Human Computer Interaction

Discussion Session 3: Humans II

Prof. Dr. Björn Eskofier
Machine Learning & Data Analytics (MaD) Lab
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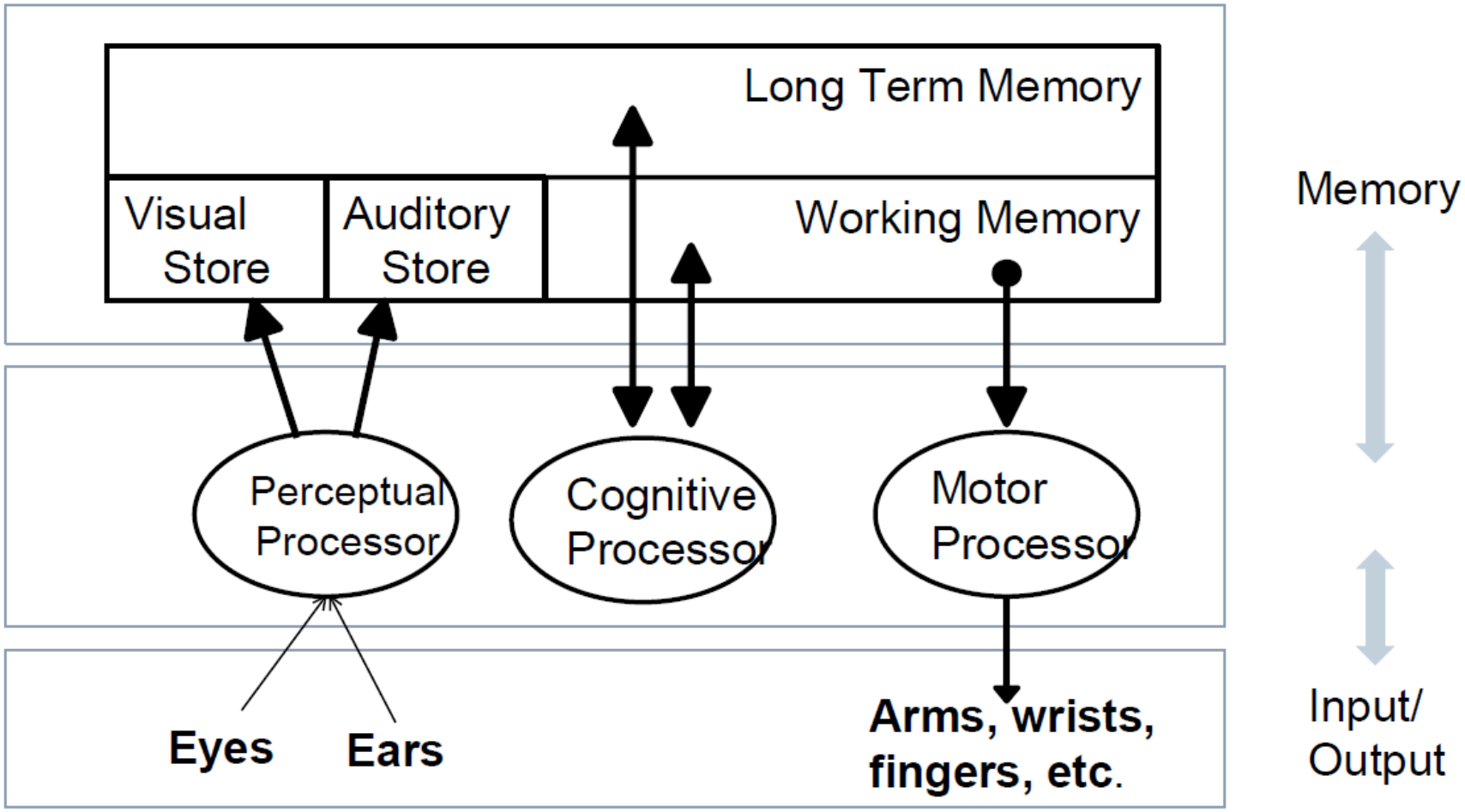
Recap and Example: Model Human Processor

Humans

Model Human Processor



From Computer Science 498bpb, Psychology of HCI

Humans

Model Human Processor

Where do you have evidence / examples that this model is in place?

Humans

Attention – Have you seen the Gorilla?

https://www.youtube.com/watch?v=vJG698U2Mvo&ab_channel=DanielSimons

Humans

Wickens Model

Four dimensions are:

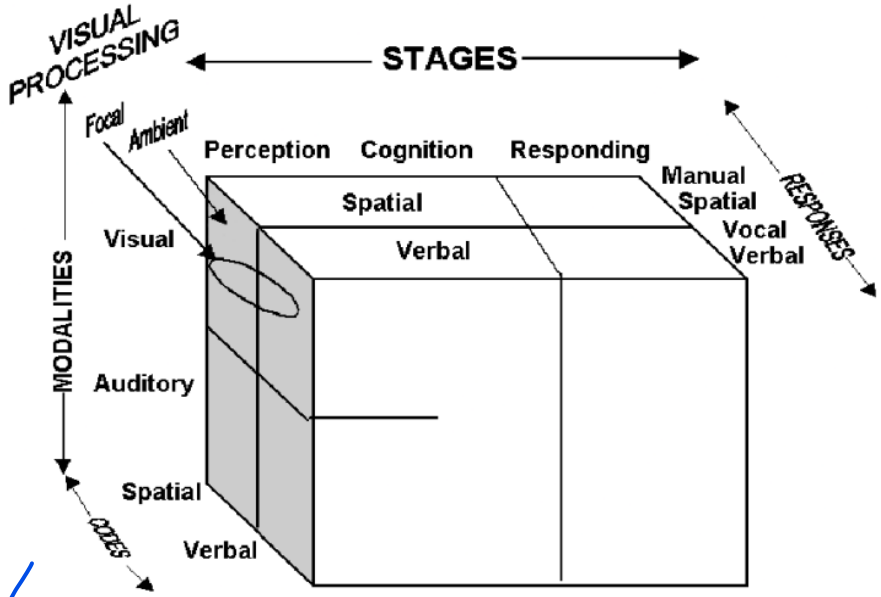
- Processing stages
- Perceptual modalities
- Visual channels
- Processing codes

Implications

- Tasks that use different resources are easier to do than tasks that require "more" of one resources
- Listening to 2 conversations?
- Searching a photo while listening?

Listening while driving

Easier than listening to conversation.



Source: Wickens, C. D.: Multiple resources and performance prediction. Theoretical Issues in Ergonomics Science. S.159–177, 2002.

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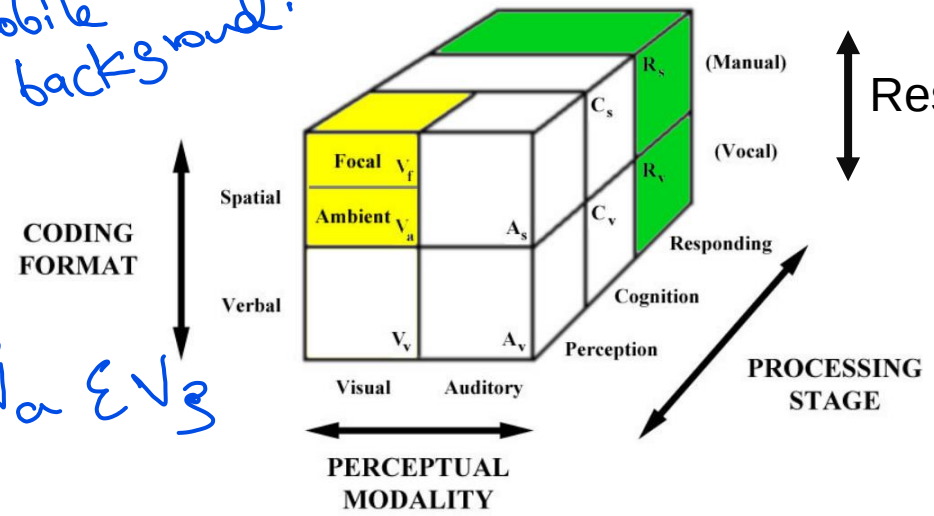
Calculate the Total Interference of the Tasks “Rural-Curve Driving” and “Auditory IVT”.

- Use the given Conflict Matrix
- Define the Demand Vectors (maximum entry = 3)
- Calculate the Total Demand, the Total Conflict and Total Interference

Conflict Matrix

focal-Mobile
Ambient - background.



coding
$V_f, V_a \in V_3$

cognition
C_s, C_v

	V_f	V_a	A_s	A_v	C_s	C_v	R_s	R_v
V_f	0.8	0.6	0.6	0.4	0.7	0.5	0.4	0.2
V_a		0.8	0.4	0.6	0.5	0.7	0.2	0.4
A_s			0.8	0.4	0.7	0.5	0.4	0.2
A_v				0.8	0.5	0.7	0.2	0.4
C_s					0.8	0.6	0.6	0.4
C_v						0.8	0.4	0.6
R_s							0.8	0.6
R_v								1.0

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Define Demand Vectors for the tasks: Maximum entry is 3

	V_f	V_a	A_s	A_v	C_S	C_V	R_S	R_V	
Rural-Curve Driving	1	2	0	0	1	0	2	0	
Auditory IVT	0	0	0	2	0	2	0	2	

Machine Learning Data Analytics FAU

Define Demand Vectors for the tasks: Maximum entry is 3

$$\frac{sum\ of\ all\ entries}{nr\ of\ resources} = \frac{1+2+1+2}{8}$$

Demand Vectors.

8 entries

	V_f	V_a	A_s	A_v	C_s	C_v	R_s	R_v	
Rural-Curve Driving	1	2	0	0	1	0	2	0	**0.75**
Auditory IVT	0	0	0	2	0	2	0	2	**0.75**

Calculate Total Demand:

Total Demand (TD) = 0.75 + 0.75 = **1.5**

Sum of 1 & 2 = Total Demand.

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Calculate Total Conflict:

Rural-Curve Driving

		1	2	0	0	1	0	2	0
		V_f	V_a	A_s	A_v	C_s	C_v	R_s	R_v
0	V_f	0.8	0.6	0.6	0.4	0.7	0.5	0.4	0.2
0	V_a		0.8	0.4	0.6	0.5	0.7	0.2	0.4
0	A_s			0.8	0.4	0.7	0.5	0.4	0.2
2	A_v				0.8	0.5	0.7	0.2	0.4
0	C_s					0.8	0.6	0.6	0.4
2	C_v						0.8	0.4	0.6
0	R_s							0.8	0.6
2	R_v								1.0

Auditory IVT

4.2
36
30
26
24
18
14

10
3
200

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Calculate Total Conflict:

Rural-Curve Driving

		1	2	0	0	1	0	2	0
		V_f	V_a	A_s	A_v	C_s	C_v	R_s	R_v
0	V_f	0.8	0.6	0.6	0.4	0.7	0.5	0.4	0.2
0	V_a		0.8	0.4	0.6	0.5	0.7	0.2	0.4
0	A_s			0.8	0.4	0.7	0.5	0.4	0.2
2	A_v				0.8	0.5	0.7	0.2	0.4
0	C_s					0.8	0.6	0.6	0.4
2	C_v						0.8	0.4	0.6
0	R_s							0.8	0.6
2	R_v								1.0

Auditory IVT

Machine Learning Data Analytics

FAU

Calculate Total Conflict:

Rural-Curve Driving

		1	2	0	0	1	0	2	0
		V_f	V_a	A_s	A_v	C_s	C_v	R_s	R_v
0	V_f	0.8	0.6	0.6	0.4	0.7	0.5	0.4	0.2
0	V_a		0.8	0.4	0.6	0.5	0.7	0.2	0.4
0	A_s			0.8	0.4	0.7	0.5	0.4	0.2
2	A_v				0.8	0.5	0.7	0.2	0.4
0	C_s					0.8	0.6	0.6	0.4
2	C_v						0.8	0.4	0.6
0	R_s							0.8	0.6
2	R_v								1.0

Auditory IVT

Machine Learning Data Analytics FAU

Calculate Total Conflict:

Rural-Curve Driving

Auditory IVT	V_f	V_a	A_s	A_v	C_s	C_v	R_s	R_v
	1	**2**	**0**	**0**	**1**	**0**	**2**	**0**
0 V_f	0.8	0.6	0.6	0.4	0.7	0.5	0.4	0.2
0 V_a		0.8	0.4	0.6	0.5	0.7	0.2	0.4
0 A_s			0.8	0.4	0.7	0.5	0.4	0.2
2 A_v				0.8	0.5	0.7	0.2	0.4
0 C_s					0.8	0.6	0.6	0.4
2 C_v						0.8	0.4	0.6
0 R_s							0.8	0.6
2 R_v								1.0

Total Conflict (TC) = 0.5 + 0.2 + 0.4 = **1.1**

Sum of intersections for both.

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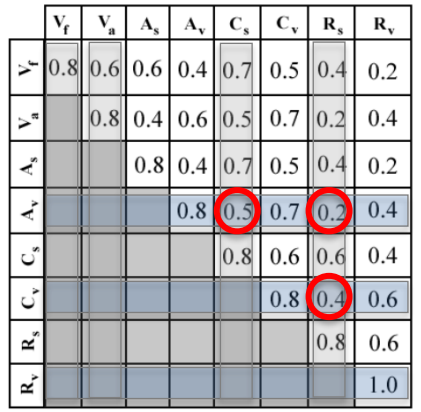
Data Analytics
FAU

Total Conflict: **TC = 1.1**



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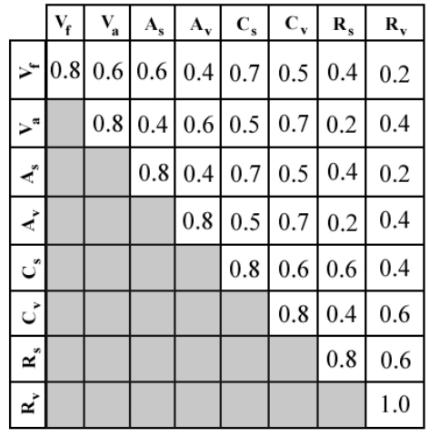
C_s					0.8	0.6	0.6	0.4
C_v						0.8	0.4	0.6
R_s							0.8	0.6
R_v								1.0

TD = Sum of all making it 3.

Scaling of TC needed:

- Maximum TD = 6 (all entries of the tasks = 3)
- Maximum TC = 20 (sum over all cells) → overwhelms TD

	V_f	V_a	A_s	A_v	C_S	C_V	R_S	R_V	
Demand Task 1	3	3	3	3	3	3	3	3	**3**
Demand Task 2	3	3	3	3	3	3	3	3	**3**
									6



	V_f	V_a	A_s	A_v	C_s	C_v	R_s	R_v
V_f	0.8	0.6	0.6	0.4	0.7	0.5	0.4	0.2
V_a		0.8	0.4	0.6	0.5	0.7	0.2	0.4
A_s			0.8	0.4	0.7	0.5	0.4	0.2
A_v				0.8	0.5	0.7	0.2	0.4
C_s					0.8	0.6	0.6	0.4
C_v						0.8	0.4	0.6
R_s							0.8	0.6
R_v								1.0

Total Conflict: **TC = 1.1**

Scaling of TC needed:

- Maximum TD = 6 (all entries of the tasks = 3)
- Maximum TC = 20 (sum over all cells) → overwhelms TD
- Scaling Factor: $\frac{\max demand}{\max conflict} = \frac{6}{20}$ $= 0.3 \quad \times TC \quad = 0.33$
- Scaled Total Conflict (STC) = $\frac{6}{20} * TC$ = 0.3 * 1.1 = **0.33**

STC = 0.33

Humans

Wickens Model

Total Interference (TI) = TD + STC = 1.5 + 0.33

TI = 1.83

Note:

- Conflict Matrix can be changed (might also change the maximum Total Conflict)
- Entries for Demand Vectors can change (does not change the maximum Total Demand but the Total Interference)

Inspired by:
https://hci.rwth-aachen.de/publications/engelen2011a.pdf

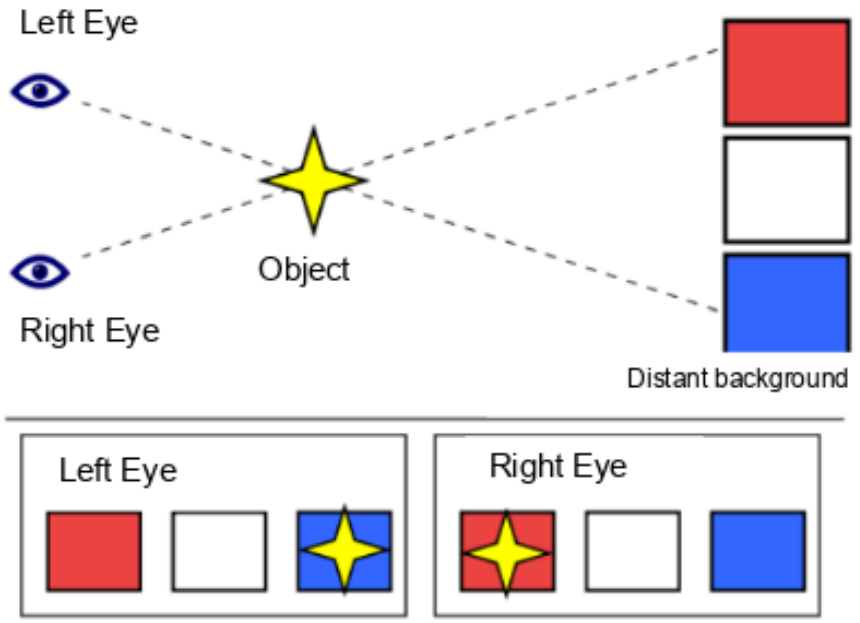
Humans: Stereo Vision, Reading, Hearing, Space, Territory and Emotions

Humans

Stereo Vision

- Everything on a 2D display is 2D ➔ We perceive 3D objects on a 2D display through experience

- “Real 3D” requires an image for each eye ➔ The **parallax** technology



Humans

Stereo Vision

- Example: **Virtual Reality Headset**
  - 2 distinct displays for each eye
  - 2 different images at high frequencies + resolution
  - Real life experience

Humans

Reading

- Can you read this text:
  - I cnlduo‘t bvleiee taht I culod aulaclty uesdtannrd waht I was rdnaieg. Unisg the icndeblire pweor of the hmuan mnid, aocdcrnig to rseecrah at Cmabrigde Uinervtisy, it dseno't mttaer in waht oderr the lterets in a wrod are, the olny irpoamtnt tihng is tahpclae. The rset can be a taotl mses and you can sitll raed it whoutit a pboerlm. Tihs is bucseae the huamn mnid deos not raed ervey ltteer by istlef, but the wrod as a wlohe. Aaznmig, huh? Yaeh and I awlyas tghhuot slelinpg was ipmorantt! See if yuor fdreins can raed tihs too.t the frsit and lsat ltteer be in the rhgit

Humans

Reading

- Such phenomena are found by conducting studies and observing people react ➔ **eye-tracking ➔ heat map**

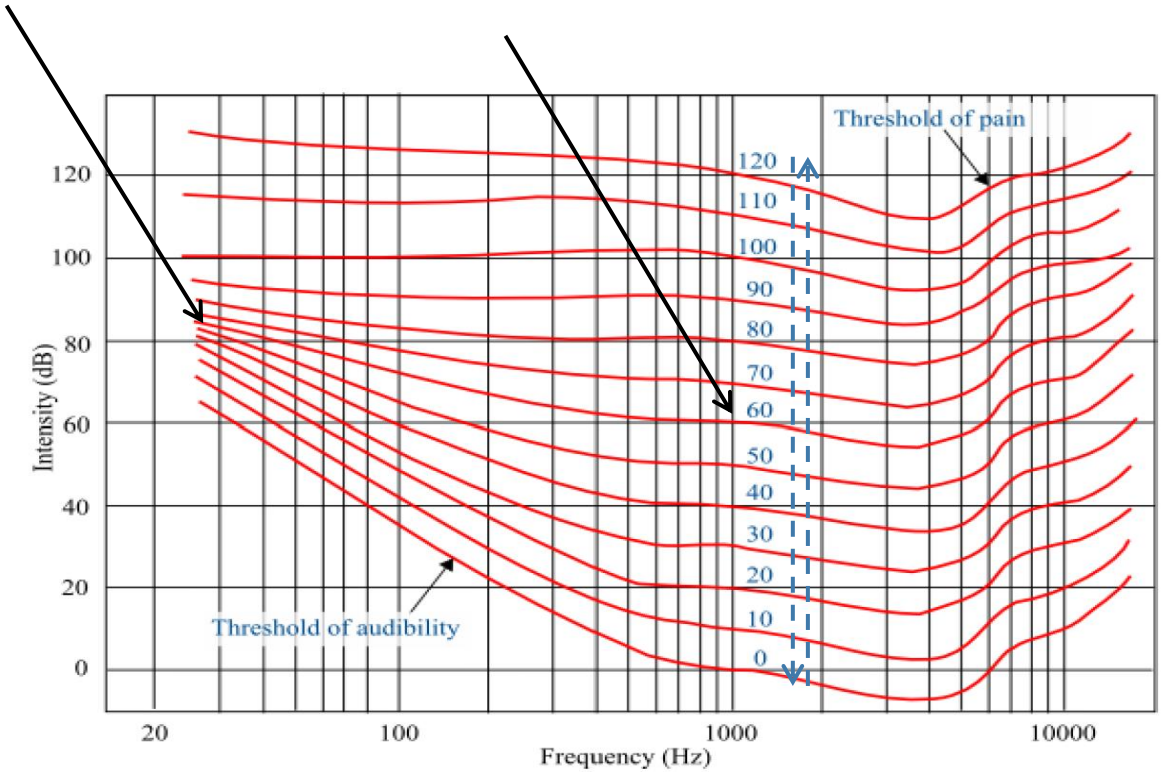
From These images:

- ✓ Users first read in a horizontal movement
- ✓ Users move down the page and read in a second horizontal movement
- ✓ Finally, users scan the content's left side in a vertical movement

Humans

Hearing

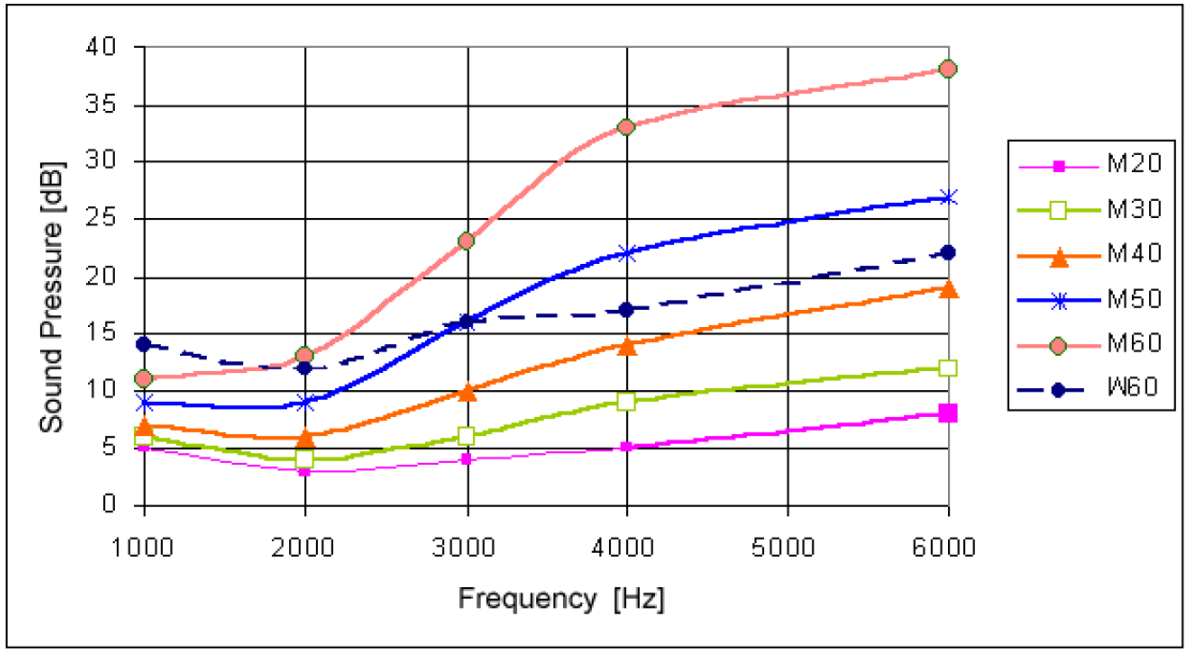
- Red curves: perceived loudness of a generated sound
- Ex: at 1000Hz, the curve in the middle shows a 60 ➔ a sine wave with 60dB intensity
- When increasing or decreasing the frequency of the sine wave, the perceived loudness changes
- Ex: for a low frequency of 30Hz we need approx. 80dB for the same 60dB loudness impression



Humans

Hearing

- The high frequency perception is affected by age
- The older you get, the higher sound pressure is required to perceive high frequencies
- The low frequency perception is not affected as severely



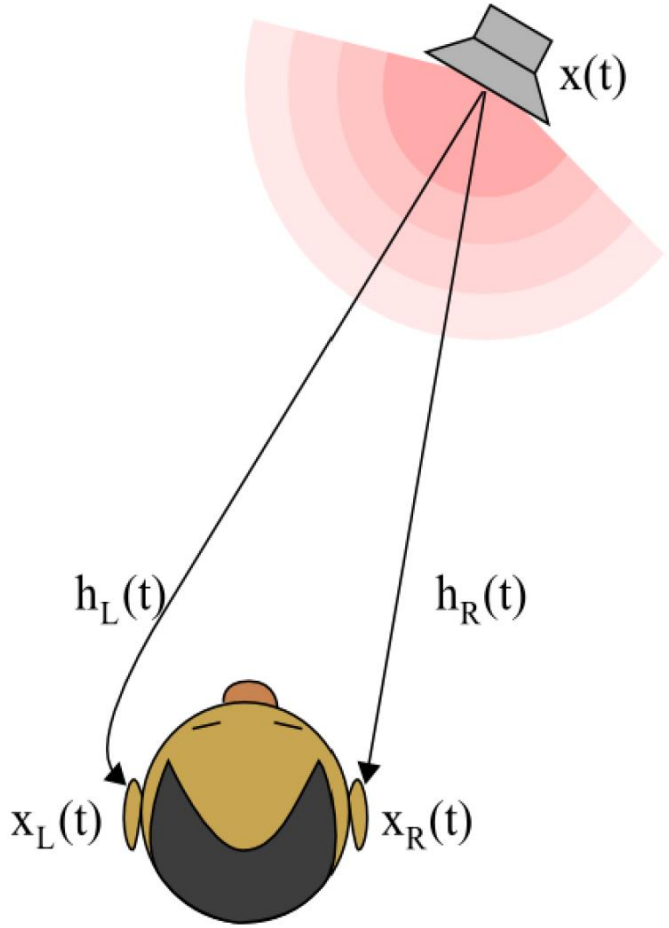
Humans

Hearing

- **Selective hearing** e.g. *cocktail party effect*
- The auditory system filters incoming information allowing selective hearing in environments with background noise
- We rely on 3 effects to locate the source:
  - Interaural time difference (ITD)
  - Interaural intensity difference (IID)
  - Head related transfer functions (HRTF)

Easily calculated

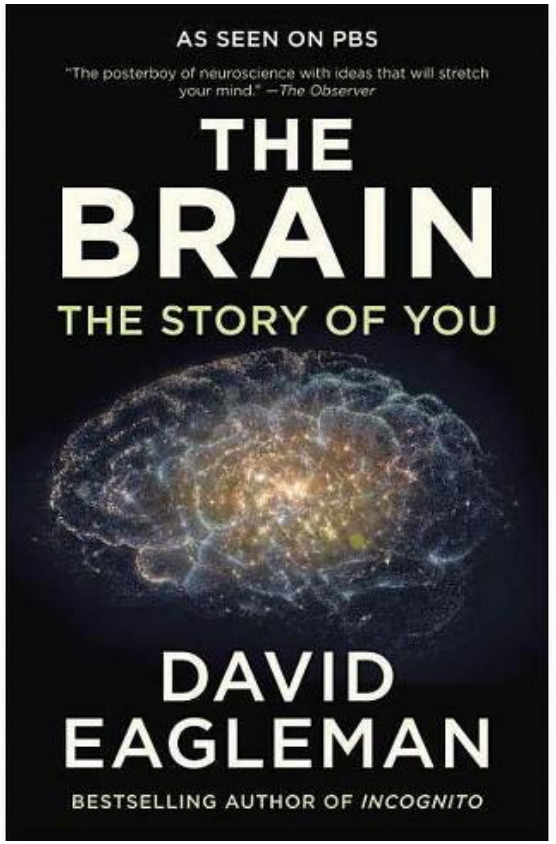
Measured in expensive experiments ➔ better experience for 360° sound used also in VR



Humans

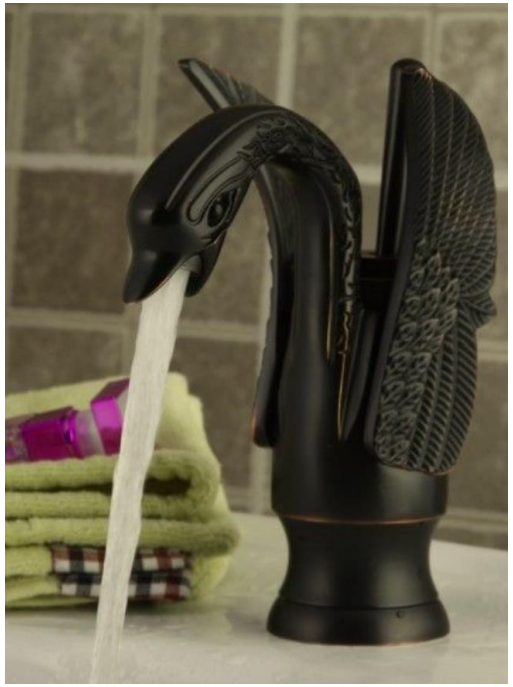
New senses for humans

https://www.ted.com/talks/david_eagleman_can_we_create_new_senses_for_humans



Affordance is the perceived possibility for action

- Objective properties that imply action possibilities (how we can use things) independent of the individual (Gibson)
- Perceived Affordance includes experience of an individual (Norman) http://doi.org/10.1145/301153.301168



Thank you for your attention!

Are there questions