QUIET EYE AND EYE QUIETNESS
Electrooculographic methods to study ocular activity during motor skills

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1 | INTRODUCTION

Quiet Eye (QE) is the final ocular fixation on the target of an action (e.g., the ball in golf putting), prior to and following movement initiation. Eye-tracking research has revealed that experts have a longer QE than novices. Remarkably, the reason why a longer quiet eye aids movement has yet to be established. The **aim of this study** was to assess the utility of EOG to reveal expert-novice differences in ocular activity.

2 | METHODS

Participants: 10 experts (handicap $M = 1.5$) and 10 novices (no handicap).

Task: Putt 60 balls to a 2.4 m distant hole.

Measures:

1. QE, measured through multiple thresholds applied to the EOG signal
   QE_{pre}: before backswing initiation
   QE_{post}: after backswing initiation
   QE_{tot}: $QE_{pre} + QE_{post}$
2. *Eye Quietness* (EQ) as *SD* of the EOG in twelve 0.5 s intervals, from –4 to +2 s (0 s = backswing initiation)
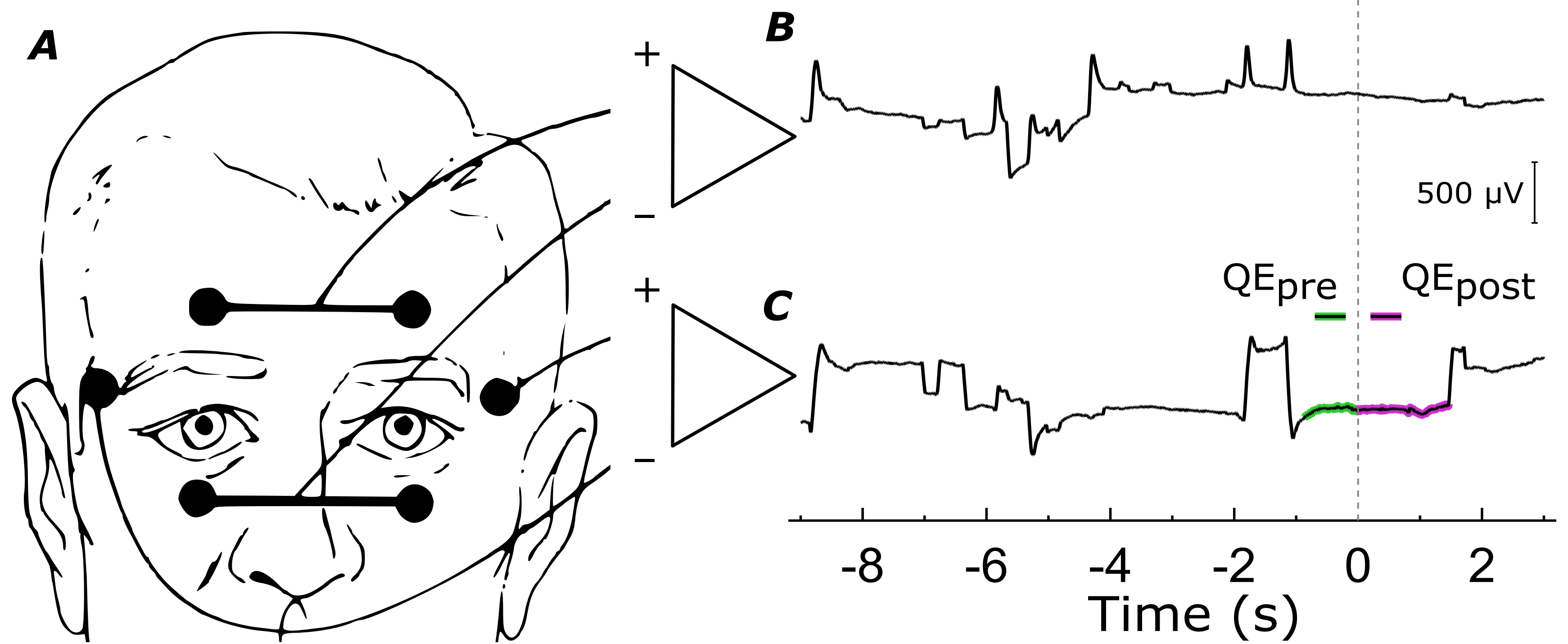3. Swing duration, as time from backswing initiation to putter-ball impact

FIGURE 1 Electrodes were applied near the eyes to measure changes in the electrical fields due to eye movements (A). Vertical (B) and horizontal (C) EOG signals were recorded as a function of time (0 s = backswing initiation). Durations of QE periods are displayed on the horizontal signal.

3 | RESULTS

QE_{total} did not differ between groups (**TABLE 1**); however, experts had shorter QE_{pre} and longer QE_{post} than novices. There were no thresholds for which experts had longer QE_{total} then novices (**FIGURE 2**). Compared to novices, experts had less EQ before and greater EQ after backswing initiation (**FIGURE 3**). Experts had longer swing durations than novices (**TABLE 1**). Swing durations correlated positively with QE_{post} ($r = .52$, $p = .02$) and negatively with EQ from 0.5 to 1 s ($r = −.63$, $p = .003$).

TABLE 1. Mean (*SD*) durations of the QE periods and swing for experts and novices, with the results of t-tests.

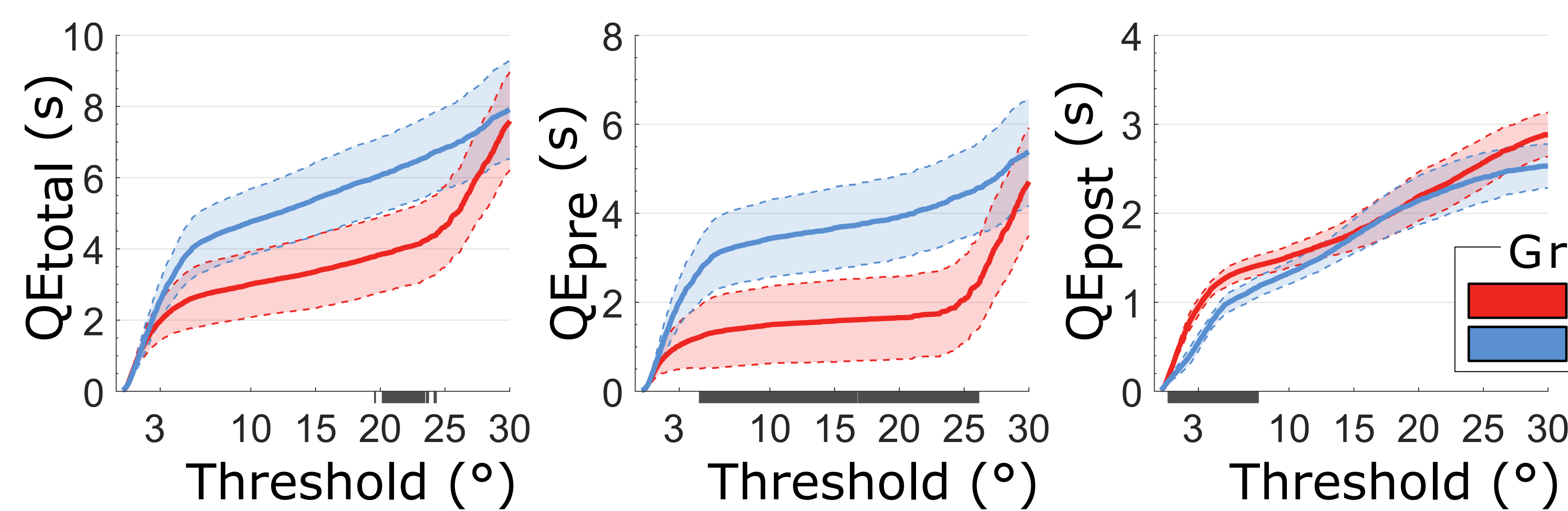|	Experts	Novices	$t(18)$	p
QE_{total} (s)	1.96 (0.48)	2.54 (1.69)	1.04	.31
QE_{pre} (s)	1.02 (0.44)	2.00 (1.61)	1.86	.08
QE_{post} (s)	0.94 (0.21)	0.55 (0.21)	4.17	< .001
Swing (s)	0.90 (0.15)	0.71 (0.14)	2.87	.01

FIGURE 2. Mean durations of the QE period as a function of Group and Threshold (°). The shaded areas represent the *SE* of each group. The grey bar below the x-axis indicates $p < .05$ for indepent-sample t-tests.
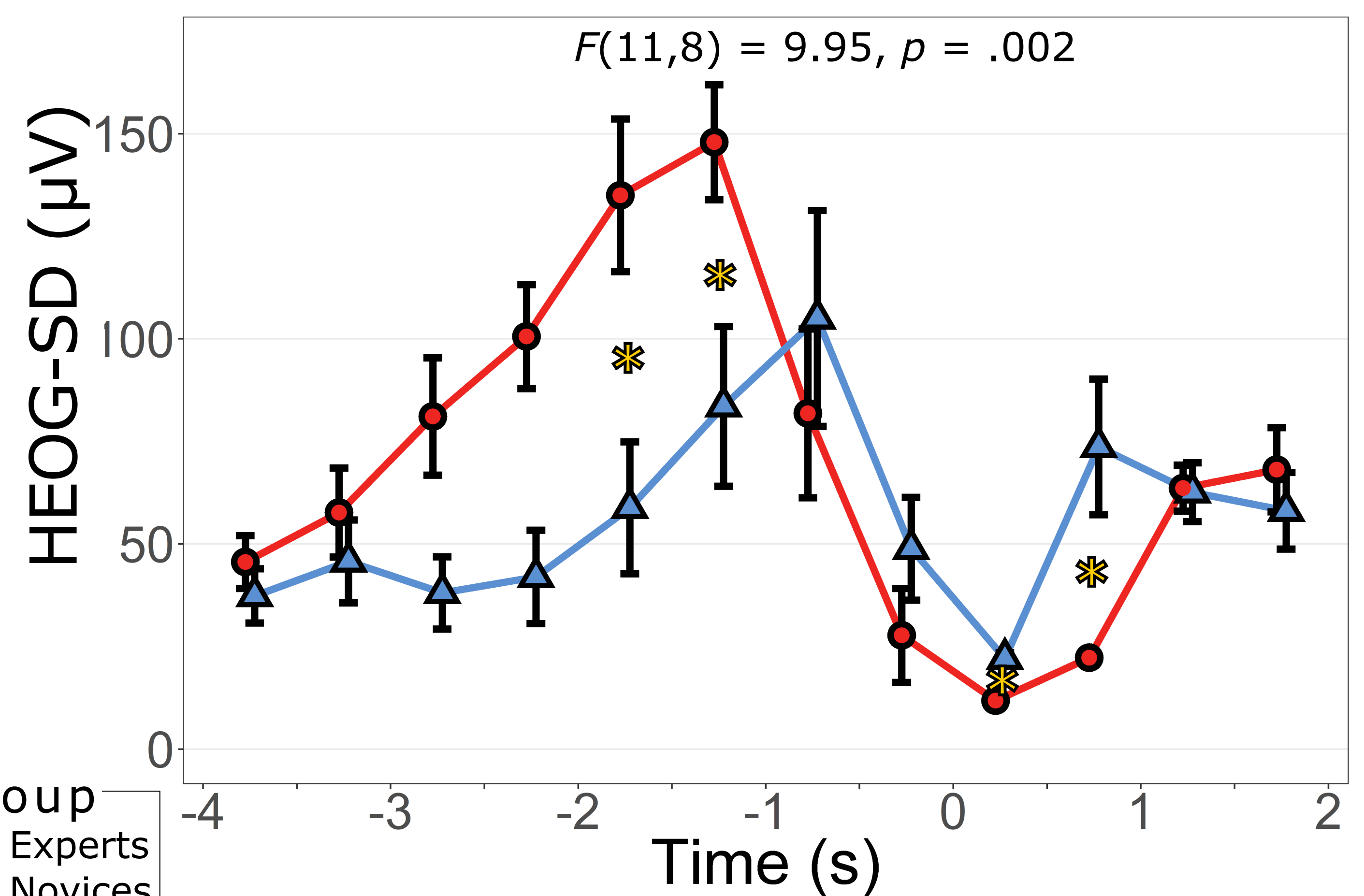

FIGURE 3. EQ (HEOG-SD) as a function of Time (s) and Group. Error bars indicate the *SE* of each group. The results of the Time x Group mixed ANOVA are reported at the top of the figure. Asterisks indicate $p < .05$ for t-tests.

4 | DISCUSSION

This study demonstrates the utility of EOG in motor control research and validates EQ as an index of ocular activity. These findings provide new evidence that expert-novice differences in ocular activity may reflect differences in the kinematics (e.g., movement duration) of how individuals execute skills.