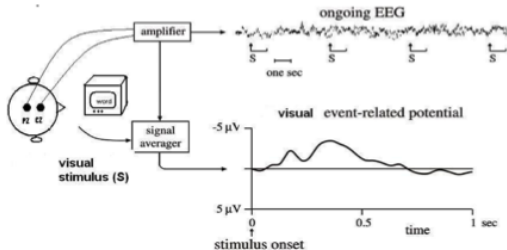
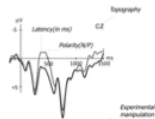
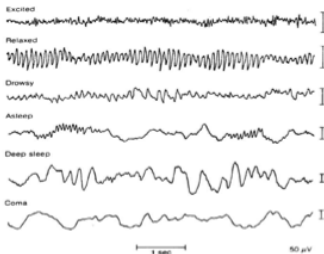
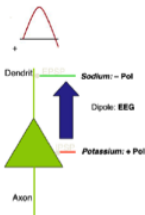
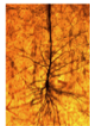
Experiment 2: Visual Attention by Relevance

Experiment 3: Event Related Potentials (EEG)



EEG (Elektroencephalography) measures electrical potential on the scalp.

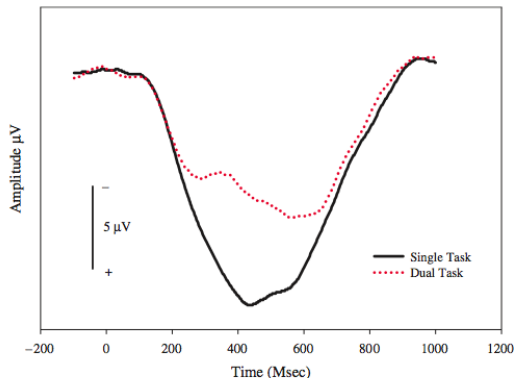
# EEG/ERP: Quick and dirty



# Event-related brain potentials (ERPs)

- Very high temporal (millisecond-by-millisecond) resolution
- ERP effects (so-called components) characterized by a set of
  - quantitative parameters (amplitude, latency)
  - qualitative parameters (polarity, topography, experimental sensitivity)
- ERPs: do subjects react to a specific stimulus? (e.g., are they surprised? do they notice something odd or dangerous about it?)

Strayer and Drews, 2007:

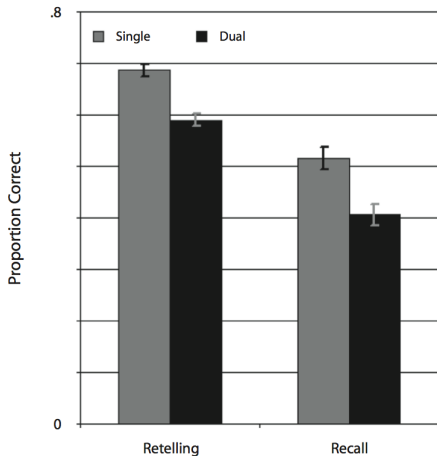


- P300 is sensitive to the attention allocated to a task (Sirevaag et al, 1989; Wickens et al, 1983)
- memory performance is superior for objects eliciting larger-amplitude P300s during encoding (Fabiani et al. 1986; Otton & Donchin, 2000)
- P300 component sensitive to task difficulty: decreasing as task demands increase (Kramer et al, 1987; Sirevaag et al., 1993)

## Language comprehension also impaired by driving

When driving, both language comprehension and production are negatively affected.  
(Becic et al., 2010)

- drivers don't remember as well what they were told

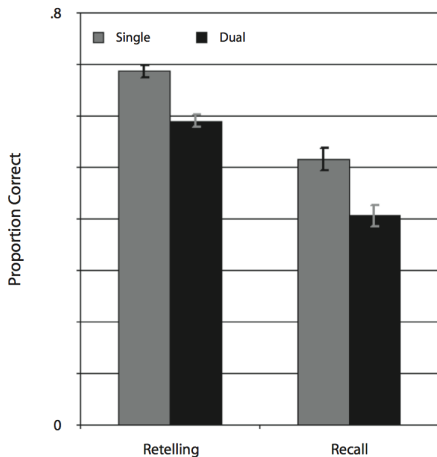




## Language comprehension also impaired by driving

When driving, both language comprehension and production are negatively affected. (Becic et al., 2010)

- drivers don't remember as well what they were told
- more language production problems during driving



## Language comprehension also impaired by driving

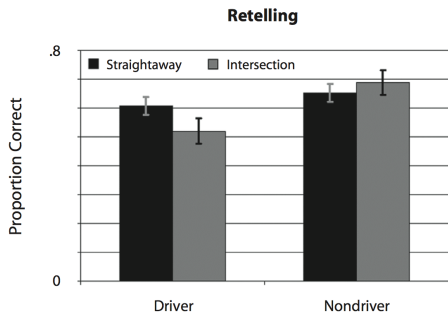
When driving, both language comprehension and production are negatively affected. (Becic et al., 2010)

- drivers don't remember as well what they were told
- more language production problems during driving
- this was true for both younger and older adults.  
(Older adults performed worse in general, but no interaction.)

## Language comprehension also impaired by driving

When driving, both language comprehension and production are negatively affected. (Becic et al., 2010)

- drivers don't remember as well what they were told
- more language production problems during driving
- this was true for both younger and older adults. (Older adults performed worse in general, but no interaction.)
- more difficult driving lead to stronger effects.



# Background: Language and Driving

Research on driving and language:

- mobile phone usage  
→ negative effect on driving
- hands-free speaking system  
→ negative effect on driving, similar to mobile
- fellow passenger  
→ ok



# Background: Language and Driving

Research on driving and language:

- mobile phone usage  
→ negative effect on driving
- hands-free speaking system  
→ negative effect on driving, similar to mobile
- fellow passenger  
→ ok



**Why?**

# What's the difference between fellow passenger vs. hands-free phone?

## Passenger adapts to traffic situation

- complexity of speech of driver and passenger lower in difficult driving (Drews et al., 2008)
- shift topic to traffic in difficult driving situation (Villing 2009a,b)
- fewer utterances when driving on city course as opposed to rural route (Crundall et al., 2005)



# What's the difference between fellow passenger vs. hands-free phone?

## Passenger adapts to traffic situation

- complexity of speech of driver and passenger lower in difficult driving (Drews et al., 2008)
- shift topic to traffic in difficult driving situation (Villing 2009a,b)
- fewer utterances when driving on city course as opposed to rural route (Crundall et al., 2005)



**Dialog systems should be more like passenger drivers and less like the remote conversational partner.**

# How to address this

Summary so far:

- During difficult driving, drivers don't remember well what they were told, and have more language problems in production.
- There are effects of inattention blindness, driver doesn't react to safety-relevant events.
- Dialog systems should adapt to the situation (like passenger and unlike remote conversational partner).

## What should we do?

- No one SINGLE good way for a dialog system to present information
- must adapt **linguistic complexity** to the user and the situation
- Can use psycholinguistic models to assess linguistic complexity



# Table of Contents

- 1 Administrative remarks
- 2 Organization
- 3 Background
  - Driving and Talking
  - Dialog Systems and Driving
  - Aging
- 4 Giving a good talk

# Some examples for dialog system domains

What kind of dialog systems are we talking about?

- Information presentation
  - Restaurant reservation
  - Flight / train booking
  - Music recommendation
  - Touristic applications (sights)
- Email
- Calendar

# Some examples for dialog system domains

What kind of dialog systems are we talking about?

- **Information presentation**
  - Restaurant reservation
  - Flight / train booking
  - Music recommendation
  - Touristic applications (sights)
- Email
- Calendar

## Example: Listing all options

S: *I found 28 round trips from Edinburgh to Brussels on October 31st and returning Edinburgh on November 6th.*

*For option 1, I have an outbound flight with KLM departing at 7 am and arriving at 8:49 am non-stop. A return flight is with KLM departing at 10:30 am and arriving at 11:28 am with 1 stopover. Ticket price is 165 Euros. Please say "next option", or, "flight details", or, "I'll take it".*

U: Next option

S: *For option 2, I have an outbound flight with KLM departing at 3:30 pm and arriving at 5:19 pm nonstop. A return flight is with KLM departing at 8:25 pm and arriving at 12:28 pm with 1 stopover. Ticket price is 165 Euros please say "next option", or, "flight details", or, "I'll take it."*

U: Next option

S: ...

Figure: Typical Information Presentation Phase of a Communicator Dialogue

# Filtering options and user modelling

- Use some criterion to select a subset of options to be presented
- User modelling: select those options that are most interesting to user
- Elicit user model by asking users for their preferences explicitly or collecting behavioral data
- Additional advantage: tailor information presentation
- cf. Carenini & Moore, 2000; Moore et al., 2004; Walker et al. 2004

## Filtering options: example

USER: I want to travel from Edinburgh to Brussels, arriving by 5 pm.

*For a starving student:*

SYS: *There's a direct flight on BMI with a good price. It arrives at four ten p.m. and costs one hundred and twelve pounds. The cheapest flight is on Ryanair. It arrives at twelve forty five p.m. and costs just fifty pounds, but it requires a connection in Dublin.*

*For a business traveller:*

SYS: *You can fly business class on British Airways, arriving at four twenty p.m., but you need to connect in Manchester. There's a direct flight on BMI, arriving at four ten p.m., but there's no availability in business class.*

Figure: Content Selection by User Modelling (FLIGHTS system)

## Option structuring: example

SIM: What restaurants do you have?

SYS: *I have found 983 restaurants. Most of them are located in Boston and Cambridge. There are 32 choices for cuisine. I also have information about price range.*

SIM: Okay tell me about the ones in Boston.

SYS: *I have found 401 restaurants in Boston. There are 29 choices for cuisine.*

SIM: Do you have any that serve seafood?

SYS: *I have found 19 seafood restaurants. They are predominantly in Back Bay, the North End, South Boston and the South End.*

SIM: In the South End.

SYS: *I have found 3 restaurants. Grill Fish on Columbus Avenue, McCormick & Schmick's on Columbus Avenue and Joseph's on High Street.*

Figure: Content Structuring (system by Polifroni et al.)

# Overview of basic approaches

- Listing all options until the user makes a choice
  - inefficient
  - relies on user to remember complex trade-offs between options → places large **memory burden** on user
- Filtering the options (based on UM)
  - doesn't **scale up** to domains with many relevant options
  - does not provide **overview** of option space
- Structuring options (without UM)
  - **exploration** of trade-offs difficult
  - mentions irrelevant entities
  - suboptimal choice of attributes for summarization



# Combining user modelling and content structuring

## Combining user modelling and content structuring

- Select relevant options
- Structure them based on user's valuations
- Automatically determine tradeoffs
- Tailor summarizations
- Improve overview of options space by briefly summarizing irrelevant options

# Combining user modelling and content structuring

## Combining user modelling and content structuring

- Select relevant options
- Structure them based on user's valuations
- Automatically determine tradeoffs
- Tailor summarizations
- Improve overview of options space by briefly summarizing irrelevant options

→ this leads to more complex linguistic structures.

# Overview of experiments

- Systems compared: UMSR (user modelling and content structuring) vs. SR system (“summarize and refine”, no user modelling)
- 2 experiments
  - ① Wizard of Oz experiment: interaction experiment with controlled complexity
  - ② dual task experiment: driving a car
- each experiments ca. 40 participants
- 6 dialog pairs (UMSR vs. SR)
- questionnaire with 5 questions after each dialog pair

## Evaluation: User Models

the business traveler	He wants, above all, to travel in business class and prefers also KLM.
the student	He cares most about price, everything else being equal
the frequent flier	She collects business miles on KLM and therefore cares most about airline

**Table:** Example user models used in our experiments.

# Questionnaires

- ① Did the system give the information in a way that was easy to understand?  
1: very hard to understand  
7: very easy to understand
- ② Did the system give X a good overview of the available options?  
1: very poor overview  
7: very good overview
- ③ Do you think there may be flights that are better options for X that the system did not tell X about?  
1: I think that is very possible  
7: I feel the system gave a good overview of all relevant options.
- ④ How quickly did the system allow X to find the optimal flight?  
1: slowly  
3: quickly
- ⑤ Forced Choice Question:  
Which of these systems would you recommend to a friend?

## Experiment 1: Single Task Interaction

- Wizard-of-Oz setting
- Results for Efficiency and Effectiveness:

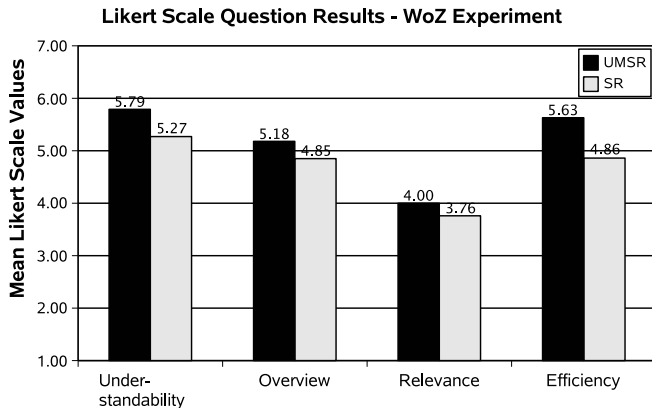
	SR	UMSR
Turns	14.53**	10.53**
Duration (sec)	391.65**	252.55**

**Table:** *Number of turns per booking and average dialogue duration for 2 bookings (in sec) for SR and UMSR*

	SR	UMSR
Best flights selected	50 (73.53%)*	62 (91.18%)*

**Table:** *How often was the “best” flight selected?*

# Experiment 1: Likert scale questions



Forced choice question:

Statistically significant preference for UMSR system

## Experiment 2: Dual Task

- Participants were driving a car (simulator) while interacting with the SDS (WoZ setting)
- Evaluation of
  - Efficiency
  - Performance in driving task
  - Usual set of evaluation questions

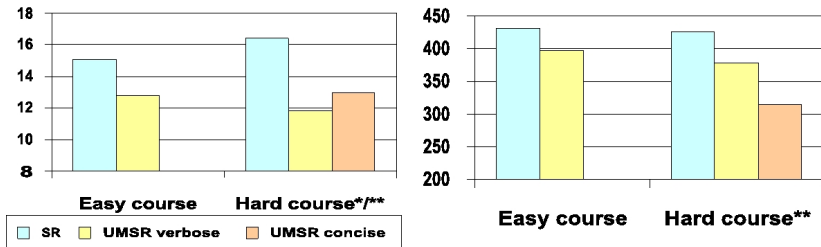
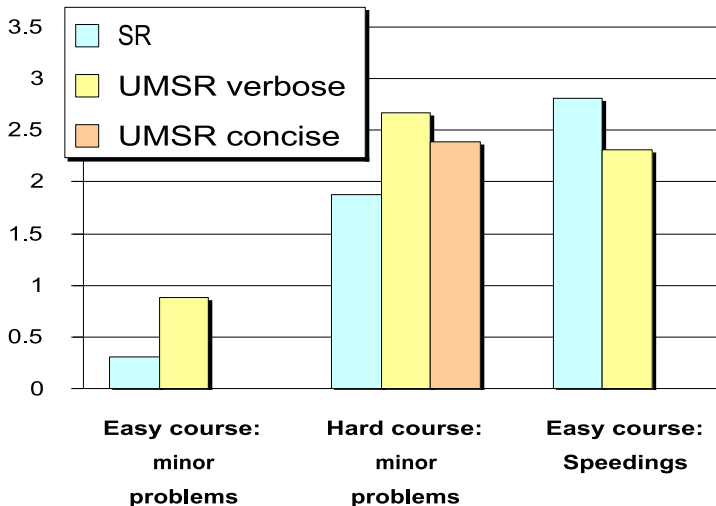


Figure: Task Completion Efficiency: # of dialog turns and dialog duration.

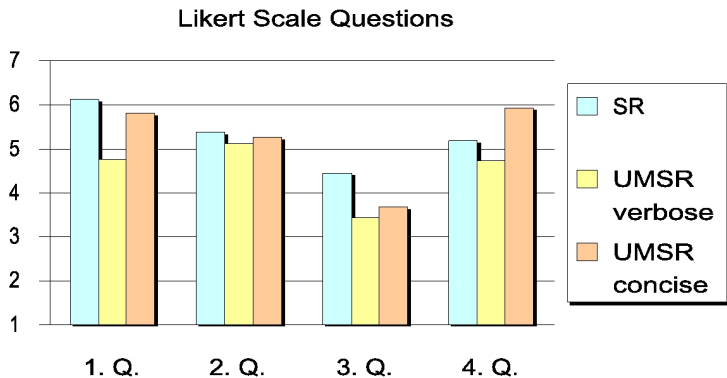


## Experiment 2: Dual Task

Driving Errors:



## Experiment 2: Dual Task



1. question: understandability
2. question: overview
3. question: relevance
4. question: efficiency

# Evaluation Summary

Overview table for the experiments:

	iteration	driving
system pref?	UMSR*	?
understandability	UMSR*	SR
overview	UMSR	SR
relevance	UMSR	SR
efficiency	UMSR*	simple UMSR
driving errors	NA	same
task success	UMSR*	UMSR*
task duration	UMSR*	UMSR*

**Conclusion:** UMSR is preferred in the single task setting, while the less complex and less memory-requiring SR strategy is preferred in dual tasking.

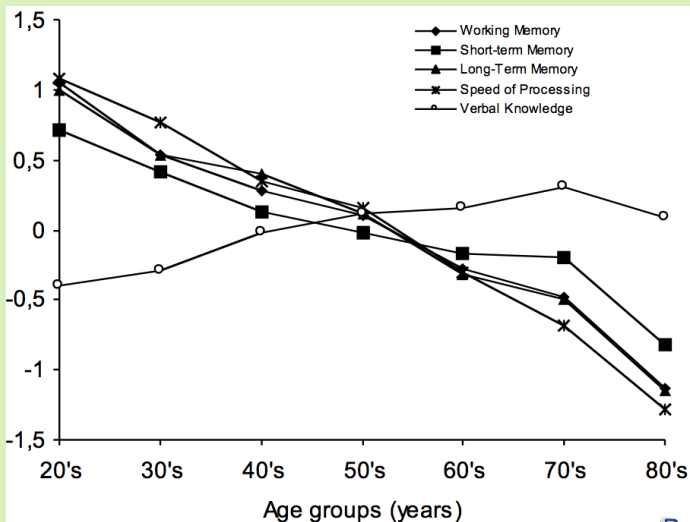
# Table of Contents

- 1 Administrative remarks
- 2 Organization
- 3 Background
  - Driving and Talking
  - Dialog Systems and Driving
  - Aging
- 4 Giving a good talk

# Aging and Cognition

- In the cognitive domain, age-related decline can be observed in a variety of cognitive abilities, such as reasoning, working memory, and speed of processing (Kray and Lindenberger, 2007).

# Aging and Cognition



(from Park et al., 1996)

# Aging and Cognition

- In the cognitive domain, age-related decline can be observed in a variety of cognitive abilities, such as reasoning, working memory, and speed of processing (Kray and Lindenberger, 2007).
- Vocabulary even increases (Ramscar et al., 2014)

# Aging and Cognition

## Results on Vocabulary size (Ramskar et al., 2014)

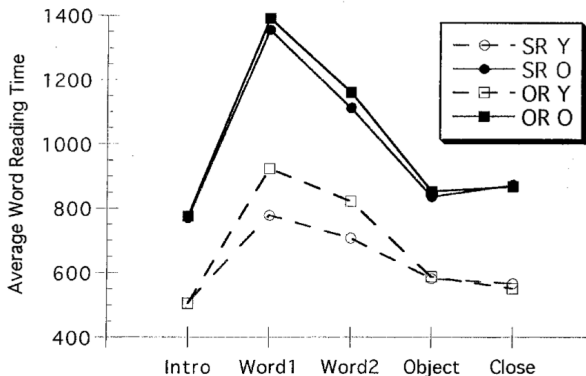
- Ramskar et al., 2014 claim that age decline effects are spurious
- claim: slower reaction times (e.g. on word recognition tasks) just due to larger vocabulary
- idea: brain doesn't work "worse", it just has more data to work with when older, so slower.
- show that older adults actually do have larger vocabulary and knowledge base
- show that larger vocabulary can be predicted to slow down word recognition tasks.



# Aging and Cognition

- In the cognitive domain, age-related decline can be observed in a variety of cognitive abilities, such as reasoning, working memory, and speed of processing (Kray and Lindenberger, 2007).
- Vocabulary even increases (Ramscar et al., 2014)
- Culturally-mediated cognitive domains – verbal knowledge and language skills remain relatively stable across the adult lifespan (Kray and Lindenberger, 2007).

# Research on aging and language comprehension



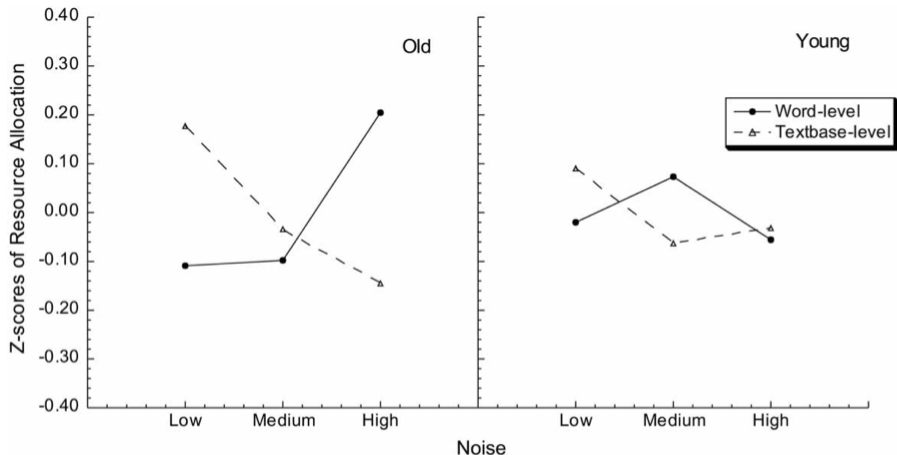
SUBJ REL: The pilot that admired the / nurse / dominated / the conversation / in the bar that evening.  
 OBJ REL: The pilot that the nurse / admired / dominated / the conversation / in the bar that evening.

- older adults did not slow down at ORC compared to SRC;
- older adults more often didn't understand ORCs.

→ elderly not able to allocate necessary resources (Stine-Morrow et al., 2000)

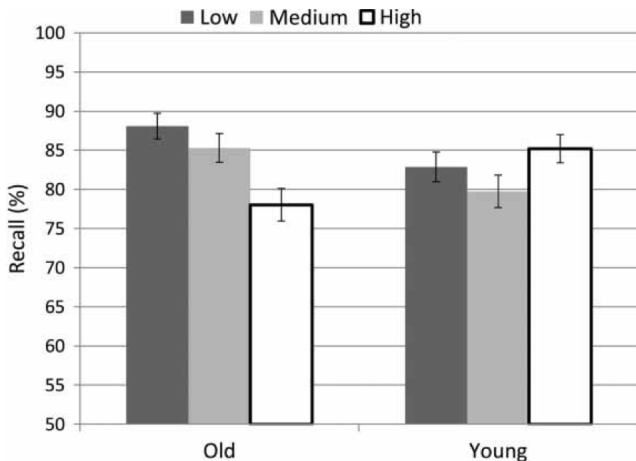
# Research on aging and language comprehension

visual clutter leads to poor understanding in old but not in young readers  
→ older adults could not allocate enough resources to deeper syntactic / semantic processing (Gao et al., 2012)



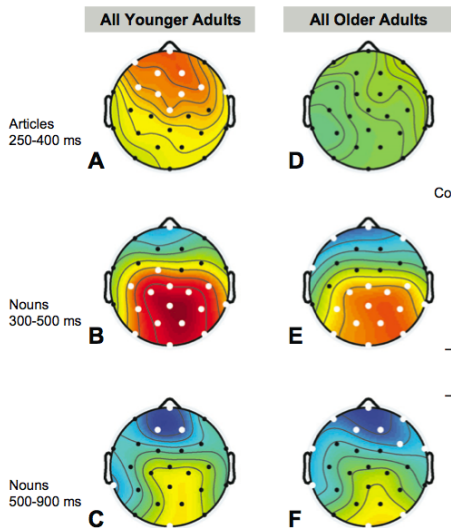
## Research on aging and language comprehension

visual clutter leads to poor understanding in old but not in young readers  
→ older adults could not allocate enough resources to deeper syntactic / semantic processing (Gao et al., 2012)



# Research on aging and language comprehension

N400 effects in older adults also for predictable items  
 → older adults do not use context cues as effectively  
 (DeLong et al., 2012)



## Age-related decline

Age-related deterioration worst for task-switching and multi-tasking.  
(Frensch et al., 1999; Kray and Lindenberger, 2000; Kray, 2006)

Why?

## Age-related decline

Age-related deterioration worst for task-switching and multi-tasking.  
(Frensch et al., 1999; Kray and Lindenberger, 2000; Kray, 2006)

Why?

- problems due to worse ability to maintain and bias context information or task-relevant information (Braver et al., 2001)
- This ability has been strongly linked to neural efficiency of the dorsolateral prefrontal cortex, a brain region that shows earlier age-related deterioration as compared with other regions of the brain (Raz et al., 2005).

# Summary Aging

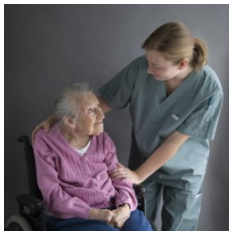
## Summary on age-related decline:

- most researchers believe that there is cognitive decline during the life span and that it affects language
- dual-tasking is affected even more strongly / earlier
- for our dialog system design, this means that adaptation is even more important for older users



## Additional note on adaptation: Elderspeak

Another example of adaptation to conversational partner:



**Elderspeak:** shorter and less complex utterances, more filler phrases, more fragments, fewer cohesive cues, slower speech rate and longer pauses

- **beneficial to comprehension:** reduced syntactic complexity; semantic elaborations
- **insulting:** more fragments; more fillers; slow speech

# Outlook

Topics in the seminar:

- Effect of aging on the brain
  - Which general skills and regions of the brain are affected?
  - In how far are language regions affected?
  - How can good performance levels in language comprehension be maintained?

# Outlook

Topics in the seminar:

- Effect of aging on the brain
  - Which general skills and regions of the brain are affected?
  - In how far are language regions affected?
  - How can good performance levels in language comprehension be maintained?
- Multi-tasking and Aging
  - how is multi-tasking performance affected by aging? (suggested focus: driving and language processing)

# Outlook

Topics in the seminar:

- Effect of aging on the brain
  - Which general skills and regions of the brain are affected?
  - In how far are language regions affected?
  - How can good performance levels in language comprehension be maintained?
- Multi-tasking and Aging
  - how is multi-tasking performance affected by aging? (suggested focus: driving and language processing)
- Working Memory
  - What's the effect of aging on working memory?
  - How is working memory used during language processing?

# Outlook

## Topics in the seminar:

- Effect of aging on the brain
  - Which general skills and regions of the brain are affected?
  - In how far are language regions affected?
  - How can good performance levels in language comprehension be maintained?
- Multi-tasking and Aging
  - how is multi-tasking performance affected by aging? (suggested focus: driving and language processing)
- Working Memory
  - What's the effect of aging on working memory?
  - How is working memory used during language processing?
- Long term memory
  - Naming latencies in younger vs. older people;
  - Is retrieval generally slower in older adults, or is it just an effect of vocabulary size?

# Outlook

## Topics in the seminar: (continued)

- Language processing at different linguistic levels in younger vs. older adults.
  - Syntax, semantics, textual comprehension.

# Outlook

Topics in the seminar: (continued)

- Language processing at different linguistic levels in younger vs. older adults.
  - Syntax, semantics, textual comprehension.
- Effect of sensory impairment on language processing
  - problems with eye sight or hearing.

(additional topics can be suggested)

# Note

FINISH YOUR LITERATURE SEARCH BEFORE THE END OF THE YEAR!



# Table of Contents

- 1 Administrative remarks
- 2 Organization
- 3 Background
  - Driving and Talking
  - Dialog Systems and Driving
  - Aging
- 4 Giving a good talk

# Giving an academic talk

Important aspects:

- Content
- Use of audio-visual aids (slides)
- Speaking style
- Preparation for Discussion

# Content

Common mistake: too many technical details, not enough motivation



*"Well, Stoddard, I think I've bounced enough ideas off you for one day."*

# Motivation

Why is the problem you are solving important?

- Make the audience feel the pain
- Make them think “I can’t believe this hasn’t been done before!”

Main message

- Have one main message to convey
- Make clear how the different parts in the talk relate to one another

# Use images instead of words!



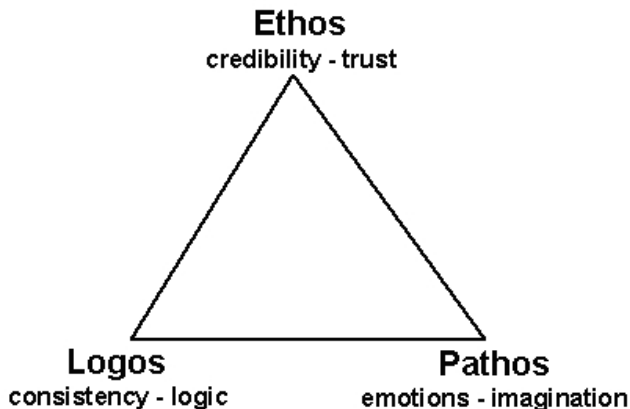
# No excessive use of bullets, no full sentences!

## All staff are concerned about the gap

- In closing the gap of employment,
- The assessment should be used to identify the type of service being rendered to the client.
- **PROCESS**-For clients who have been terminated due to cause, suitable employment can be found in many industries and or companies.
- **OUTCOME** the client will be able to identify 3-5 industries or companies that may hire them given their ability and competence profile.
- A functional resume will be used to minimize the impact of loss of employment and breaks in service.
- Clients will be able to conduct research into industry or companies that would b suitable employment matches for them.

# Rhetoric Devices

- Use rhetorics to link ideas and parts of presentation.
- Rhetoric questions (“Why is this important?”)



# Giving the talk

usually better

Talk

Stand

Move

Vary the pitch of your voice

Speak loudly, facing the audience

Make eye contact

Finish within your time limit

Rehearse

Notice your audience; respond to it

Emulate excellent speakers

usually worse

Read

Sit

Stand still

Speak in a monotone

Mumble, facing downward

Stare at your laptop

Run overtime

Don't practice because you are too busy working on the slides

Ignore audience behavior

Emulate your advisor, even if s/he gives lousy talks



# How to prepare for your presentation

- Do your literature search very early
- Read paper(s) thoroughly well in advance (aim for 3 weeks before your presentation date)!
- in order to understand them well, you'll probably have to read them 2-3 times! Send me an email if there is something you don't understand.
- prepare your slides, start at least 2 weeks before presentation
- note: making *good* slides takes a lot of time!
- meet me **one week before your presentation**, send slides *before* the meeting
- train your presentation style in front of your flatmate / the mirror / ...
- you'll probably have to go through your presentation 3-10 times before you'll be able to give it well.

# To Summarize

For next week, please:

- sign up for the mailing list
- choose a topic and let me know by email
- choose a method to report on