How does the world get into our heads?

VISION ZERO.
Keiner kommt um. Alle kommen an.

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Diplom-Psychologin Lisa Falkenberg
How does the world get into our heads?

How does the world get into out heads?

1. How does our brain process the information when we are driving a car?

2. What are we capable of doing at the same time?

3. How important is the way we guide our eyes in this context?

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Do you trust your eyes?

I will now show you a sequence from an interrogation:

The old and venerable owner of a beautiful English manor has been murdered and an inspector is investigating the case.

Look carefully, listen carefully and then tell me who’s the murderer.

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WHODUNNIT?

Do you trust your eyes?

It is a wonderful example that shows the role our attention plays. Psychologists refer to this phenomenon as

“**change blindness** or **inattentional blindness**”

and it affects even the smartest ones of us.

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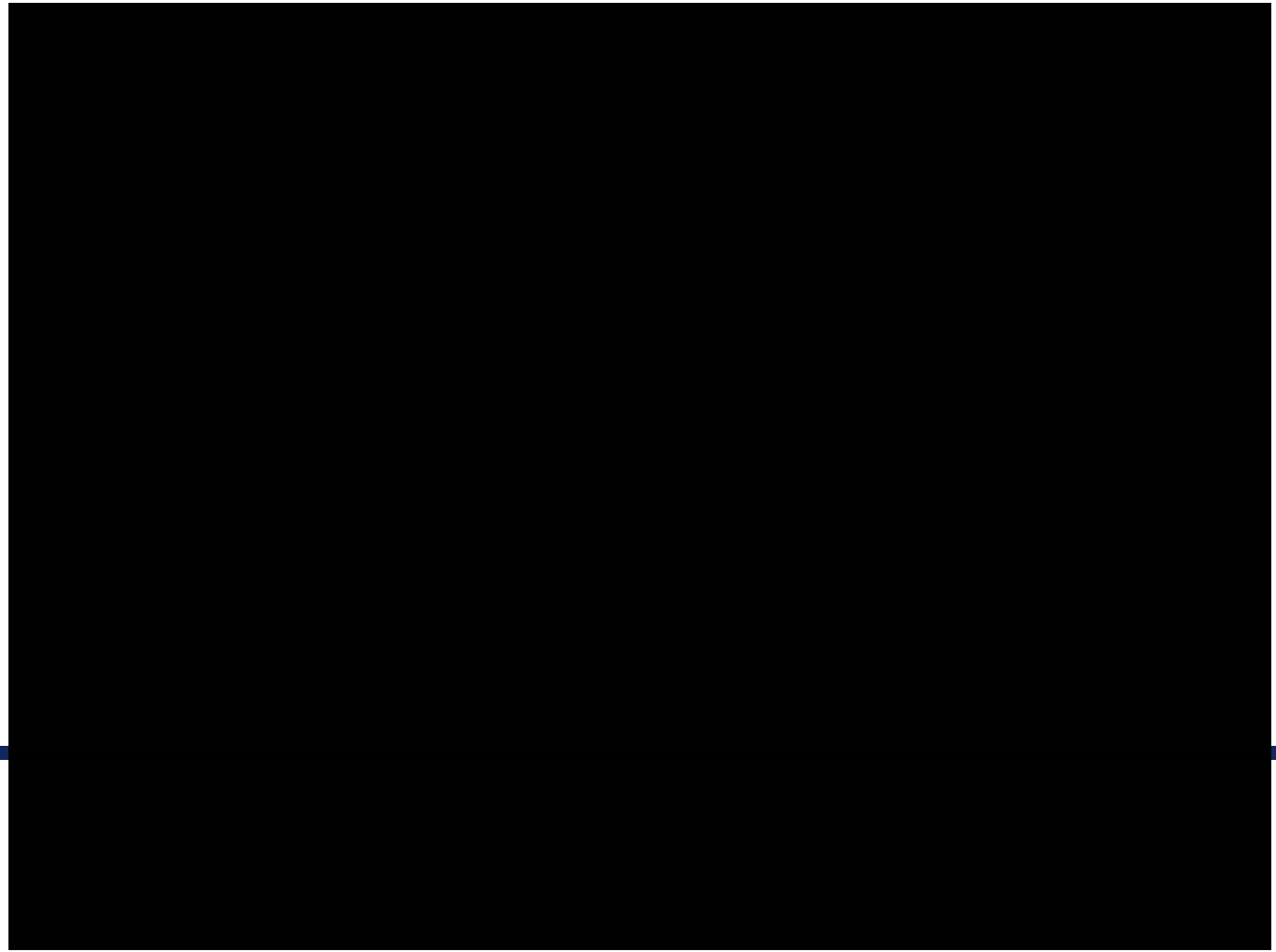

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Attention

What we perceive is controlled by attention processes, which can be understood as selection processes or filters.

They determine what we do or do not perceive.

What we focus on and where we direct our attention is a matter of desires, wishes and motives.

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Attention

Our attention can be focused on one individual activity or it can be divided between several activities.

We can direct our attention exclusively to one task in a way that we do not take notice of any other things that are happening around us

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Attention

What we see therefore depends on how we direct our attention.

Depending on what our current focus of attention is, we fail to notice certain, however possibly essential things.

This applies to all areas of life, not just to traffic.

We see, but we fail to observe.

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... und wer fährt?
BG
DURA

Information processing and multitasking

1. What are we capable of doing simultaneously?
2. Does what we call “multitasking” deserve this name?

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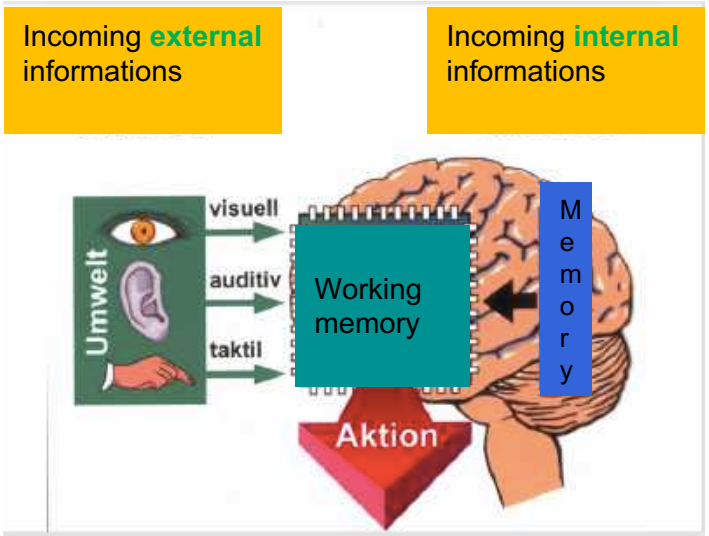
Information processing and multitasking



Model by Prof. Dr. Ungerer,

Laboratory of Sensorimotor Research,
University of Bremen

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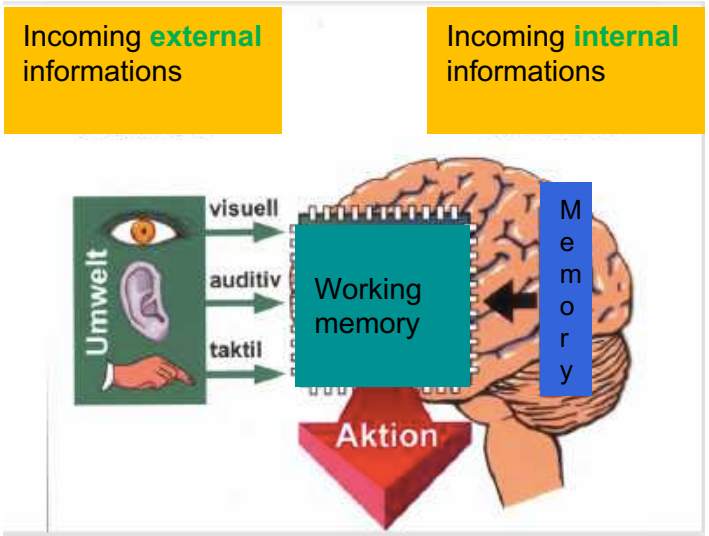
Information processing and multitasking



Working Memory:

- part of our memory and key to managing the flow of information.
- The entirety of the information a person organizes in his working memory is called **information budget.**
- Information from different areas enters the working memory. The working memory has a **limited capacity.**

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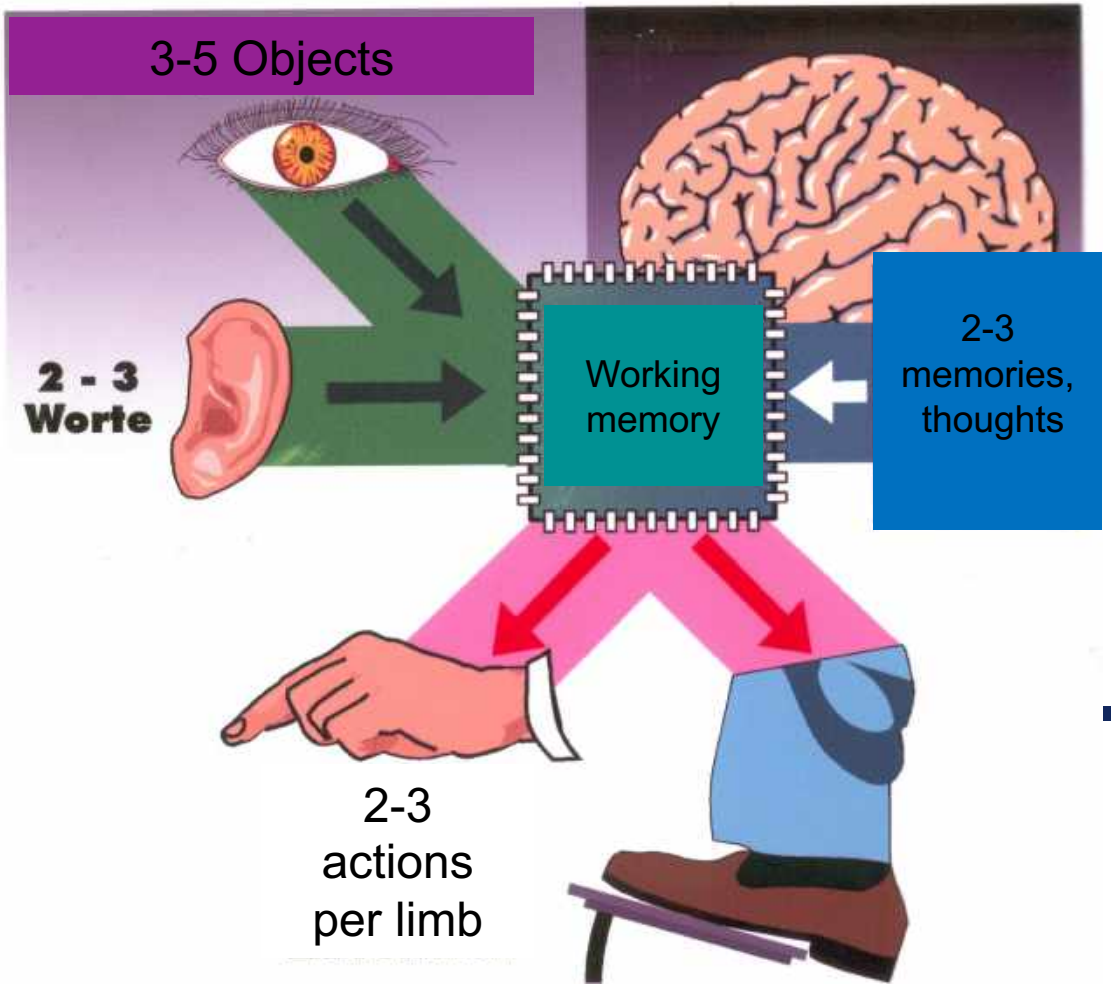
Incoming **external** informations

Incoming **internal** informations



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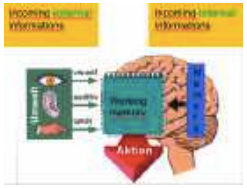
Information processing



- About fifteen different pieces of information can end up in the working memory.
- The term **duration of presence** refers to the retention time we have available to perceive, assess and specifically link incoming information to information in the memory, to make a decision and to initiate action appropriate to the situation.
- On average, the duration of presence lasts about **five to six seconds**.

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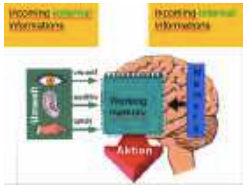
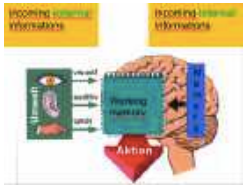
Information processing



- Duration of presence varies according to our state of mind.
- Stress is a crucial factor, as the duration of presence is reduced under stress.
- The duration of presence can drop as far as below one second – when this happens, we speak of “**information bankruptcy**”.

Information processing



What characterizes an unfocused driver is not the fact that the driver is not focused.

It is that the driver directs his attention to “side activities” and blocks the working memory with information irrelevant for the traffic situation.

The actual main task of “driving on the road” becomes a secondary matter while the distraction itself shifts into the focus.

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Information processing and multitasking

People tend to continue talking on the phone also in critical situations, as pausing a conversation on a mobile phone can give the impression that the line is interrupted.

Since people on the phone cannot see each other, a pause in the midst of a sentence can be misinterpreted by the other as indecisiveness or hesitation.

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Information processing and multitasking

- Test persons who talk on the phone in city traffic have to correct their steering behavior up to ten times more often in order to keep in the right lane.
- The more difficult the conversation became, the less often the test persons looked into rear view mirror

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Information processing and multitasking

- People reach the limits of their mental capacity when they try to talk about one thing and think about another at the same time.
- Thinking and interacting with the environment rely on capacities located in the same regions of the brain: the lateral prefrontal cortex.
- Such a conflict arises also in the visual cortex when it processes new external images and at the same time brings past mental images to the fore for contemplation.
- These activities compete for the same neuronal networks and are therefore difficult to combine.

Information processing and multitasking

1. For most people, an accident is – statistically speaking – a rare occurrence. According to the Federal Statistical Office, 3,059 people had died in traffic accidents in the year 2019, which means that the number of fatalities has dropped to a historical low.
2. Many people believe that “Accidents happen to others, I will be all right”.

Psychologists refer to this attitude as **“illusion of one’s own safety”** and “**learned carelessness**”.

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When driving a car is considered a mostly private, routine activity, which is seemingly easy, it seems difficult **to be critical of oneself!**

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Driving a car is a demanding activity under risk conditions, which often takes place under complex circumstances.

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Yerkes-Dodson-Law

In 1906, the U. S. psychologists Robert M. Yerkes and John Dillingham Dodson described the relationship between our performance and our activation level.

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Level of competence

How well we can perform certain tasks depends on our capabilities. Someone, who is well trained and can rely on his capabilities, will be able to cope with situations involving a lot of pressure better than someone whose capabilities are less pronounced.

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Complexity of the task

How difficult is the task? It is easier to drive on a wide, straight road than on a tight, curvy one. There are many inter-individual differences in view of the degree of complexity a person can deal with.

Self-confidence

Someone who believes in himself and his capabilities will be more capable of acting under high activation and stress than someone with self-doubts.

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Personality

Our personality also influences how we respond to demands and stress. Extroverts tend to find it easier to cope with stress than introverts who can perform better when there is no pressure.

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Level of activation

Consciously or unconsciously, we try to maintain an optimal level of arousal in everyday life. Also when driving a car.

When we are bored while driving (= low level of activation), there is a certain chance that we will reach for the phone, a cigarette or something to drink.

Obviously, we perceive routine driving activities such as steering, shifting or braking as being too easy.

So if we are seemingly underchallenged, we automatically look for new challenges and then begin to engage in additional tasks at the same time.

multitasking = the ability of computer operating systems to perform more than one task at the same time.

However, the way our brain works is not really comparable to how a computer works: Just attempt to add and at the same time multiply the numbers 14 and 3 within one second. A computer can do this – for us, this is impossible.

Psychologists speak of multitasking when a person performs two or more tasks at the same time. The tasks must have objectives independent from each other.

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1. Difficulty of the task

Very **simple activities** hardly occupy our brain, it is therefore easy to combine monotonous activities with difficult ones, e.g. eating and talking on the phone or doing the dishes and engaging in conversation.

2. Similarity

Try to grasp how often the letters “e”, “S” and “t” appear in this paragraph at once glance. Or try to silently read this paragraph while counting out loud the number of words.

These activities are very similar, which means that they make use of the same neuronal networks and are therefore difficult to combine.

2. Similarity

A conflict arises in the visual cortex when it has to process new external images while bringing past mental images to the fore for contemplation.

And this is exactly what makes using a phone while driving so dangerous.

When we are on the phone, we bring memories, thoughts etc. from the long-term memory into the working memory, we generate images in our mind's eye – and do not spot the road sign with the speed limit for the external road traffic.

3. Level or practice

The more we practice, the smaller will have to be capacities that are needed.

Remember when you had to shift gears in a car for the first time. Most of us paid close attention, had to learn to detect whether they had chosen the right gear and to coordinate their feed on the gas and clutch pedal. At the beginning, this completely absorbed our attention.

Although we may sometimes get the impression that we are capable of accomplishing and directing our attention to several tasks at once, our attention in fact toggles between one task and the other.

Psychologists call this “**task-switching”.**

One task is either finished or interrupted before we begin with the next. **Our attention is never divided between two simultaneous tasks.**

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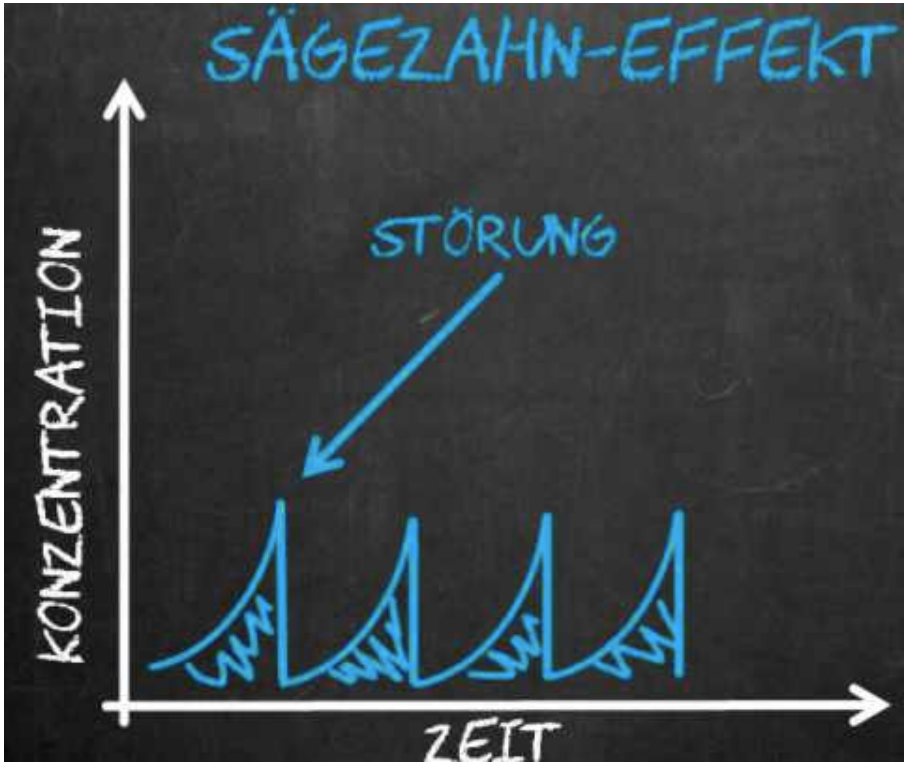
Saw-tooth-effect



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When we interrupt a task and direct our attention on something else, the information relating to the first tasks is lost.

If we then want to continue where we left, we have to collect the information again from the long-term memory or from our surrounding.

When we try to deal with several tasks at once, we have to divide our attention. **This reduces our performance in each individual task.**

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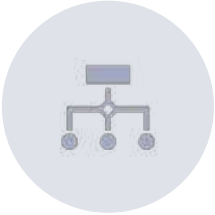
Multitasking: Not a good idea!

Resist the urge to do several things at once, because multitasking does not work.

Our brain is wired for serial processing.



The amount of information we can process is limited.

Practice single-tasking!

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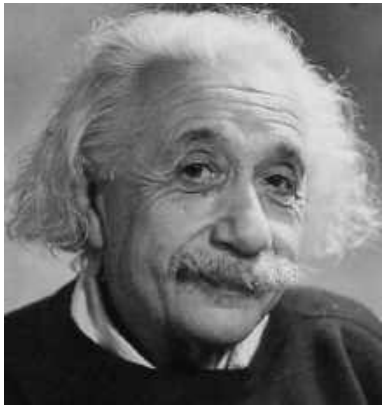
Any man who can drive safely while kissing a pretty girl is simply not giving the kiss the attention it deserves!

Albert Einstein



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Information consumes the attention of its recipients. Hence, a wealth of information creates a poverty of attention.

Herbert Simon, winner of the Nobel Prize in Economics

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Most time is lost by trying to gain time.

John Steinbeck, U. S. winner of the Nobel Prize in Literature

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WE SEE WHERE YOUR EYES ARE TURNING

Research on eye-tracking while driving a car

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WE SEE WHERE YOUR EYES ARE TURNING

“You turn where your eyes turn”.

“If you look at the traffic cones, you will knock them over”.

What do you think: Do you agree with these two statements?

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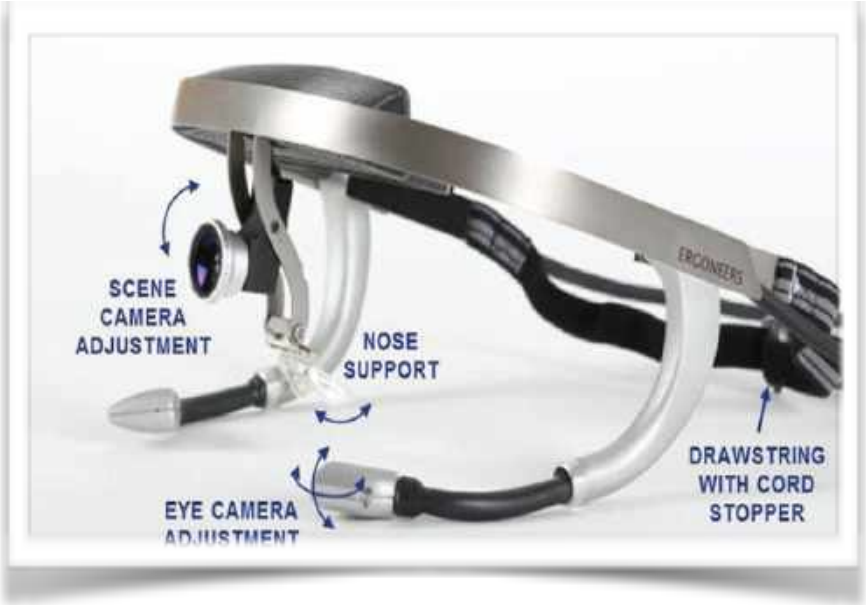
Eye-tracking-camera



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Eye-tracking-camera

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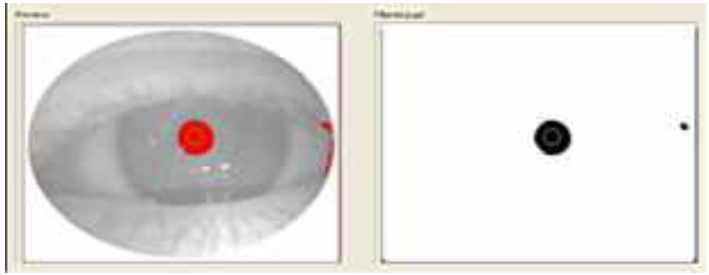
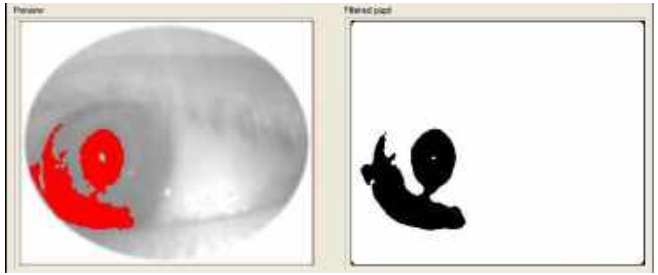
Eye-tracking-camera: Calibration





Left: exact calibration

right: imprecise calibration

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Eye-tracking-camera: Calibration

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Nato Air Base Teveren: Slalom

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Nato Air Base Teveren: Slalom

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Mental Representation

- The eye sees, but the brain percieves

- In the dark, you do not „see“ with your eyes, but with your brain

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Our retina: the sensory cells of our eyes

- about 120 million rod cells and 6-7 million cone cells.
- rods are responsible for seeing in black and white or our night vision (scotopic vision)
- cones are responsible for our photopic vision under daylight conditions.

Our retina: the sensory cells of our eyes

- Our vision is sharpest in the area of our central vision = fovea centralis.
- Fovea centralis is composed only of closely packed cones. While it lacks rods, it contains about 140,000 cones per mm^2.
- When adapting to the light, it has also an excellent visual acuity, a very high sensitivity to light differences and it is able to recognize colors.
- It also has the distinct ability to identify slow moving objects.

Our retina: the sensory cells of our eyes

- In the periphery, the ability to recognize colors decreases.
- The peripheral retina, which contains rod cells, has a rather poor visual acuity when compared to the fovea centralis and less light sensitivity.
- It is very sensitive to fast moving or changing objects and it can perceive them with more accuracy than the fovea centralis.
- In the outer (peripheral) segment, up to 150 rod cells share a single nerve pathway. For this reason, the periphery accommodates only black and white vision with a low resolution, but it is a lot more sensitive to change.

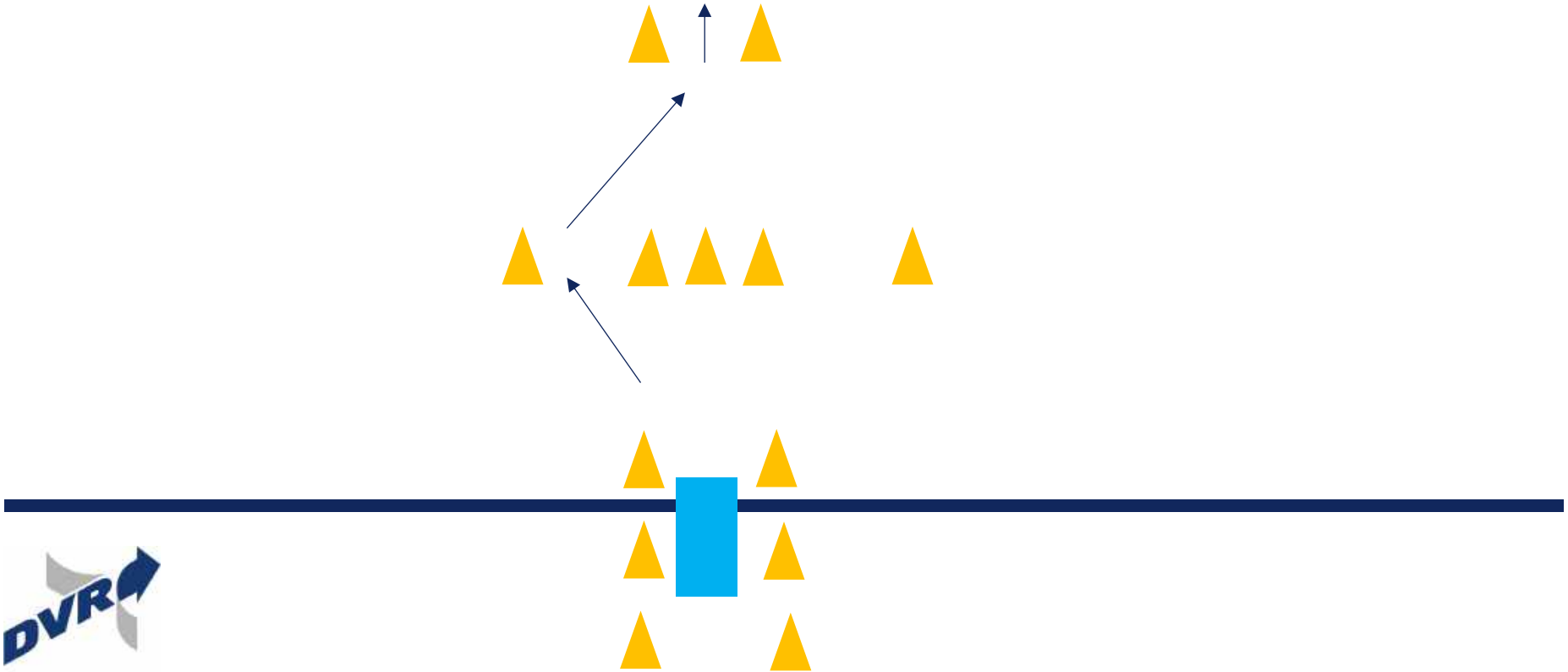
Visual information is only collected at fixation

- For this reason, the traffic cone needs to be fixated, that means looked at.
- The fixation must last at least 100 ms.
- This means that the eye can scan the slalom in very little time to create an internal map.

Visual information is only collected at fixation

- We have to keep our eyes shortly on the objects to be able to perceive and further process them.
- What we have learned and experienced individually affects our visual strategy.

Avoiding a suddenly appearing obstacle



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Try to quickly pick up relevant information.

Look at where you are heading.

Keep your gaze point dynamic, i.e. be aware of the area in front of your vehicle, but also of the road ahead of you, to where you are driving.

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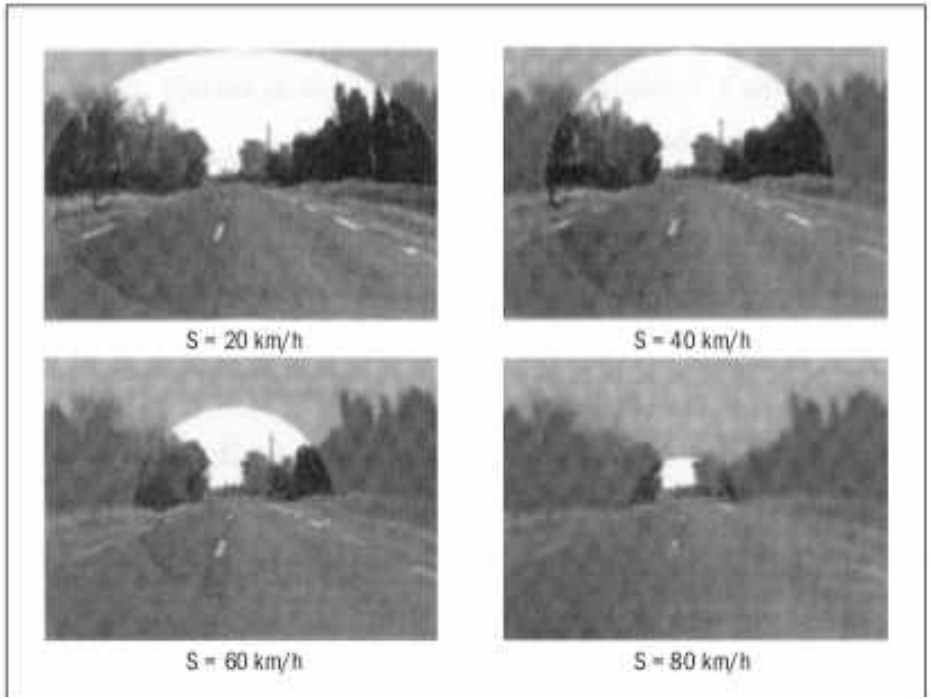
My fixation point is where I will be in three seconds?

This would imply that the fixation point will be further away when I go faster and that the angle of vision decreases with increasing speed, meaning that the “relevant field of view” will be shrinking.

Decrease of the visual field at different speed levels



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Visual field at different speed levels

50 km/h

85 km/h

85 km/h

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Different speed levels

Contrary to popular belief, the drivers look at the area **close** to the vehicle when driving at **higher speeds**, that is the area where obstacles are most immediate.

This makes sense, because the faster I go, the more information I have to process at the same time.

However, since our brain can only absorb and process a certain amount of information, I look closer in front of the vehicle and thereby reduce the incoming information.

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How we dircet our gaze when being on phone

- When having a conversation/talking on the phone, the gaze point is closer to the vehicle than in the same situation when there is no conversation.
- What is more, the area of fixation is in the center while the driver who is not being distracted tends to look at the lane markings on the side.
- The eyes also do not switch as much as between object when being distracted.

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How we dircet our gaze when being on phone

It is difficult to think about a certain matter and interact with the environment at the same time.

The reason: When thinking, our brain creates images. But at the same time external images have to be processed. Both use capacities in the same brain areas – and this can lead to bottlenecks.

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Summary of findings

- ✓ Most of the time, we look at objects automatically and unconsciously based on an individually acquired visual strategy.
- ✓ To perceive visual stimuli, we have to shortly fixate them, so the brain can create a mental representation.
- ✓ The faster we go in a car, the more likely it is that we will look close in front of the car and not further ahead of us, as it is often claimed.
- ✓ Distraction negatively affects our visual strategy.

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Summary of findings

We have to get away from the idea that the chronological order of a car driver's gaze behavior is completely determined or, in other words, that **there is only one adequate gaze behavior for a particular situation**.

There is rather a number of gaze behaviors that are adequate for the same situation.

Our personal needs and what we have learned and experienced determines where we direct our attention when driving.

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