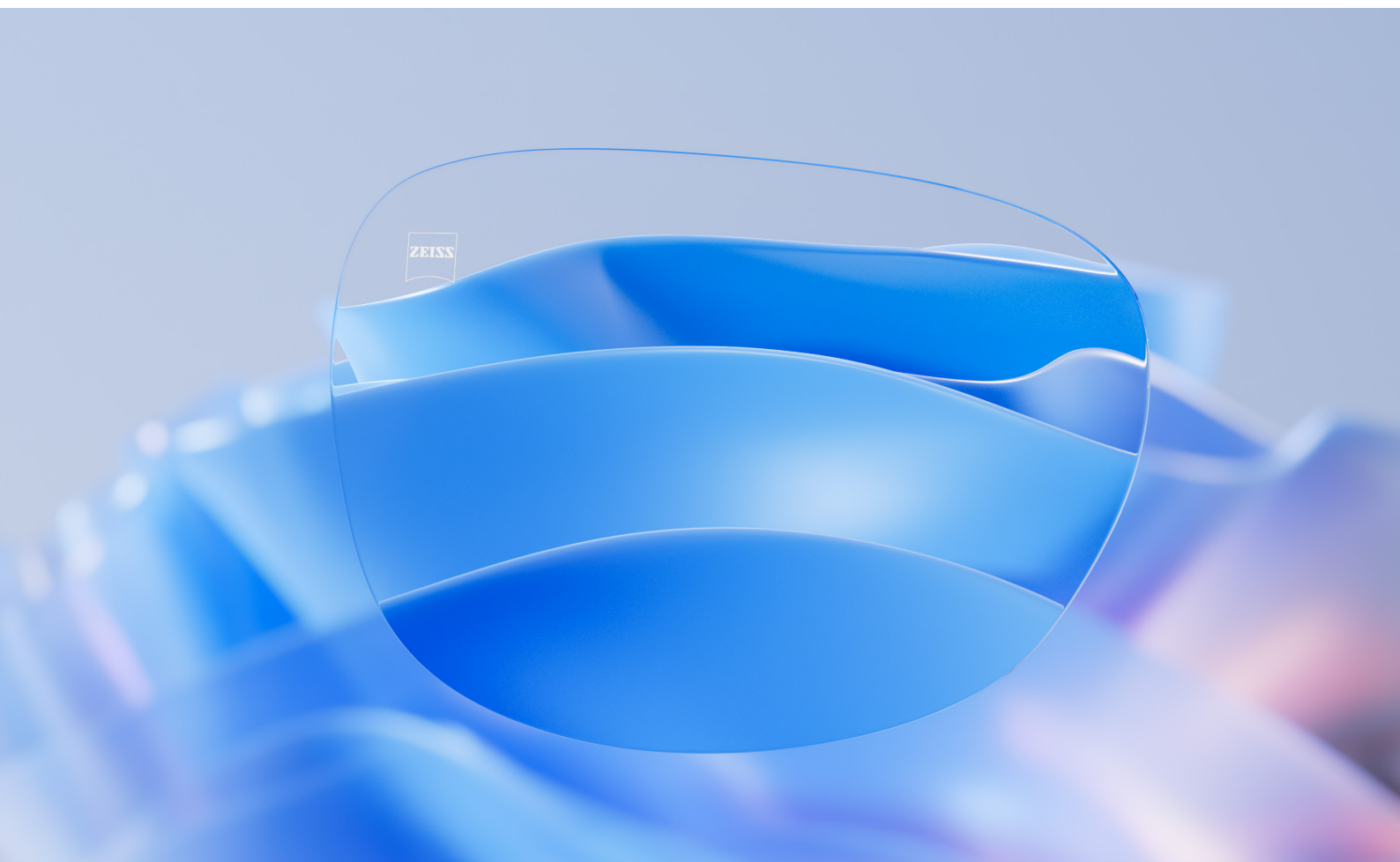


## **ZEISS ClearMind lenses**

See clearly. Think clearly.



Seeing beyond

# ZEISS ClearMind lenses

In today's visually demanding environment, the sheer volume of visual stimuli continues to rise, contributing to a pervasive sense of media overload. As members of an information-driven society, individuals often experience feelings of being overwhelmed, which can hinder concentration and focus on tasks. Compounded by blurry vision and the inability to perceive the world with clarity, these challenges can further exacerbate the situation, negatively impacting overall well-being.

ZEISS ClearMind lenses offer a groundbreaking solution to these challenges. Designed to deliver exceptionally clear vision, this innovative lens portfolio addresses peripheral aberrations in areas crucial for everyday use. By minimizing the necessity for the eyes to navigate through the lens's blurry zones, ZEISS ClearMind lenses reduce cognitive load as substantiated by the ZEISS Visual Perception Study 2025. Wearers also reported enhanced focus and improved concentration on tasks. The principle is simple: clear vision leads to clear thinking.

Moreover, ZEISS ClearMind lenses promote vitalized eyes throughout the day, contributing positively to the overall well-being of the wearer. By optimizing visual clarity and reducing cognitive load, these lenses support a more comfortable and focused visual experience.

## Market insights: Consumer needs and trends

In our increasingly visually demanding environment, individuals are confronted with a constant barrage of movement and layers of information, where digital and physical stimuli vie for attention. This overwhelming visual landscape not only saturates our surroundings but also places a variety of impressions on our eyes.

The volume of visual stimuli continues to escalate, whether it be the bright lights, signage, and advertisements of urban settings or the incessant flow of information delivered through digital devices. The integration of social media and real-time news updates can contribute to a phenomenon known as information overload.<sup>[1]</sup> Studies show that the average number of devices owned per capita worldwide rose from 2.4 to 3.6 between 2018 and 2023.<sup>[2]</sup> Everyone of us can consider him- or herself as part of an information society.<sup>[3][4]</sup>

The pervasive nature of visual overload can lead to individuals experiencing feelings of being overwhelmed, which in turn

poses challenges in maintaining concentration and focus on tasks. This state of disarray can result in disorganized thoughts, ultimately impacting overall well-being.<sup>[5][6]</sup> Blurry vision, not being able to see the world clearly, having to guess or interpret unclear information, can be assumed to intensify the situation even further as research shows that vision is correlated with well-being. Lower vision is therefore associated with a highly significant negative impact on well-being, which can be perceived e.g. as concentration problems or the feeling of tiredness.<sup>[7]</sup>

In summary, the development of the ZEISS ClearMind lens portfolio is based on three key consumer insights:

- We live in a visually noisy world with many visual stimuli to process.
- This can result in a sense of feeling overwhelmed.
- Blurry vision intensifies this situation even further.

## Visual perception: The connection between eyes and brain

In the past, ZEISS has already invested effort into understanding light, optics, and the anatomy of the eye as well as physiology of vision. After following the path of decoding visual behaviour, the insights to date are now complemented by investigating visual cognition, which in summary leads to a first step in the direction of a holistic understanding of visual perception.

Vision is a complex process that is driven primarily by the brain rather than the eyes alone. From an anatomical and physiological perspective, the retina is an extension of the central nervous system, underscoring the close integration between ocular structures and cerebral processing. When light enters the eye, it passes through the refractive media

and is focused onto the retina, where photoreceptors convert the optical signal into neural impulses. These signals are transmitted via the optic nerve and associated visual pathways to the primary visual cortex in the occipital lobe (see Figure 1).<sup>[8]</sup>

### Understanding the visual pathway

Light enters our eyes, in many cases through spectacle lenses. The light passes through the optical media including the cornea and the crystalline lens – onto the retina in the back of the eye. On the retina, the light is absorbed by the photoreceptors, namely rods and cones, where phototransduction converts light into neural signals. These signals undergo initial preprocessing within the retinal circuitry and are transmitted via bipolar cells to retinal ganglion cells. The ganglion cell's axons exit the eye as the optic nerve. This optic nerve travels through our brain: first to the so-called optic chiasm. This is where the nerve fibers of the optic nerve converge, with only the nasal fibers crossing, while the temporal fibers stay in their side for both eyes. That is why everything on the right side of our environment is processed in the left side of our brain, and everything on the left side is processed in the right side of the brain.

Beyond initial cortical processing, visual information is distributed to specialized regions of the brain responsible for higher-level functions such as object and shape recognition, motion perception, spatial orientation, and visual attention.<sup>[8][9]</sup>



Figure 1: Schematic illustration of the visual pathway: Light enters the eye, passes the refractive media, and is projected onto the retina. There, it is translated into a neural signal, leaving the eye via the optic nerve and is ultimately forwarded to the visual cortex.

## The working memory and cognitive load

To form a comprehensive understanding of our surroundings, we rely on more than just auditory and visual stimuli. Our brain integrates all sensory inputs, including visual, auditory, tactile, and proprioceptive information, to create a cohesive and unique perception of the environment. This multisensory integration is crucial for accurate spatial awareness and effective interaction with our surroundings. This has an impact on our so-called working memory:

Working memory is a cognitive system responsible for temporarily holding and processing information needed for complex tasks such as reasoning, learning, and comprehension. Its capacity is limited and directly related to a person's cognitive load, which serves as a measure for the amount of information our working memory processes at any given time.<sup>[10][11]</sup> For an analogy helping to understand the concept of working memory, see the corresponding box on the right.

Under conditions of blur, our ability to identify and interpret complex stimuli is assumed to be further compromised, as we need to compensate for the lack of clear visual information.

The brain receives incomplete information and tries to make up for that through logical combinations – but: a higher capacity of working memory is needed. Thus, this may result in an increased cognitive load.

### Understanding the concept of working memory

In order to understand the concept of working memory, an analogy might help: We can imagine the brain is like a computer, and the capacity to handle cognitive load is similar to the computer's RAM (Random Access Memory). Just as a computer uses RAM to temporarily store and manage data needed for immediate tasks, the brain uses cognitive resources to process and handle information in real-time. When there are too many tasks or pieces of information to manage at once, cognitive load increases, much like a computer running multiple applications simultaneously. If the cognitive load becomes too high, the brain, like a computer with insufficient RAM, may struggle to keep up, leading to issues with processing.

# Blur impacts cognitive load: The ZEISS Visual Perception Study 2025

The relation between blur and cognitive load has been examined with the ZEISS Visual Perception Study 2025. For more in-depth information on this study, please refer to the ZEISS ClearMind lenses Scientific Fundamentals Paper.<sup>[12]</sup>

It is well-known that older adults often encounter increased cognitive demands when performing fine visuomotor tasks – the coordination of visual perception and motor actions – at closer distances<sup>[13]</sup>. Using this as an inspiration, a pegboard task was designed aiming at modulating cognitive load. Participants were instructed to pick up beads from a tray and arrange them on the pegboard to replicate a specific pattern.

The task was performed by all participants under conditions with fully corrected, clear as well as blurred vision. The latter was induced by cylinder lenses of power 1.25 dpt. To correct for the close working distance, in all conditions spherical power (+2.75 dpt) was added.

Participants' cognitive load was assessed subjectively via a scientifically validated questionnaire called NASA Task Load Index (NASA-TLX) and objectively via electroencephalography (EEG) measurements.

EEG (for a schematic illustration, see Fig. 2) is a non-invasive neuroimaging modality used to measure electrical activity in the brain while participants perform tasks. By placing electrodes on the scalp, EEG captures neural signals that have been extensively studied to gain insights into brain functions.

A widely examined EEG-derived metric is cognitive load. It is well-known that the so-called theta-band activity (a specific frequency band of the brain's electrical activity), particularly in the front part of the brain, i.e. frontal and prefrontal areas,

increases with higher cognitive load.<sup>[14][15][16]</sup> By analyzing frequency-specific activity, EEG thus provides valuable information about visual processes and impact on cognitive load.

Results of the study showed that the NASA-TLX score increased strongly with blurry vision. For EEG, especially the front part of the brain showed higher theta activity under blurred vision conditions. This is a clear sign that the participants had to compensate for the reduced visual input with higher cognitive load to solve the task.<sup>[17]</sup>

In summary, this study was the first globally to demonstrate that lens-induced blur impacts cognitive load evidenced by EEG data.<sup>[17]</sup>



Figure 2: Schematic illustration of EEG measurements: Electrodes are placed on the participant's scalp via a cap in a non-invasive manner

## ZEISS NeurOptix technology – the signature of ZEISS ClearMind lenses

If increased blur elevates cognitive load, then enhanced clarity will likely reduce it. This underscores the importance of understanding how individuals actually use their eyes and spectacle lenses in everyday situations. It is not enough to recognize that blur matters, we must also understand when, where, and how people experience it in real life. With this knowledge, lens design can be tailored to optimize the clear

areas of the lens, ensuring that wearers benefit from improved visual clarity and reduced cognitive load.

Daily visual behaviour is characterized by a series of eye movements, fixations, and the varying visual tasks we engage in throughout the day. Additionally, the specific areas of the spectacle lens that are most frequently utilized play a

significant role in this process. By thoroughly analyzing these eye-lens interaction patterns, we can identify the critical zones that must remain optimally clear to enhance visual performance and comfort for the wearer.

This knowledge enables a new generation of spectacle lens design. With insights on real-world visual behaviour, we can create a lens design fingerprint that mirrors the wearer's natural visual behavior.

- **Maximized clarity:** The lens is optimized to provide the clearest vision in the areas where the eyes are most frequently directed.
- **Minimized aberrations:** Lens-induced blur caused by optical aberrations is reduced in zones that are critical for all-day visual tasks.
- **Cognitive load reduction:** By minimizing blur, we also decrease cognitive load, allowing for more efficient visual processing.
- **Enhanced comfort:** This approach ensures comfortable and clear vision across the full spectrum of daily activities.

The lens design is grounded in extensive research across vision science, cognitive load theory, and real-world eye behavior, providing a scientifically robust foundation for enhanced visual performance. ZEISS ClearMind lenses are engineered to deliver clear images to the brain by adapting to natural visual behavior in a dynamic environment filled with visual information and noise. By minimizing lens-induced blur, these lenses aim to reduce cognitive load, thereby supporting comfort throughout the day.

The enabling technology of ZEISS ClearMind lenses is ZEISS NeuroOptix technology, an advanced design intelligence that considers neuroscience effects into lens design optimization. This works as follows:

## 1. Maps real eye behavior

ZEISS NeuroOptix technology is based on analyses how people naturally use their eyes throughout the day, i.e. how long eyes stay in certain areas, or how tasks shift between near, intermediate, and distance.

A re-evaluation of the ZEISS Global Vision Study 2020/21<sup>[18]</sup> revealed the share of vision tasks in daily life for all ages (see Figure 3). These tasks can be allocated to specific visual behaviour.

## 2. Pinpoints real visual behavior on the lens surface

People do not just “look through a lens.” They gaze, multitask, scroll, read, drive, work, and relax.

A profound comprehension of the visual tasks performed in daily life facilitates the precise identification of the specific regions on the spectacle lens essential for these tasks. This process is grounded in a sophisticated mathematical model that integrates ZEISS's extensive knowledge of ocular movements, visual behavior, and the position of lens wear. The robustness of this model is exemplified through gaze-lens intersection research (see Figure 4).

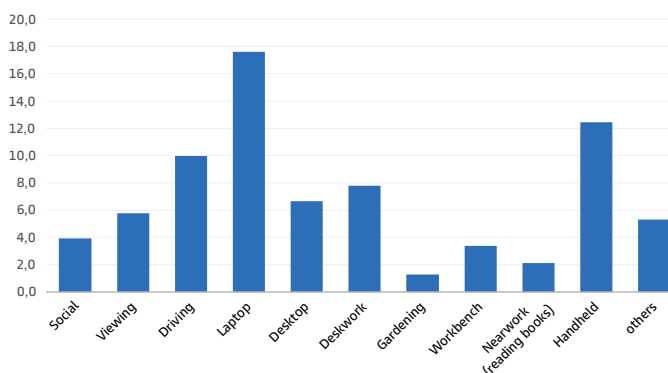


Figure 3: Share of vision tasks performed daily in % over all ages, data based on Global Vision Study <sup>[18]</sup>

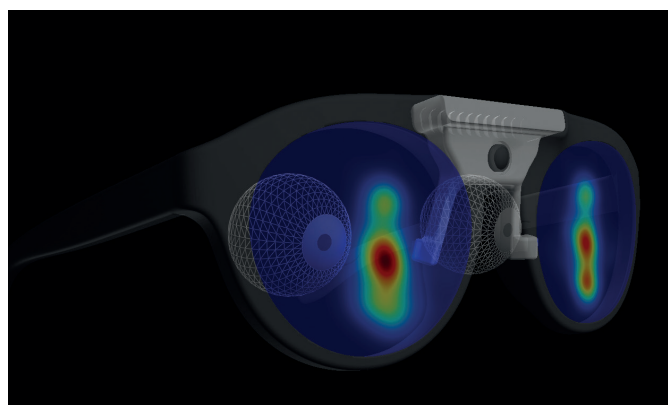


Figure 4: Schematic illustration of gaze and lens intersection of visual behaviour, data recorded with Neon 2 (PupilLabs)

## 3. Links level of blur perception to cognitive load

Not all blur is equal. Some levels of blur are barely perceived; others may trigger cognitive load.

ZEISS NeuroOptix technology focuses intensively on the thresholds of noticeable blur (see Figure 5) <sup>[19]</sup>. This enables to identify zones where blur creates unnecessary cognitive load. As limits of noticeable blur differ for far, intermediate, and near distances, noticeable blur is consequently considered with adjusted variable thresholds. Vision zones in which clarity is assumed to lead to the largest cognitive benefit, to ensure the lens supports effortless vision, are prioritized.

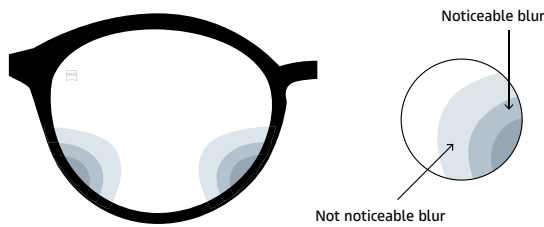


Figure 5: Schematic illustration of noticeable levels of blur according to [19]

#### 4. Counteracts the cognitive load from lens-induced blur

In ZEISS lenses, excellent optics and lens aesthetics are balanced. However, there are residual errors left that could not be eliminated in the past. Now we go a step further and consider those for the optimization.

For *progressive and digital lenses*, traditional lens geometry can induce blur that forces the brain to compensate. Depending on prescription and whether a plus or minus lens is needed, positive or negative mean power errors occur when looking obliquely through the periphery of the lens:

In plus lenses, a negative mean power error for oblique gaze directions through the lens periphery remains and in minus lenses, there is a positive mean power error for oblique gaze directions through the lens periphery.

The residual mean power error for gaze directions through the lens periphery is not directly perceptible but impacts the power progression, adversely affecting the visual experience, leading to increased peripheral blur in both plus and minus lenses.

To mitigate the geometrical effects and increased blur levels as described above, a geometric optical control algorithm is employed to counteract the influences of individual prescriptions (meaning every individual combination of sphere, cylinder and axis) on lens geometry – and to ensure that the originally intended design fingerprint is provided to the wearer.

In *single vision lenses*, the lower portion of the lens is typically utilized for near tasks. Therefore, it is essential that this area of the lens remains free from any blur to ensure that the visual system can function smoothly without interruption.

In ZEISS ClearMind lenses, a three-dimensional object-space model is considered to adjust the lens surface for optimization of the lens optics. Compared to previous lens designs, this object-space model has been improved to better fit the wearer's needs by increasing the distance between the area for far vision and the area for near vision. The design target has been fine-tuned to the improved object-space model, resulting in a softer distribution of blur and a larger zone without noticeable blur.

#### 5. Creates a neural lens fingerprint

Using optical, behavioral and neurological insights as described above, ZEISS NeurOptix technology shapes a lens-design fingerprint that mirrors the wearer's real visual priorities and needs.

This means that clarity is provided in the areas most relevant for all-day usage, the lens design is optimized for transitions where the eyes naturally move, and lens-geometry-induced blur is minimized in sensitive areas.

For ZEISS Progressive ClearMind lenses, this results in

- Up to **30%** less blur towards the edges compared to ZEISS progressive standard lenses.
- Up to **10%** less blur towards the edges compared to ZEISS Progressive SmartLife lenses
- Up to **7%** larger zones of clear vision than ZEISS progressive standard lenses for far distance.
- Up to **9%** larger zones of clear vision than ZEISS Progressive SmartLife lenses for far distance.
- Up to **45%** larger zones of clear vision than ZEISS progressive standard lenses for intermediate distance.
- Up to **26%** larger zones of clear vision than ZEISS Progressive SmartLife lenses for intermediate distance.
- Up to **73%** larger zones of clear vision than ZEISS progressive standard lenses for near distance.
- Up to **41%** larger zones of clear vision than ZEISS Progressive SmartLife lenses for near distance.<sup>[20]</sup>

ZEISS Digital ClearMind lenses show

- Up to **7%** larger zones of clear vision than ZEISS Digital lenses for intermediate distance.
- Up to **28%** larger zones of clear vision than ZEISS Digital lenses for near distance.
- Up to **11%** less blur towards the edges compared to ZEISS Digital lenses.<sup>[20]</sup>

ZEISS Single Vision ClearMind lenses offer

- Up to **7%** larger zones of clear vision with no visible blur than ZEISS Single Vision SmartLife lenses.
- Up to **48%** larger zones of clear vision with no visible blur than ZEISS Finished Single Vision ClearView lenses.
- Up to **38%** less blur towards the edges compared to ZEISS Finished Single Vision ClearView lenses.<sup>[20]</sup>

For more in-depth information on NeurOptix technology and for information on all essential and customization technologies involved, please refer to the ZEISS ClearMind lenses Technology Fundamentals Paper.<sup>[21]</sup>

# Vitalized eyes

ZEISS ClearMind lenses alleviate tired eyes by optimizing accommodative relief, thereby reducing the strain on the eyes. This optimization is key for maintaining a sense of vitality throughout the day. Moreover, a stable tear film is associated with lower levels of eye fatigue <sup>[22]</sup>, further supporting the feeling of vitalized eyes. Therefore, it is essential to blink regularly to keep the cornea hydrated and prevent dry eyes.

ZEISS ClearMind lenses are proven to contribute to a stable tear film by keeping up a regular blink rate. This has been tested in

a blinded study where participants had to fulfill a visuomotor task with ZEISS Progressive ClearMind lenses as well as ZEISS progressive standard lenses for three times, each. Blink rate was recorded via eyetracking. Results showed that compared to ZEISS progressive standard lenses, blink rate is on average 16% higher with ZEISS Progressive ClearMind lenses.<sup>[17]</sup>

ZEISS ClearMind lens wearers experience the benefit as 69% of them say that their eyes feel vitalized throughout the day.<sup>[23]</sup>

## The ZEISS ClearMind lens portfolio

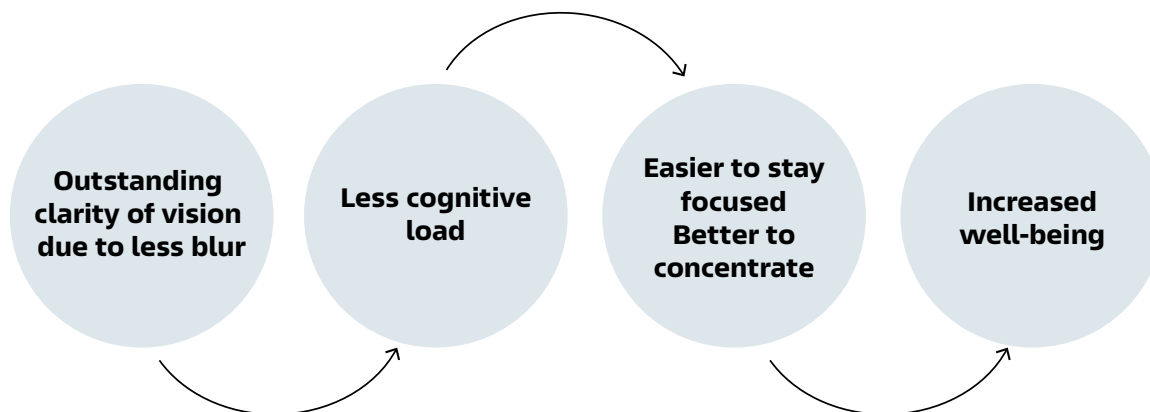


Figure 6: Rationale for the development of ZEISS ClearMind lenses.

For the development of ZEISS ClearMind lenses, the target was to deliver outstanding clarity to the brain by optimizing blur in the key areas for daily usage – to achieve extremely clear vision and support the reduction of cognitive load and increase well-being (see Figure 6).

The ZEISS ClearMind lens portfolio includes single vision as well as Digital lenses (with an additional power of +0.50 to +1.25 dpt) and progressive lenses (with an additional power of +0.75 to +4.00 dpt). Figure 7 shows an overview. Single vision and Digital lenses are available as a Superb and Individual 3 version, whereas progressive lenses are available as a Pure, Plus, Superb, and Individual 3 version.

Benefits of the different focal types are:

- ZEISS Single Vision ClearMind lenses are engineered to minimize peripheral blur and to ensure that the lower portion of the lens remains free from any blur, expanding the effective

visual field compared to conventional ZEISS single vision lenses. This design aims at reducing cognitive load through uninterrupted visual clarity.

- ZEISS Digital ClearMind lenses are delivering accommodative support and are engineered to minimize peripheral blur, thereby expanding the effective visual field compared to ZEISS's previous top-tier Digital lenses. This design aims to reduce cognitive load.
- ZEISS Progressive ClearMind lenses are designed to minimize and optimize peripheral blur, thereby expanding the effective visual field compared to ZEISS Progressive SmartLife lenses resulting in large fields of clear vision at all distances and in all directions with an extra-large intermediate zone. Additionally, the lenses optimize the vision flow to facilitate smooth transitions between different focal areas. Both are intended to enhance clarity of vision and reduce cognitive load.

All products in the ZEISS ClearMind portfolio are also available in a PRO version - dedicated to providing wearers with the most individualized visual experience possible. This is enabled by the advanced ZEISS Individual Luminance Design 2.0 technology, featured by the ZEISS i.Profiler<sup>plus</sup> and ZEISS VISUREF 1000, taking into account the individual size of pupil as unique characteristic. This results in a further individualization and upgrades to ZEISS ClearMind PRO lenses.

ZEISS ClearMind lenses are available in 1.50, 1.53, 1.59, 1.60, 1.67, and 1.74 indices, and come by default with ZEISS UVProtect technology, but can also be offered in ZEISS BlueGuard material. They can be combined with ZEISS DuraVision Chrome, Silver, Platinum, Gold and BlueProtect coatings as well as with sun tints, ZEISS PhotoFusion X, ZEISS Adaptive Sun, and polarized lenses.



18 - 29		30 - 45		45+			
Young adults		Adults		Mature adults + Elderly			
ZEISS ClearMind lenses							
Single Vision		Digital		Progressives			
Superb	Individual 3	Superb	Individual 3	Pure	Plus	Superb	Individual 3

Figure 7: The ZEISS ClearMind lens portfolio.

## How the consumer benefits from ZEISS ClearMind lenses

As an innovative solution, this portfolio stands for extremely clear vision by reducing peripheral aberrations in the areas which are relevant for all-day usage. By that, the eye gazes through blurry areas of the lens as infrequently as possible. Wearers experience the difference:

- **96%** of wearers confirm extremely clear vision.<sup>[23]</sup>
- **75%** of wearers confirm that it feels easier for them to stay focused with these lenses and **76%** of wearers state that the lenses increased their ability to concentrate on tasks.<sup>[23]</sup>
- Ultimately, **8 out of 10** wearers confirm that these lenses contribute positively to their overall feeling of well-being.<sup>[23]</sup>

In addition, a blinded study has been conducted at the ZEISS Vision Science Lab. Applying the NASA-TLX questionnaire, this study showed that **9 out of 10** wearers experienced less cognitive load, with an average reduction by **14%** for ZEISS Progressive ClearMind lenses compared to ZEISS progressive standard lenses.<sup>[17]</sup>

ZEISS ClearMind lenses alleviate tired eyes due to accommodative relief optimization which reduces the eye's effort. This ensures your eyes feel vitalized throughout the day. Specifically, Digital lenses help to reduce extra strained eyes due to accommodative issues:

- **85%** of wearers confirm that ZEISS Digital ClearMind lenses provide an extra stress reduction for their eyes.<sup>[23]</sup>
- As already stated above, **69%** of wearers say that their eyes feel vitalized throughout the day.<sup>[23]</sup>

Finally, **99%** of wearers state the lenses are thin & light and they look good & stylish with them.<sup>[23]</sup>

# How the eye care professional benefits from ZEISS ClearMind lenses

The ZEISS ClearMind lens portfolio includes progressive, Digital, and single vision lenses all with the signature ZEISS NeuroOptix technology for advanced blur management techniques to reduce the eye's effort and cognitive load for the brain. Eye care professionals (ECPs) know the value of exceptional vision solutions. With ZEISS Progressive ClearMind lenses, a customized experience for progressive lens wearers across four levels is provided: Pure, Plus, Superb, and Individual 3. Consumers can be served even better, elevating the eye care professional's practice. Benefits are according to an ECP feedback evaluation in various countries globally:

- **91%** of ECPs say the portfolio is easy to dispense.<sup>[24]</sup>
- **95%** of ECPs confirm that their customers reacted positively to their new ZEISS Digital ClearMind lenses.<sup>[25]</sup>
- **95%** of ECPs confirm that they would recommend the new lenses once they are commercialized.<sup>[25]</sup>
- **91%** of ECPs confirm that the new ZEISS ClearMind lenses are a valuable addition to the existing ZEISS portfolio.<sup>[24]</sup>
- **84%** of ECPs state that ZEISS ClearMind lenses are superior to the ZEISS SmartLife lenses.<sup>[24]</sup>
- **93%** of ECPs confirm that ZEISS developed again an innovative lens solution that help them deliver excellent care to their customers.<sup>[24]</sup>

## Conclusion

Combining well-established with novel technologies based on the latest insights on consumer needs and visual perception, the ZEISS ClearMind lens portfolio offers extremely clear vision and relief from tired eyes.

The portfolio includes progressive, digital, and single vision lenses – providing the most sophisticated, individualized lens portfolio possible. ZEISS ClearMind lenses manage the wearer's cognitive load and can help to alleviate mental effort, ultimately contributing to overall well-being. See clearly. Think clearly.

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