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

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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 eye feature samples.

Challenges

The participant must look straight at the calibration target, and keep the eye still. Also, optical conditions may confuse gaze the estimation algorithm.

The participant may move his eye during calibration for a variety of reasons:
- Anticipation (looking ahead too soon)
- Square-wave jerks, glissades, blinks
- Distraction
- Poor task instructions
- Etc.

Gaze estimation may be faltering 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
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)
Masks (37), clean eye-lashes (112)
Dominant left eye (64), right eye (85)
Eye-lashes directed down (8), forward (32), up (109)
Eye cleft: medium (13), narrow (3), open (133)
Eye colour: blue (112), brown (35), quite other (2)

RESULTS

Data analysis using a linear mixed-effects model: the lme4 package of R.

Accuracy (offset) is predicted by:

Precision (RMS) is predicted by:

Amount of data loss is predicted by:

Accuracy is better with experienced operators

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).

RESULTS

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

Data loss:

Higher position on monitor better Glasses make data loss worse
Better accuracy on dominant eye Accuracy decreases over time

Accuracy:

Participant-controlled calibration best
Higher position on monitor better
Better accuracy on dominant eye
Accuracy decreases over time

PRECISION:

Participant-controlled calibration best
Higher position on monitor better
Blue eyes are worse than brown
Glasses make precision worse
Open eye physiology better
Precision decreases over time

Accuracy:

Participant-controlled calibration best
Higher position on monitor better
Better accuracy on dominant eye
Accuracy decreases over time

Amount of data loss is predicted by:

Accuracy is better with experienced operators

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