Compensation Comparison Method for Assessment of Retinal Straylight

Luuk Franssen, Joris E. Coppens, and Thomas J. T. P. van den Berg

PURPOSE. Presently, no instrument or method exists that is generally accepted for routine clinical assessment of (functional) retinal straylight. Yet retinal straylight is the cause of major patient complaints, such as hindrance from glare and loss of contrast. It results from disturbances in the optical media that increase light–scattering over angles of 1° to 90°. Its assessment would help to decide whether to perform surgery for (early) cataract and would help in the evaluation of corneal or vitreal turbidity.

METHODS. The psychophysical technique of the “direct compensation” method was adapted to make it suitable for routine clinical assessment. In the new approach, called “compensation comparison,” the central test field is subdivided into two half fields: one with and one without counterphase compensation light. The subject’s task is a forced-choice comparison between the two half fields, to decide which half flickers more strongly. A theoretical form for the respective psychometric function was defined and experimentally verified in a laboratory experiment involving seven subjects, with and without artificially increased light scattering. The method was applied in a separate multicenter study. Its reliability was additionally tested with a commercial implement (C-Quant; Oculus Optikgeräte, Wetzlar-Dutenhofen, Germany).

RESULTS. A repeated-measures SD of 0.07 log units was achieved, to be compared with differences in the young normal population of 0.4 log units and an increase with healthy aging by 0.5 log units at 80 years and by 1.0 or more log units with (early) cataract or corneal disturbances. Reliability was further found to be high when using the commercial version of the method.

CONCLUSIONS. The compensation comparison method for measuring retinal straylight is suited for clinical use to diagnose patients with complaints caused by large angle light scattering in the eye such as early cataract. (Invest Ophthalmol Vis Sci. 2006;47:768–776) DOI:10.1167/iovs.05-0690

Since the beginning of the 20th century, the importance of retinal straylight for visual function has been well recognized by many investigators. After Cobb1 introduced the concept of equivalent veiling luminance, Holladay2 and Stiles3 applied the concept in a disability glare formula, which has been well accepted and widely used. Retinal straylight was first studied in the normal aging population (reviewed by Vos4), and it was found to increase with age. Subsequently, it was also studied in eyes with various ocular diseases, such as cataract,6–7 and corneal edema,8 where the straylight was found to increase with an increase in opacity and irregularity of ocular media. The extent to which retinal straylight from headlights of oncoming cars impairs visual function in night traffic has been investigated by many researchers (see Ref. 9 for a review).

Retinal straylight can be seen as the outer skirt of the point-spread function,10 outside, say, 1°. It causes a veiling luminance over the whole retina that adds to the retinal projection of the visual scene, thereby reducing the contrast of the retinal image. Disability glare, as defined by the Commission International d’Eclairage,9 corresponds to retinal straylight, which is quantified by means of the concept of equivalent luminance (i.e., the [external] luminance that has the same visual effect as the glare source at some angular distance).7

The first attempts to measure intraocular straylight by means of equivalent luminance involved the comparison of two threshold measurements: one threshold in the presence of a distant glare source and one threshold in the presence of a homogeneous background (equivalent) luminance.4 Van den Berg and IJspeert11 compared the results from various groups, all using this method, and concluded that these results varied considerably. Moreover, the method was not widely used, because it was not easily accessible for clinical application. As easy-to-use alternatives, so-called glare testers were introduced that usually consisted of visual acuity (e.g., ETDRS,12,13 Ferris-Bailey,13 or Regan14 charts) or contrast sensitivity (e.g., sinusoidal gratings,12,13,15 Landolt rings,12,16 or Pelli-Robson charts12,13,14,15) test, with and without a glare source presented at some angular distance in the visual field. Although glare testers were occasionally appraised favorably,14 more often provided unreliable results, demonstrated by their outcomes correlating badly with various validity measures such as outdoor visual acuity in bright sunlight,12,15 a questionnaire assessing perceived visual disability,13,16 or directly measured forward light scatter.14,16 Also, the repeatability and discriminative ability of studied glare tests were found to be inadequate.14,16 A particular example is the omission of the glare measurement results, performed with the Miller-Nadler glare tester, in the final results of the large multicenter PERK study,18 because the glare tester was not sensitive enough to detect small but significant amounts of light scattering,19 which was also mentioned in later studies.14,20 As a result of these issues with glare testers, a standard way of glare measurement was never adopted, and some overview papers discussing glare test problems appeared.21–25

To improve on this situation, Van den Berg5 proposed a new psychophysical method, called the direct compensation method. In short, this method works as follows (Fig. 1): A bright, ring-shaped, flickering light source is presented at a certain angular distance (θ) from a (dark) test field. Because of intraocular scatter, part of the light from the bright straylight source is projected on the retina at the location of the test field, inducing a (weak) flicker in the test field. To determine the exact amount of straylight, variable counterphase compensation light is presented in the test field. By adjustment of the amount of compensation light, the flicker perception in the test field can be extinguished. In this way, there is “direct

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departments of three clinics, the standard deviations of differences between repeated measurements found in such a field study were 0.15 and 0.18 log units, for two different implementations of the direct compensation method. It appears that the method has some major drawbacks for routine clinical or large-scale use: (1) Judgment of the weak flicker in the test field often appeared to be difficult for untrained subjects. This seemed to be caused by the presence of the strong flicker of the straylight source. (2) Usually, visual tests are based on what subjects actually see. On the contrary, in the direct compensation method, the subjects have to indicate whether the flicker perception has disappeared. The continuous flickering of the straylight source in the periphery made this contraintuitive task even more difficult. (3) The accuracy of the measurement seemed to depend on the adjustment strategy, which could differ considerably between subjects, and on proper explanation of the test. (4) There was no control over an individual’s measurement reliability. (5) Subjects had the ability to influence the test outcome. This aspect is particularly important in the field of driver testing.

As a result of these drawbacks, the straylight meter largely remained limited to laboratory use. The instrument could not be used on a large scale, such as clinical diagnosis or occupational health testing. For these applications, the test must be easy to understand, easy and quick to perform, easy to explain, and fraud resistant. Also it should be criterion independent, so that the values have universal validity and results from different locations can be compared.

To overcome these limitations, we proposed a new method to measure retinal straylight, the “compensation comparison” method. In essence, this method presents exactly the same stimuli to the subject as the direct compensation method. Note that in the direct compensation method, the amount of compensation light is varied until the straylight flicker has disappeared. In other words, in the direct compensation method, the subject compares different stimuli sequentially. In contrast, in the compensation comparison method, two stimuli of the direct compensation method are presented to and compared by the subject simultaneously. In this way, the direct compensation method is implemented as a two-alternative forced-choice (2AFC) approach. The characteristics of the psychometric function for this 2AFC method will be reported in this article. This function determines what comparisons would be the best to use. The compensation comparison method has been summarized in abstract form (Van den Berg TJTP, et al. IOVS 2005;46:ARVO E-Abstract 4315) and in a patent. 47

The compensation comparison method has been used in a field study involving 2422 subjects (GLARE, see www.glare.be) and in other projects such as a study investigating the wave-length dependence of retinal straylight. 48 Some results from the GLARE study, pertinent to the present question, will be used in this report. In this study, several visual tests, including straylight measurements, were performed among a population of drivers in Europe, spread over five age categories. Data were collected in clinics in The Netherlands, Austria, Germany, Spain, and Belgium. Since the study was designed to assess the prevalence of vision impairments in the driving population, the only inclusion criterion was being an active driver. As a result, the measured population consisted of a wide range of subjects, including ages from 20 to 85, visual acuities below 0.5 (logMAR [logarithm of the minimum angle of resolution] 0.3) to more than 1.0 (logMAR 0.0), visual field defects, and other ocular diseases such as glaucoma and cataract. This huge variation in ocular conditions provided an ideal opportunity to evaluate the compensation comparison method in clinical practice.

In the present paper, the principles, design considerations, and advantages of the compensation comparison method with respect to the direct compensation method are discussed, and a model for flicker comparison using this method is proposed.

![Method for Assessment of Retinal Straylight](image)

**Figure 1.** The direct compensation method. Retinal modulation in a foveal test field (inset: black field), resulting from scattered light from a constantly flickering annulus (white) is plotted against the amount of counterphase modulation in that test field. At point s, the flicker is extinguished, and the precise value of straylight found.
and tested in a laboratory experiment. This model comprises a psychometric function designed to describe the (stochastic) characteristics of the responses in a compensation comparison experiment. For simplicity, real error responses (false-positive and false-negative mistakes of the subjects) were not included in the formulas that follow. These values are very low (on the order of 1% or less) in laboratory experiments. Their inclusion is straightforward though, and they were included in the final formulas used for the field study. The reliability of the compensation comparison method was tested with a commercially available embodiment of the method (C-Quant; manufactured by the Germany based firm Oculus Optikgeräte GmbH (Wetzlar-Dutenhofen, Germany).17

**METHODS**

The compensation comparison method was tested on seven subjects (age range, 21–57 years; mean 30). They were laboratory students and coworkers, including the authors. All subjects were without ocular defects. Testing was performed monocularly on the subject’s preferred eye. Refraction ranged from −7 to +5 D. All measurements were performed with a light–diffusing filter (Black Pro Mist 2 BPM; Tiffen Manufacturing, Hauppauge, NY) in front of the tested eye. This filter, among a collection of 23 commercially available light–diffusing filters, was found to have the best light-scattering characteristics for mimicking (early) cataract or aging effects in the human crystalline lens.9

As mentioned before, the compensation comparison method was evaluated in the European GLARE study. In the course of this study, some improvements were made on the implementation of the test, as will be described at the end of this section.

For stimulus generation, a computer system with either a CRT monitor or combination of digital light processing (DLP) projector and back-projection screen was used. The straylight source was a white light annulus extending from 7° to 14°. Because of the approximate 1/9 dependence of retinal straylight, this corresponds to a 10° scattering angle.10

To test the reliability of the clinical version of the compensation comparison method (C-Quant; Oculus Optikgeräte), 17 subjects with no experience in the direct compensation and compensation comparison measuring techniques were recruited from a neighboring institute. The average age was 44 years (range, 28–81). Except for the oldest subject, all were without ocular defects. Refraction ranged from −7 to +3 D. All measurements were performed monocularly on the subjects’ preferred eyes, without glasses or contacts. Thoroughly cleaned trial glasses were used when appropriate. All subjects performed six measurements: three without and three with the BPM2 filter in front of the studied eye.

**Basics of the Compensation Comparison Method**

The test screen layout of the compensation comparison–based straylight meter is similar to that of the direct compensation method, only the test field is now divided in two halves (Fig. 2). Compensation light is presented in one of the two test field halves (randomly chosen, referred to as field b in the remainder of the article), whereas no compensation light is present in the other test field half (referred to as field a). As a result, two flickers are perceived, that differ in modulation depth: one results from straylight only (field a), the other is a combination of straylight and compensation light (field b), flickering in counterphase with this straylight. Simplified, the procedure runs as follows (Fig. 3): during the test, a series of limited-duration stimuli are presented that differ in the amount of compensation light in test field b. After a 2AFC paradigm, the task for the subject is to decide for each stimulus which test field half flickers stronger. The subject’s responses are recorded by means of two push buttons, representing the left and right test fields. Using the psychophysical model for this flicker comparison task, which will be described in detail later in the article, a psychometric curve is fitted to the subject’s responses, from which both the straylight parameter and a measure for the quality of the measurement can be deduced.

The fitting process makes use of a maximum-likelihood procedure that can briefly be described as follows. Assume that an experiment consists of n stimuli, to which n binary answers (e.g., yes or no, left or right) are obtained. Given a specific psychometric function, each answer of a subject has a certain likelihood, ranging between 0 and 1, since a psychometric function gives a certain probability (between 0 and 1) for a certain answer (yes or no) to the stimulus. For a complete experiment, the n answers correspond to n likelihoods. The total likelihood of the experiment is defined as the product of these n likelihoods, and the value of this total likelihood depends on the assumed psychometric function. The best-fitting psychometric function is the one that gives the highest total-likelihood value (Fig. 4 shows an example of an actual compensation comparison experiment). For a more complete description of the maximum-likelihood concept, a separate paper discussing reliability assessment in the compensation comparison method, using the likelihood function, is in preparation (Coppens JE, et al., manuscript submitted).

It must be noted that the compensation light added in field b results in a change in average luminance. This change may confuse the subject, cause bias, or form a clue to manipulate the test outcome. To ensure that the two test fields are only different in retinal modulation, an offset of half the compensation value is added to field a (Fig. 5). This equates the average luminance in both test fields, while maintaining the (absolute) modulation.

**Trial Strategy**

The measurement procedure (Fig. 4 shows an example of an actual measurement from the GLARE study) consists of two consecutive stages with different types of stimuli: the “dark” or “initial” phase and the “light” or “final” phase. The initial phase (Fig. 4, dots) serves to obtain a first coarse estimate of the straylight value and to make the task easy at first. The final phase (Fig. 4, X’s) serves to refine the first coarse estimate. In the initial phase, the amount of straylight is varied by varying the intensity of the flickering ring, while the compensation light is kept constant. In this phase, the task is very easy at first, becoming gradually more difficult, until the straylight value of the respective individual is approached. In other words, apart from giving a first coarse estimate, the initial phase serves as a training phase for the flicker comparison task, in which the potentially disturbing peripheral
flicker is very weak at first. In the final phase, maximum light intensity of the straylight source is used, to have maximum light intensity in the comparison task. At higher light intensities, the comparison task is performed more accurately (see also the Results section).

The stimuli in the initial phase are equidistant, with a step size of 0.1 log units (except for the first step which is 0.3 log units) and presented in order from high to low straylight (Fig. 4, increasing numbers). The absolute stimulus values of the initial phase can be placed differently and can be chosen by the operator, but in the GLARE study it was set to adjust for the known population averages as a function of age. The example given in Figure 4 is for a 30-year-old subject. For a 70-year-old subject, all initial phase stimuli were shifted upward by 0.3 log units.

In the first stimulus, a very weakly flickering ring is presented (stimulus 1 in Fig. 4). Then it is very easy to recognize the test field half with compensation. Subsequently, the intensity of the ring is increased, thereby increasing the difficulty of the flicker comparison task. This relates to the real-life experience of being disturbed more and more by glare sources with higher intensities. In the final phase, the ring flickers at constant intensity, whereas the compensation luminance in field b is varied. The stimuli in the final phase (Fig. 4, dots) are logarithmically equidistant at 0.05 log units in a fixed interval around the first coarse estimate of the 50% point of the psychometric curve, as based on the data of the initial phase (Fig. 4, dots). In the final phase, the stimuli are presented in random order, according to the method of constant stimuli.

The Psychometric Function

As a basis to describe the psychometric function, we started out from the well-known logistic function. Comparing two flickering test fields a and b with different modulation depths, the chance probability \( P \) of choosing one of the test fields as having the stronger flicker was written as (Fig. 6)

\[
P = \frac{1}{1 + e^{-\frac{MDC_c}{MDC_a + MDC_b}}},
\]

where \( MDC_c \) is the parameter in the equation, giving a critical value for modulation depth contrast. \( MDC \) is the independent variable in the equation, giving the contrast between the two flickers, defined as

\[
MDC = \frac{MD_a - MD_b}{MD_a + MD_b},
\]

where \( MD_a \) and \( MD_b \) represent the retinal modulation depths in both test fields.

It must be noted that the light the fovea (the two half fields) receives, consists of two parts: light originating from the flickering annulus by the process of scattering and light originating from the half fields the subject is looking at. Both lights correspond to certain luminances in the outside world (in the two half fields). The light originating from scatter (i.e., the straylight) corresponds to an outside luminance (called equivalent luminance) according to the equation.
where \( L_{eq} \) is the luminance of the straylight ring, and \( s \) is the “straylight parameter,” a value that characterizes the amount of light-scattering in the eye under investigation. A more extensive explanation has been published. Conversely, because \( L_{eq} \) is known, we can use equation 3 to express the external luminance in the test fields (as seen by the fovea) in “equivalent” straylight parameter units. In other words, each given external luminance \( L \) corresponds to an equivalent \( s \) value. The modulation depths can then be written as

\[
MD_a = \frac{L_a^\text{off} - L_a^\text{on}}{L_a^\text{off} + L_a^\text{on}} \quad \text{and} \quad MD_b = \frac{L_b^\text{off} + L_b^\text{on}}{L_b^\text{off} + L_b^\text{on}}. \tag{4}
\]

where \( L \) is the true equivalent luminance, or eventually a combination of both. \( L_a^\text{off} \) and \( L_b^\text{off} \) represent the light in the off-phase of the straylight ring, whereas \( L_a^\text{on} \) and \( L_b^\text{on} \) represent the light in the on-phase of the straylight ring. By combining equations 3 and 4, we can express the retinal light levels in (equivalent) straylight parameter units, referred to as ‘equivalent’ straylight parameter units.

\[
MD_a = \frac{S_a^\text{off} - S_a^\text{on}}{S_a^\text{off} + S_a^\text{on}} \quad \text{and} \quad MD_b = \frac{S_b^\text{off} - S_b^\text{on}}{S_b^\text{off} + S_b^\text{on}}. \tag{5}
\]

Plotting the probability against \( S_{\text{comp}} \) or \( \log(S_{\text{comp}}) \) results in psychometric curves as in Figure 3b and Figure 4, respectively. The model parameters (\( s \) and \( MD_{\text{c}} \)) were fitted by means of a maximum-likelihood procedure (described in short earlier) to the seven subjects’ laboratory data.

Once the shape of the psychometric function has been established, estimation of the straylight parameter value \( s \) in individual subjects involves shifting of the psychometric function to fit the dataset of that individual. Fitting is achieved by means of the maximum-likelihood procedure, as just outlined. An example of such a fit is given in Figure 4. In this case, \( \log(s) \) was found to be 0.85. The straylight value is determined by the horizontal position of the minimum of the curve, where \( MD_{\text{c}} = 0 \) and \( S_{\text{comp}} = s \). This approach was applied in the European GLARE study involving 2422 subjects in total. In the course of the study, some improvements were made on the implementation of the straylight test: (1) A three-trial instruction phase was added before the real measurement, to familiarize the subject with the flicker-comparison task. (2) The subject’s responses were displayed to the operator during the measurement, making it possible to interfere in case the response pattern was erratic and start a new measurement after additional explanation. (3) The luminance in the test fields was increased by a factor of 2 in the initial phase, making the measurement easier for older subjects. In total, 1073 subjects were measured with this final version (including these improvements). More detailed reports of this study are in preparation, but some preliminary data will be given herein to test the psychometric function (equation 1) and to illustrate the performance of the test.

RESULTS

Figure 7 shows the results of experiments performed to evaluate the model described in the previous section. All measure-
ments were repeated with the cataract simulating BPM2 filter in front of the eye. Values for the independently fitted parameters $s$ and $MDC_c$ are given in Table 1.

Figure 7 shows that the mathematical expression for the psychometric function, proposed in the Methods section (equation 1), performs very well in describing all measurements. Apart from the straylight value $\log(s)$, which determines the horizontal position of the curve, the differences in shape between the curves in Figure 7 all derive from differences in one parameter only, $MDC_c$ (see also Table 1). Although the differences are not large, there seems to be a systematic effect of a steeper slope ($MDC_c$ somewhat lower) with more straylight (cataract model curves). This may be understood by noting that with more straylight (curve shifted to the right), the
flicker intensity in the central test fields is higher, which might make the flicker comparison task easier. This may turn out to be an advantage in practice. Speculatively, in eyes that are in worse ophthalmic condition, possible detrimental effects on psychometric behavior may be counteracted by this phenomenon.

The model was further validated by applying it to field measurements of 1073 subjects, performed in the European GLARE study, as described in the previous section. The wide variation in ocular conditions found in this population can be expected to reflect itself in different psychophysical behavior, and therefore in psychometric functions that differ between these 1073 individuals. To analyze this, all measurements were performed twice and divided in nine groups of equal size, sorted on the differences between the two repeated measurements. In each group, equation 1 was then fitted to all data, after normalizing each individual curve for the individual straylight value. Results are given in Figure 8. The best 67% (top six panels) of the 1073 subjects have a repeated-measurement SD of 0.036, and 89% (all but the last panel) of 0.059 log units, whereas the SD for all measurements is 0.099 log units.

The C-Quant measurements are summarized in Figure 9. The three separate measurements without a filter are plotted against the average of these three measurements. This figure shows that the repeatability of the compensation comparison method is very high. In addition to these repeatability data, the average of the three measurements with the BPM2 filter is also plotted against the average of the three measurements without filter. The dashed line represents the expected straylight value for the eye-plus-filter combination, obtained by adding the straylight values of the filter and the eye on a linear scale.

**DISCUSSION**

In this article, we have presented an approach toward retinal straylight measurement, intended to be feasible for routine

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**TABLE 1. Maximum-Likelihood Fits of Equation 1 to the Compensation Comparison Measurements**

<table>
<thead>
<tr>
<th>Initials</th>
<th>Age (y)</th>
<th>Average Age Normal Log (Straylight Parameter)</th>
<th>Log (Straylight Parameter)</th>
<th>Shape Parameter</th>
<th>Log(MDC&lt;sub&gt;c&lt;/sub&gt;)</th>
<th>Shape Parameter</th>
<th>Log(MDC&lt;sub&gt;c&lt;/sub&gt;)</th>
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<tr>
<td>TK</td>
<td>24</td>
<td>0.85</td>
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<td>1.31</td>
<td>−1.07</td>
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<tr>
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<td>23</td>
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<td>0.81</td>
<td>−0.98</td>
<td>1.27</td>
<td>−1.08</td>
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<tr>
<td>TB</td>
<td>57</td>
<td>1.00</td>
<td>1.15</td>
<td>−0.98</td>
<td>1.57</td>
<td>−1.68</td>
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<tr>
<td>JC</td>
<td>35</td>
<td>0.87</td>
<td>1.08</td>
<td>−0.99</td>
<td>1.39</td>
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<tr>
<td>LF</td>
<td>29</td>
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<td>0.76</td>
<td>−0.77</td>
<td>1.26</td>
<td>−1.09</td>
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<tr>
<td>LR</td>
<td>21</td>
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<td>0.55</td>
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<tr>
<td>GS</td>
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<td>0.66</td>
<td>−0.79</td>
<td>1.20</td>
<td>−1.25</td>
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<tr>
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<td></td>
<td>−0.90</td>
<td>1.17</td>
<td></td>
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<td>SD</td>
<td></td>
<td></td>
<td>0.13</td>
<td>0.24</td>
<td></td>
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</table>

Data were obtained in seven subjects, without and with a BPM2 filter (artificial straylight increase) in front of the measured eye. Fitted parameters are the straylight parameter $s$ and the critical modulation depth contrast $MDC_c$, the latter being the shape parameter for the psychometric function.
The log(\(s\)) values with BPM2 filter show less variation. This is because the total straylight is a combination of the filter (which itself has log(\(s\)) = 1.12) and the eye (log(\(s\)) values from 0.55 to 1.15). The experimental values for the eye-filter combinations (log(\(s\)) values from 1.20 to 1.39) correspond well to values that can be predicted by calculation (log(\(s\)) values from 1.22 to 1.44).

Figure 8 shows that the model is capable of accurately describing the psychophysical behavior of a population that varies widely with respect to physical condition of the eye. Subdividing the population according to differences between two repeated measurements reveals different slopes of the psychometric curves of the various subgroups, accounted for in the model by different MDC values. The model fits fairly well to all subgroups of Figure 8, except for the subgroup with the largest repeated measurement differences (lower right panel). For some cases in this subgroup, response behavior was so erratic that reliably fitting a psychometric curve and therefore reliably estimating the log(\(s\)) value, is not possible. To detect such erratic behavior automatically during measurements, we developed a reliability parameter, as mentioned earlier. This parameter must assume a certain shape of the psychometric function and was based on the analysis in the present paper. After the lowest-quality measurements were filtered out with this parameter, the overall SD of repeated measurements was between 0.06 and 0.1 log units, which is very good, considering the variation in straylight parameter in the (clinical) population.

Figure 9 shows that the compensation comparison method gives highly repeatable results in untrained subjects, over a wide range of straylight values. The measurements with BPM2 filter follow the additive model for eye plus filter very accurately, indicating that the instrument measures absolute straylight values very well. The fitted log(\(s\)) value for the filter (1.14) is very well in accordance with the objectively measured log(\(s\)) value for this filter of 1.12.

The compensation comparison method for measuring retinal straylight was designed as an improvement on the direct compensation technique. According to feedback we got from the operators in the clinics who participated in the GLARE study and who also had earlier experience with the direct compensation method, the task is easier and more intuitive (mostly suprathreshold, short stimulus presentations), easier to explain and less dependent on explanation from the operator. The measurement time is fixed and limited, making the test more pleasant for both patient and operator. However, we did not collect systematic statistical data on these subjective assessments. Moreover, the reliability of the compensation comparison method was shown to be very good, and a reliability index was developed, based on the dataset of a tested individual.

Given these advantages, retinal straylight measurement is now possible on a large scale and in the clinical routine. As a result, the compensation comparison method described in this article has been implemented in a commercially available measurement device (the C-Quant; Oculus Optikgeräte). For future development, the model for flicker comparison gives a basis for improving on the measurement performance by studying different measurement strategies, such as adaptive methods.

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