



## Our eyes are always in motion

whether looking around or focusing intently

### **Interview with Dr. Katharina Rifai, Neuroscientist and Physicist at the ZEISS Vision Science Lab, Tübingen (Germany)**

#### *Our eyes never seem to stay in one place. Is this actually true?*

When speaking to someone else, we've all looked at the other person and realized that our eyes are moving constantly. They move specifically in the direction where we want to look. This makes vision an active process – rather than just functioning like a static video camera. So, a person's eyes are never really still.

#### *Do our eyes always move at the same rate of speed?*

There are three typical eye movements. First, there are so called saccades. That's the name for these rapid movements that are always happening both consciously and unconsciously. Once they start, this type of eye movement can't be stopped. It lasts for just a few millisecond. These movements allow the eyes to find a new fixation point. But many saccades are just a reflex. Second, there are visual fixations, especially on objects we either want or have to focus on. Drift happens while fixating, i.e. the eye slowly wanders. And then there's the saccade in miniature, the microsaccade. The third type of eye movement is the pursuit of moving objects. Incidentally, the eye muscles are very powerful. They're capable of performing extremely quick movements as well as concentrating on a moving object.

#### *Can you improve the eye by training these muscles?*

No, we can't train the muscles. Moving your eyes more frequently doesn't make them better. And, as I already said, the saccades are happening constantly. That means the muscles are always active, even when it's dark.

#### *If we want to see something, we also move our head and not just our eyes. Are these movements also part of visual behavior?*

Of course the head, along with the eyes, plays an important role in vision because lowering or turning our head determines where we can focus. There are situations where we initially only move our eyes and then either don't move our head at all or only do so later. Or this all happens simultaneously. That's something else you can study.



***How do you study a person's visual behavior? And why do it?***

A common method is eye tracking. Eye tracking allows us to see where someone is looking. It's important for understanding what information a person perceives in a given situation – we learn what they're paying attention to. Since our research is application oriented and we're part of ZEISS, we're particularly interested in this information for developing spectacle lenses. Our questions center on which areas of a spectacle lens a person looks through and when.

***What experiments are then performed?***

The processing of visual information in the brain plays a central role in how we perceive the world. We study the visual process using psychophysics. When designing an experiment, we control what visual information is shown and ask the test subjects binary questions. i.e. did the person see object X or not? We then draw conclusions about the visual process. Of course, we always base our studies on existing research results in conjunction with our experiments. By doing so, we can achieve new scientific findings.



***These days, everyone is using digital devices, moving around a lot and is always on the move. Does it affect my visual behavior if I do a lot of things simultaneously?***

This means changes to the number of saccades are only limited since the saccades, for example, continue to take place even during fixation. But you have to devote more effort in visual processing in the face of so much information. And this also affects our movements. Cognitively, a lot more is being asked of us. And what definitely happens is that it changes what we look at and requires far more accommodation, i.e. the eye's ability to focus. For example: if I'm walking along a busy street with my smartphone in hand toward the subway while passing by people and cars, there's a host of things I have to pay attention to if I want to stay safe. There's a lot going on at different distances, but this nevertheless requires my attention. The lens of the eye has to work constantly. A lot of things I deliberately focus on by choosing to look in a particular direction and focus, whereas other

things stay at the periphery of my vision. I just see them out of the corner of my eye. Sometimes, I'll just move my eyes toward what's of interest to me, while other times I'll move my head as well and fixate on the object. Of course, there's a tremendous difference between this and a situation where I'm reading a book in a peaceful location or having a conversation in a quiet spot without looking down at my smartphone from time to time.

***Has the smartphone had a demonstrable effect on our visual behavior?***

Yes, absolutely. We were able to prove this in an eye tracking study. The study showed that the presence of a smartphone significantly alters visual behavior in three different situations: when speaking to someone else, performing computer work and while moving. Our visual behavior becomes far more pronounced vertically. We still spend a lot of time looking straight ahead and toward the periphery, i.e. to the right and left. But there are also eye movements we make significantly more frequently than we did before, such as looking down. This means that we do not fully direct our head in the direction of gaze. We frequently only look down when using smartphones instead of tilting our head down as well. These findings directly inform modern lens designs because they show that we spend a lot of time looking through the lower part of the lens in particular.

***Thank you very much for talking to us.***

Would you like to know more about visual behavior? Watch our video! We are also happy to share with you video footage or arrange interviews with ours experts.



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