White Paper

ZEISS SmartLife Young Single Vision lenses

ZEISS SmartLife Young Single Vision lenses are specially optimized for the changing vision and physical requirements of kids and teenagers.

Seeing beyond

ZEISS SmartLife Young Single Vision lenses

ZEISS SmartLife Young Single Vision lenses are perfectly matched to younger age groups' (6-19 years) active, digital and educational lifestyle, as well as their age-related anatomical requirements (like position of wear, frame parameters and lens design parameters are) to optimize for the best possible visual performance to meet the wearer's daily activities.

As a result, ZEISS SmartLife Young Single Vision lenses have up to 60% wider fields of clear view compared to conventional ZEISS Single Vision lenses.[1]

In addition, ZEISS SmartLife Young Single Vision lenses provide full UV protection of the eyes and surrounding skin against harmful UV radiation while spending time outdoors. If blue light protection is desired and/or recommended by the eye care professional, ZEISS BlueGuard® material can be added additionally.

Being connected and active
Across the world and all age groups, digital devices are a significant part of people's everyday life. From an early age, the digital environment becomes an integral part of educational and social activities in a child's normal everyday life producing a multi-cognitive online / offline generation. They are used to play, learn, and communicated by using smart-digital devices and technologies like augmented reality. Therefore, the phygital world (combination of physical and digital world) becomes more immersive and relevant even for kids and teenagers.

A present survey asked parents a series of questions about their children (age <12 years) and how they engage with digital devices. As a result, 60% of parents say, their children began engaging a smartphone before the age of 5.[2] Additionally, studies from 2019 conducted in UK found out that in the age between 8 and 11 years, 93% of children go online for nearly 13 ½ hours a week and 18% already have a social media profile. While in the group between 12 and 15 years of age, 99% go online for almost 20 ½ hours a week and almost 69% have a social media profile.[3]

Apart of the increasing time younger age groups spend in front of digital devices, they keep habitual lifestyle patterns like being outdoors playing, doing sports or just meeting with friends.

In a present survey, 1,450 households in the US were asked about how much time children spent outdoors. In average they report children spent at least two hours outdoor daily.[4] Another study conducted in the U.S. on 1,200 households found that children aged between 2-10 years spend on average 19 hours per week using digital devices, while spending 11 hours per week playing outdoors.[5]

Anatomical Changes
Besides the behavioral patterns in young people's lifestyle, it is obvious that they undergo big anatomical and physiological changes during this stage of life. For instance, the arm-span length increases and their facial anatomy changes which influences the viewing distances and position of wear parameters.

Looking at the lens market, it happens quite often that children are served with lenses like nonspecific optimized or individualized stock lenses. Stock lenses are commonly neither specifically designed for children's age-related position parameter of wear nor their lifestyle. Therefore, they are often a comprise in terms of visual comfort and cosmetics - it is a one-size- fits all solution.

Conclusion
Kids and teenagers' way of living and daily behavior develop similar to their parent's life – they have a connected and active lifestyle no matter if spending time indoors or outdoors. Therefore, their digital and active lifestyle, as well as the physical growth needs to be considered in the lens design calculation to provide best possible vision performance for every situation all day long.

Viewing distance
Anatomical and physical properties have an impact on the viewing distance of the lens wearers. The usage of handheld digital devices requires our hands for control and our arm-length to hold the device at an appropriate distance.

The physical growth of the arms may an influencing factor to an increasing viewing distance during the growth phase of younger age groups. The mean arm span length of 8-year-old boys and girls is 127.1 cm compared to 175.5 cm at the age of 18.[6]

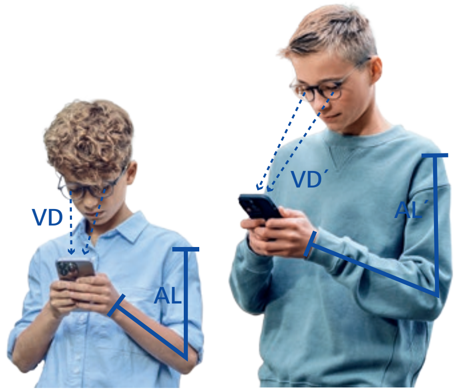


Figure 1. Schematic visualization of the age dependent arm length (AL; AL´) and the viewing distance – VD´; VD.

Various studies researched on the viewing and reading distance of digital devices in younger age groups. Figure 2 illustrates the findings of these studies. The graph shows the age-related increase of the viewing distance beginning at the age of 6 years with 20cm and indicate a constant value at the age of 20 with 30cm.[7],[8],[9],[10] It can be assumed that the rising viewing distance is based on the increasing age-dependent arm-span length.

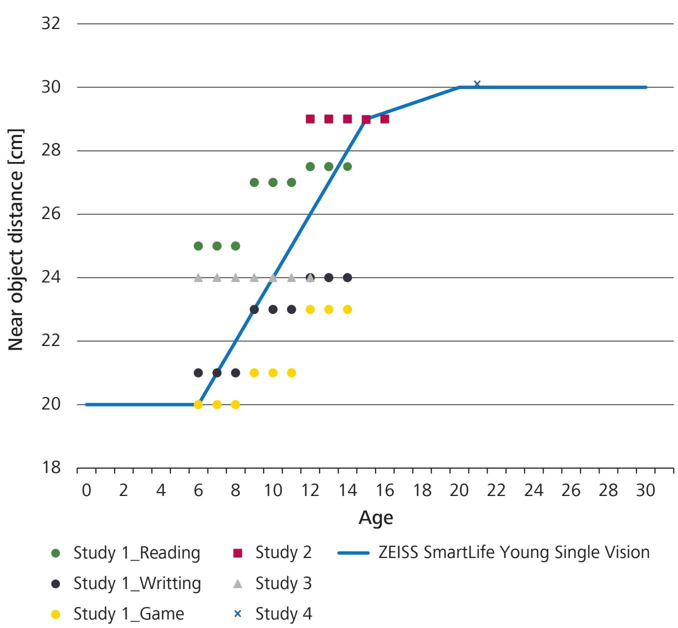


Figure 2. Proposed near object distance for ZEISS SmartLife Young Single Vision lenses based on the evaluation of 4 scientific studies.

Visual behavior

A major finding in the development of ZEISS SmartLife lenses for adults in 2019 was, that while people are connected and on-the-move, their visual behavior changes. A ZEISS study on visual behavior found that eyeglass wearers using their smartphones are looking through the lower area of the lens. This behavior was found during desk work, conversation and walking while using a smartphone.

As a result, wearers use a larger lens area for visual fixations because when using a smartphone, eye movements shifted significantly down. These study results are considered in the adapted 3D object-space-model of the lens design.[11]

Facial Anatomy change

Facial anatomy and morphology properties have an impact on the Position of Wear (PoW) parameters and as a result on the optical performance of the lens.

The human's face consists of fixed anatomical features like eyes, nose, lips, chin etc. But the facial characteristics change during our entire lifetime, especially at younger ages (Figure 3).

Figure 3. Schematic facial properties at different ages of boys and girls.

Figure 4 shows the facial growth changes between 7-17 years old girls (upper row) and boys. The blue shaded areas at the lower row shows the part of significant differences, grey colored areas; no significant changes. The biggest average changes occur between the age of 7 and 14 years; in girls at the age of 7-13 and boys 11-14. In the age between 14-16 years, especially the area around the eyes became deeper in relation to the facial plane.[12]

Another facial anatomical change at this age group is the increasing interpupillary distance – PD. A present study with 1,311 subjects of an age group between 1-19 years stated a mean PD of 42mm at the age of 1 year and 62mm at the age of 19.[13]

Figure 4. Visualization of facial growth changes by color deviation maps between the ages of 7 and 17 years in girls upper row & boys. The statistical significance changes were analyzed per vertex and coded in blue shades (significant differences) or grey (no significant differences) on the superimposed average faces.

The PD is a relevant factor ensuring best possible vision performance because this value ensures the pupils match up with the optical center of the lenses.

ZEISS analyzed and evaluated 1 million data points about children PoW parameters of individual order data from the year 2020 to 2022. The data of the PD values are consistent with the study findings on age-related facial changes (Figure 5).

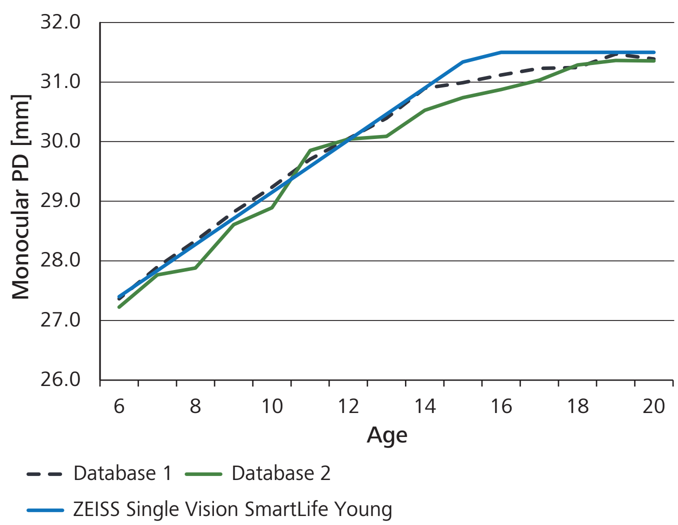


Figure 5. Age related monocular pupil distance.

Besides PD, fitting length and height, distance between lenses (DBL) and frame box data showed significant differences between the considered age groups.

Those findings are incorporated into the age-related lens design calculation additionally to the age-dependent viewing distance.

Pupil Size

The pupil takes care of the light intensity entering the eye. The dynamic of the pupil changes with age which has an effect of the incoming light and the visual performance e. g. depth of focus.

The larger the diameter of the pupil, the larger the incoming light beam and vice versa which is both age- and light-dependent. These changing properties can affect retinal illuminance and depth of focus, making pupil diameter an important consideration when optimizing lenses.

A study conducted in 2015 of 272 participants age group 1-18 years shows that the maximum average pupil size (low light conditions) at the age of 1 year is 4.82mm compared to the age of 16 year of 6.01mm. Under bright light condition the difference was 3.44mm at the age of 1 year compared to 3.92mm at the age of 16 years.[14]

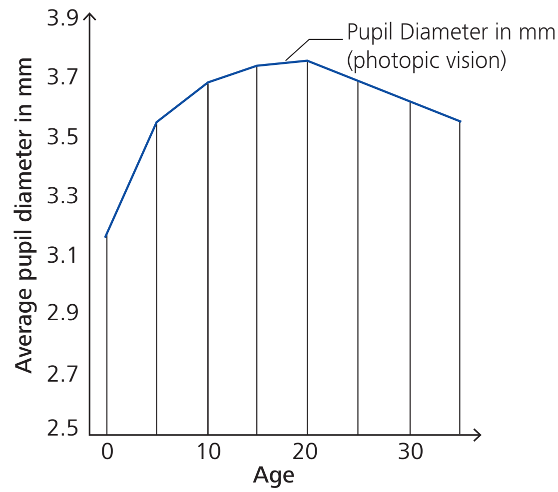


Figure 6. Age related pupil diameter at the age from 0-35 years.

Figure 6 shows that the pupil size grows until the age of 20 and declines afterwards.[15]

Another study investigated the pupil size while reading digital and print media. While reading on digital devices, the pupil size can be reduced up to 20% compared to print media because of the light exposure of the screen.[16] The study results also indicate the need of considering light conditions related to the pupil size ensuring best visual performance.

In summary, the pupil size is affected by various factors. Therefore, considering the wearers age and the incoming light beam are essential to ensure best visual performance.

Summary

Children and teenagers use digital devices every day, during their leisure time or for education, being indoors or outdoors. This connected and active lifestyle influences their visual behavior. In addition, various age-related anatomical and physical changes are occurring in this age range. Both, the changing visual behavior and the anatomical changes must be considered for ZEISS SmartLife Young Single Vision lens design providing the best possible vision for kids and teenagers.

ZEISS SmartLife Young Single Vision lenses

ZEISS SmartLife Young Single Vision lenses are designed to perfectly match young peoples connected lifestyle and anatomy.

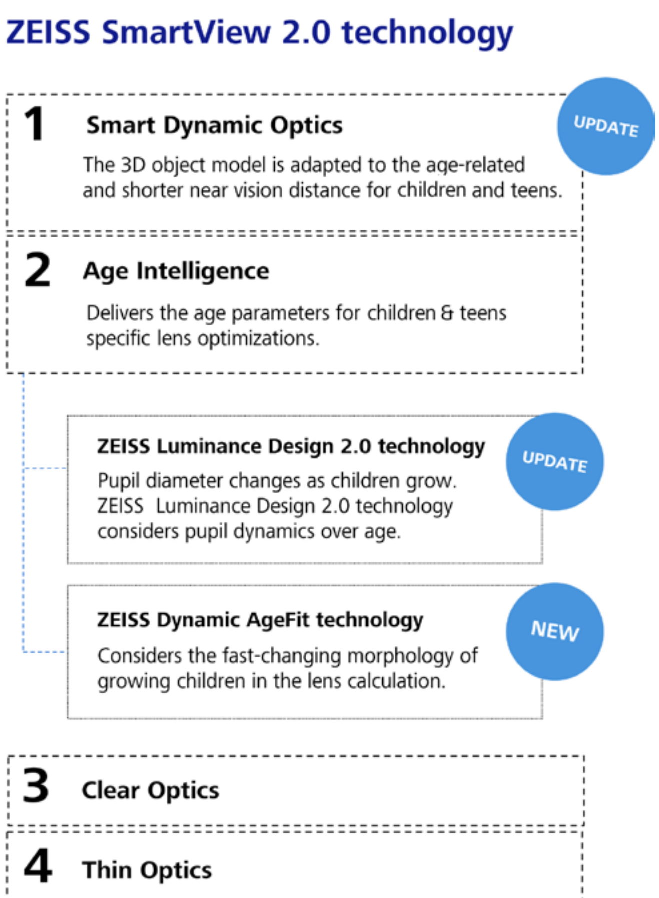
ZEISS SmartView® 2.0 technology considers young people's visual behavior being connected and active. Therefore, ZEISS SmartLife Young Single Vision lenses provide up to 60% wider fields of clear view and showed better optical performance compared to conventional ZEISS Single Vision lenses.[17]

ZEISS Dynamic AgeFit® technology considers your child´s facial age-related anatomy and ZEISS Luminance Design® 2.0 technology incorporates your child's increasing pupil diameter to assure best optical performance of the lenses. Furthermore, they provide full UV protection thanks to ZEISS UVProtect technology. ZEISS BlueGuard material can be added additionally and provides excellent blue light protection indoors and outdoors.

ZEISS technologies – adapted & made for young age groups

The following diagram gives an overview of the Technologies in cooperated in ZEISS SmartLife Young Single Vision lenses. ZEISS SmartView 2.0 technology included in all ZEISS SmartLife lenses and has been adapted and updated to meet the target group needs. Therefore, Smart Dynamic Optics (3D object -space-model) has been adapted to the age-related viewing distance. Age Intelligence is the enabler for two technologies for ZEISS SmartLife Young Single Vision lenses:

- ZEISS Luminance Design 2.0 technology has been adapted considering the age-related pupil diameter of the wearer.
- ZEISS Dynamic AgeFit technology has been developed specifically for this age group. It considers the age-related changing PoW and frame parameters for best possible optical performance depending on the wearers age.



ZEISS SmartView 2.0 technology – adapted for young age groups

ZEISS SmartView 2.0 technology was launched with ZEISS SmartLife lenses for adults (age >20 years) and is the base for ZEISS SmartLife Young Single Vision Young lenses considering the needs and requirements for the age of 6-19 years.

ZEISS Smart Dynamic Optics - now considers viewing distances of younger age group

ZEISS Smart Dynamic Optics considers the correlation between the viewing angles and object distances for sharp vision at all distances especially when lowering the gaze while focusing on near objects for their connected and active lifestyle (Figure 7).

Children have different viewing distances e. g. on smartphones than adults due to the anatomical difference. The viewing distance is increasing at this age group from 20 to 30cm. Therefore, the existing 3D object-space-model which is based on adults viewing distance has been adapted to children's age-related viewing distance based on the given age.

The age is provided by the order intake. Based on that, the value of the age-related viewing distance is considered individually for the 3D object-space-model.

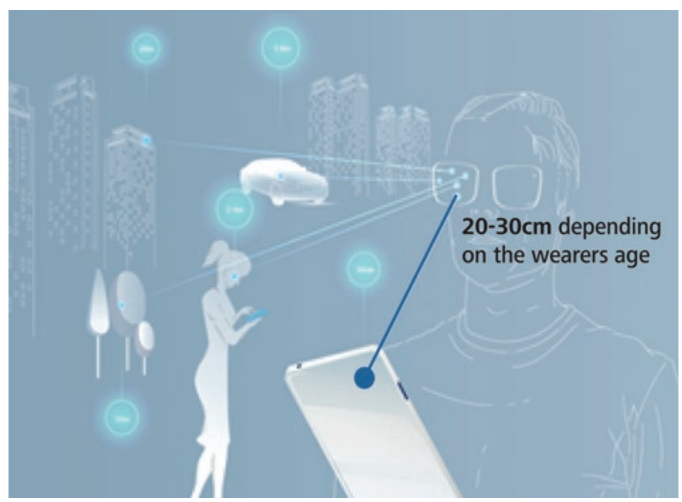


Figure 7. Age-related 3D object-space-model of ZEISS SmartLife Young Single Vision lenses.

ZEISS Age Intelligence

As a part of the ZEISS SmartView 2.0 technology, Age Intelligence delivers the age parameter for ZEISS Luminance Design 2.0 technology and ZEISS Dynamic AgeFit technology.

ZEISS Luminance Design 2.0 technology

Pupil diameter increases until the age of 20 with significant changes from 1-19 years. Therefore, ZEISS Luminance Design 2.0 technology considers the wearers age-related pupil size for the lens calculation to achieve the best possible optical performance of the lens fitted to the customer's age. In case the age is not given, a default value for this age group is used.

ZEISS Dynamic AgeFit technology

Studies and internal data show, that children´s PD has a dynamic age-related change and other parameters like fitting length/ high, distance between lenses, etc. affected as well (Figure 8).

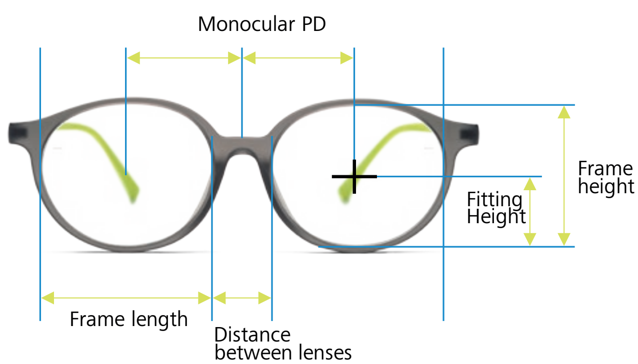


Figure 8. Adapted PoW parameters for ZEISS SmartLife Young Single Vision lens design.

ZEISS Dynamic AgeFit technology incorporates these age-related changing parameters into the lens design calculation by considering the individual wearers age and frame data. The wearers age is transferred by the order intake, if no age is given a default value for this age group will be used.

Protection

ZEISS SmartLife Young Single Vision lenses come standard with sunglass-level™ UV protection based on UVProtect technology by ZEISS.

ZEISS BlueGuard material blocks up to 40% of blue light while spending time outdoors and/or indoors and can be added individually.[17]

ZEISS SmartLife Young Single Vision lenses are also available with ZEISS PhotoFusion® X to avoid annoying glare form the sun being active outdoors.

For anti-reflective protection, all ZEISS SmartLife Young Single Vision lenses are available with all ZEISS DuraVision® coatings.

Additional Product related Papers:

- ZEISS BlueGuard material-White Paper 0000139.40741

NOTES

Sources

[1] ZEISS Single Vision SmartLife Young lenses with wider fields of clear view of up to 60% for smartphone and handheld devices distances compared to ZEISS Single Vision stock lenses. Estimation is based on calculation for binocular vision considering object field areas below a threshold of 0.25D RMSPE for range -6.00D up to 6.00D in the age group 6 - 20 years, same base curve distribution as ZEISS Single Vision stock lens. Qualitative analyses by Technology & Innovation, Carl Zeiss Vision International GmbH, DE, 2022.

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[17] ZEISS Single Vision SmartLife Young lenses with wider fields of clear view of up to 60% for smartphone and handheld devices distances compared to ZEISS Single Vision stock lenses within the range of -4.0 D to +4.0 D and the age group 6 - 20 years. Calculation is based on calculation for binocular vision considering object field areas below a threshold of 0.25D RMSPE for range -4.00D up to 4.00D, same base curve distribution as ZEISS Single Vision stock lens. Qualitative analyses by Technology & Innovation, Carl Zeiss Vision International GmbH, DE, 2022.

[18] Measurements and calculations based on the BVB (Blue-Violet-Blocking) metric. Analyses by Technology and Innovation, Carl Zeiss Vision International GmbH, DE 2020.

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Seeing beyond