Participants know best : The effect of calibration method on data quality

Holmqvist, Kenneth; Nyström, Marcus; Andersson, Richard; van de Weijer, Joost

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Participants know best – the effect of calibration method on data quality

**BACKGROUND**

1. Automatic calibration
   - Software decides when eye feature samples are recorded.

2. Operator-controlled
   - The operator clicks a button to record eye feature samples.

3. Participant-controlled: The participant clicks a button to record samples.

### Challenges

- The participant must look straight at the calibration target, and keep the eye still. Also, optical conditions may confuse gaze estimation.
- The participant may move his eye during calibration for a variety of reasons:
  - Anticipation (looking too soon)
  - Square-wave jerks, glissades, blinks
  - Distraction
  - Poor task instructions
  - Etc.
- Gaze estimation may be hampered due to:
  - Reflection in glasses
  - Split corneal reflection in lenses
  - The corneal reflection is in the sclera
  - The pupil or corneal reflection are covered by eyelashes or eyelids
  - Etc.

**METHOD**

### Data recording

- Four stations with identical SMI HiSpeed 500 Hz binocular eye-trackers.
- Six operators (five experienced, one novice)
- 149 non-prescreened students of economics.
- Two recordings: Just after calibration, and after 15 minutes of reading.

- Automatic (44), Operator-controlled (62), Participant-controlled (43)

### Glasses (12), lenses (35), uncorrected vision (102)

- Mascara (37), clean eye-lashes (112)
- Dominant left eye (64), right eye (85)
- Eye-lashes directed down (8), forward (32), up (109)
- Eye colour: medium (13), narrow (3), open (133)

**RESULTS**

### Accuracy (offset) is predicted by:

<table>
<thead>
<tr>
<th>Predictor</th>
<th>min.o6</th>
<th>max.o6</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant-controlled</td>
<td>0.0001</td>
<td>0.0008</td>
<td>0.0001</td>
</tr>
<tr>
<td>Operator-controlled</td>
<td>0.0000</td>
<td>0.0005</td>
<td>0.0001</td>
</tr>
<tr>
<td>Off-center target</td>
<td>0.0001</td>
<td>0.0005</td>
<td>0.0001</td>
</tr>
<tr>
<td>Target placed low</td>
<td>0.0001</td>
<td>0.0005</td>
<td>0.0001</td>
</tr>
<tr>
<td>Measurement error</td>
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<td>0.0005</td>
<td>0.0001</td>
</tr>
<tr>
<td>EyeColorBlue</td>
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<td>0.0001</td>
</tr>
<tr>
<td>EyeColorGreen</td>
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<td>0.0018</td>
<td>0.0018</td>
</tr>
<tr>
<td>VisionAlbGlaze</td>
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<td>0.0013</td>
<td>0.0002</td>
</tr>
<tr>
<td>VisionAlbLenses</td>
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<td>0.0012</td>
<td>0.0005</td>
</tr>
<tr>
<td>VisionEyeLash</td>
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<td>0.0011</td>
<td>0.0005</td>
</tr>
<tr>
<td>OperatorAccuracy</td>
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<td>0.0010</td>
<td>0.0003</td>
</tr>
<tr>
<td>ParticipantAccuracy</td>
<td>0.0006</td>
<td>0.0010</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

### Amount of data loss is predicted by:

<table>
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<tr>
<th>Predictor</th>
<th>min.o6</th>
<th>max.o6</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator-controlled</td>
<td>0.0005</td>
<td>0.0009</td>
<td>0.0003</td>
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<tr>
<td>VisionAlbGlaze</td>
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<tr>
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<tr>
<td>VisionEyeLash</td>
<td>0.0004</td>
<td>0.0007</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

### Data loss: Higher position on monitor better

- Glasses make data loss worse
- Open eye physiology better
- Accuracy decreases over time

**RESULTS**

### Accuracy is better with experienced operators

- Operators 2-6 had extensive experience with this particular eye-tracker.
- Operator 1 had only recorded with head-mounted eye-trackers.

### Dominant eye (Miles test) gives better accuracy

- No difference between L and R eye.
- Left dominant (LD) and right dominant (RD) eye give better accuracy than non-dominant eyes (LN and RN).