iScience, Volume *26*

Supplemental information

Highly reproducible eyeblink timing during formula car driving

Ryota Nishizono, Naoki Saijo, and Makio Kashino

Supplementary Information

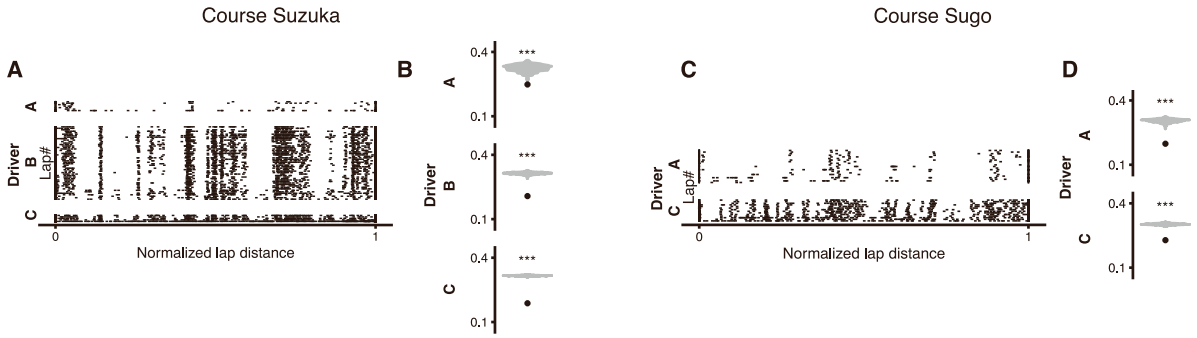

Figure S1. Raster plots of eyeblink trains and the corresponding plots for SPIKE-distances for Course Suzuka and Sugo. (A, C) Raster plots of eyeblink trains. Faster laps are shown above for each driver. (B, D) SPIKE-distance of the actual data (black circle) and surrogate data (violin plot). The left two panels are for course Suzuka, and the right two panels are for course Sugo. Asterisks indicate statistically significant differences between conditions, using the notation: *** for $p < 0.001$.

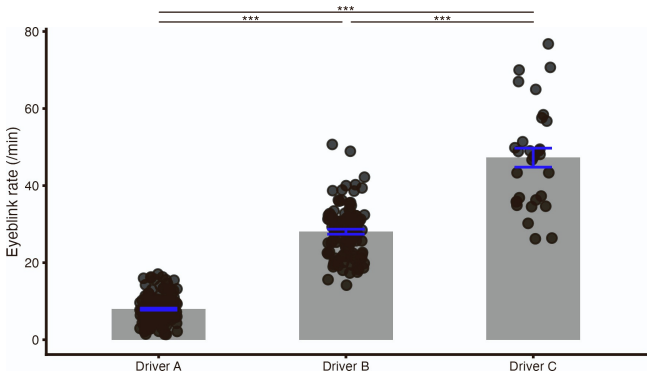

Figure S2. Eyeblink rates per lap for all three courses relating to Figure 1F. Data are represented as mean ± standard deviations across laps for each driver

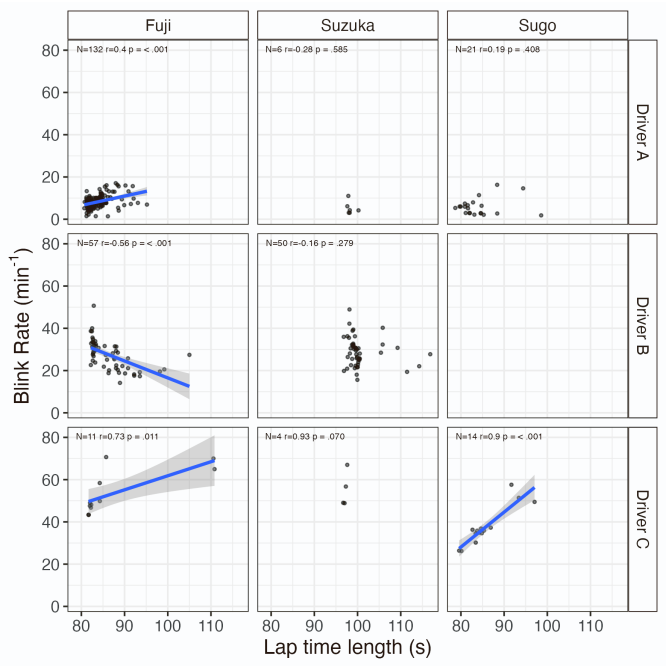

Figure S3. Correlation between eyeblink rate vs. lap time length for all possible course and driver combinations. For the $p < 0.05$ combinations, the blue linear regression line and 95% gray confidence interval are overlaid.

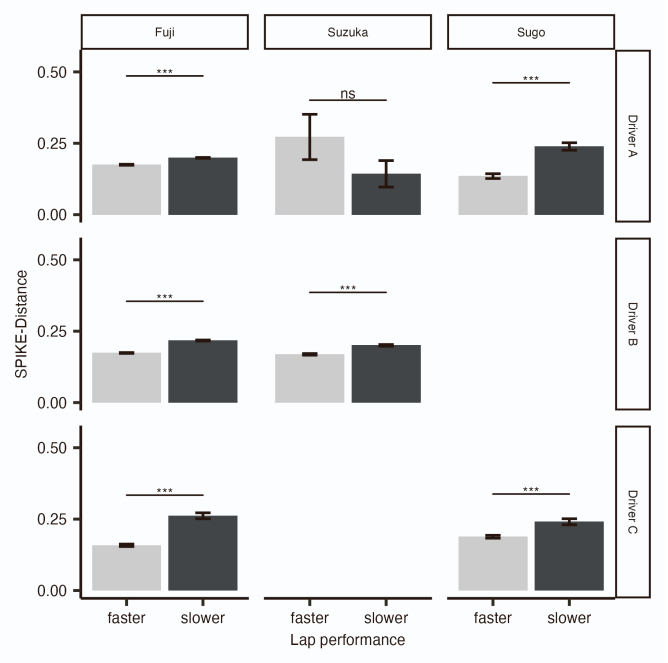

Figure S4. Piecewise SPIKE-distances within faster and slower laps for all possible course and driver combinations. The effect sizes, as measured by Cohen's d, varied across the different drivers and tracks. In Fuji, the effect sizes were 0.34 for Driver A, 1.4 for Driver B, and 3.5 for Driver C. In Suzuka, the effect size for Driver B was 0.6. In Sugo, the effect sizes were 1.3 for Driver A and 1.4 for Driver C. Asterisks indicate statistically significant differences between conditions using the notation: *** for $p < 0.001$ and n.s. for not significant.

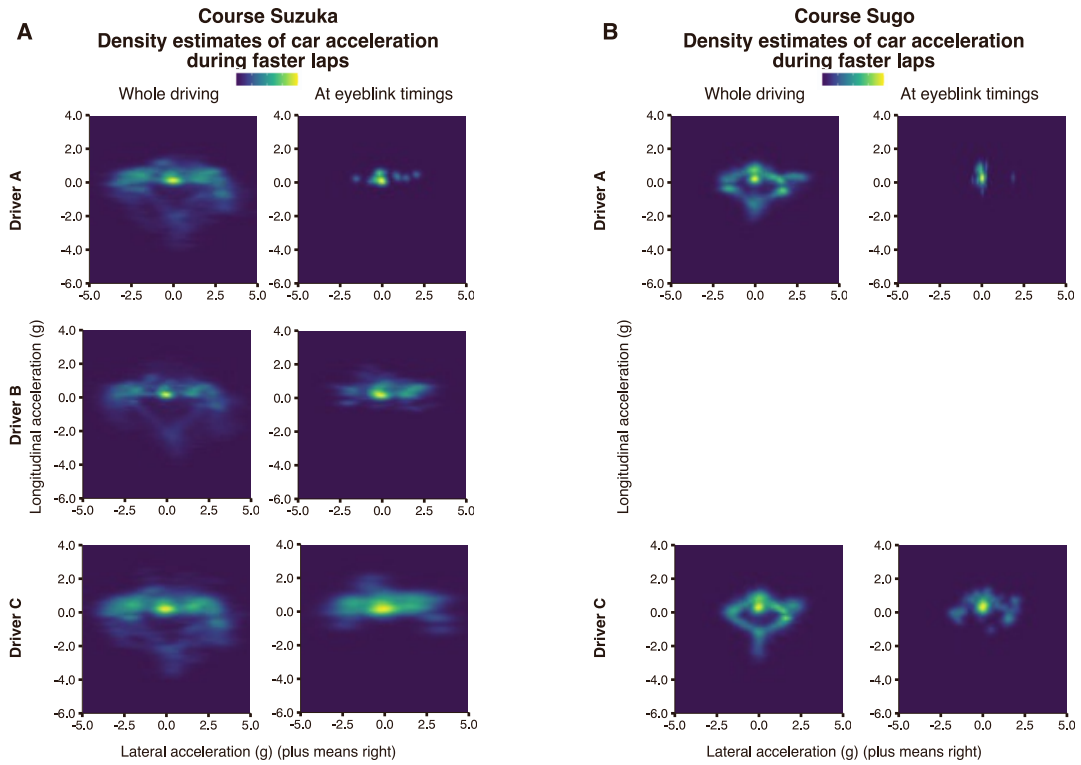

Figure S5. (A, B) Two-dimensionally estimated density of vehicle acceleration by three drivers throughout driving (left) and at eyeblink timing (right). (A) For course Suzuka. (B) For course Sugo. For course Sugo, the entire observation was conducted under wet road surface conditions.

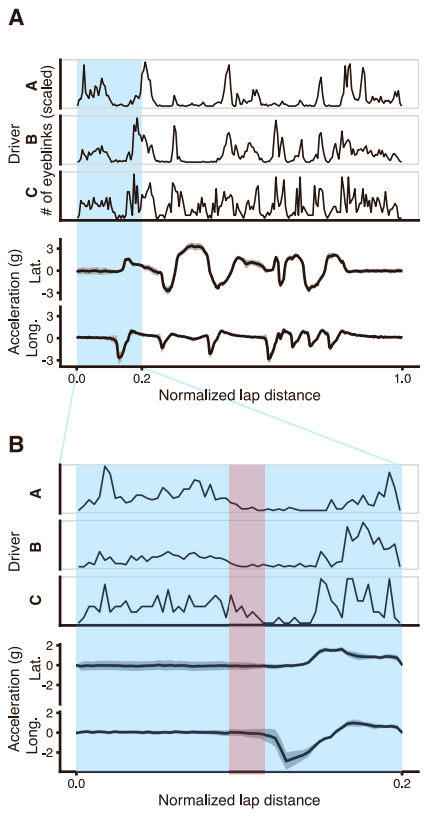

Figure S6. (A,B) Time course of eyeblink count density in the Fuji course (top) and acceleration (bottom). For acceleration, the mean (black line) ± and standard deviation (gray area) are depicted. (A) For the entire Fuji course. (B) A close-up of (A) (range 0.0-0.2). The red-shaded region of (B) represents immediately before braking for cornering, when acceleration is close to zero. Nevertheless, the eyeblink count density has already decreased at this stage.

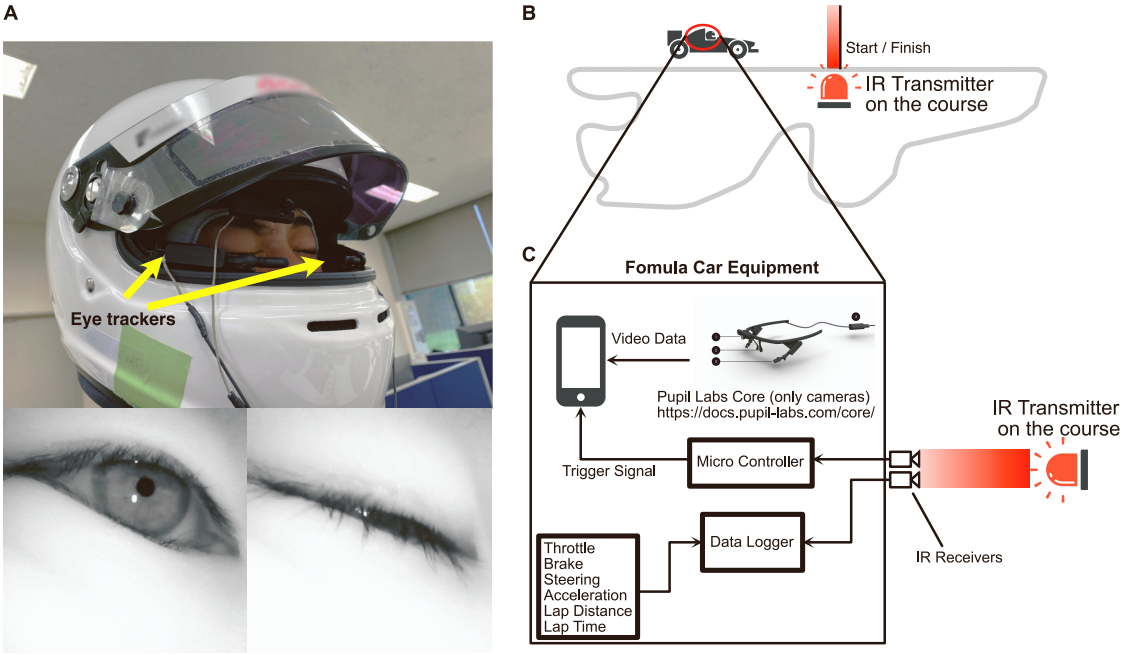

Figure S7. System setup to record eyeblink and car driving behavior simultaneously. (A) above: the eye tracker was secured to a three-dimensionally-printed mount on the helmet's rim. below: captured eye images. (B) Temporal calibration system. Above: Infrared (IR) light beacon was located close to the start/finish line. Below: Both the eyetracking system and car telemetry data logger were connected to adjacent infrared light receivers, which simultaneously received infrared light from the beacon and added markers for temporal calibration.

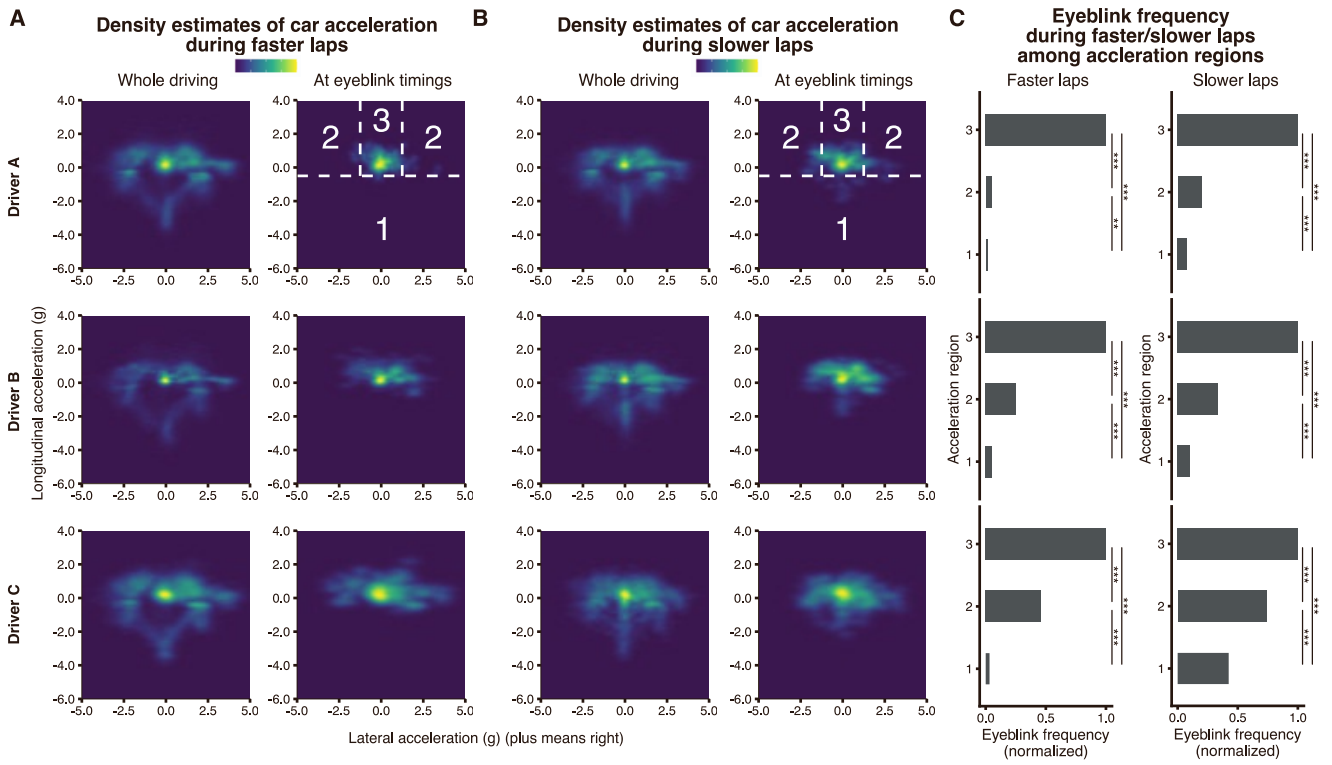

Figure S8. The effect of acceleration on eyeblink frequency at a moment depended on the driving lap pace. (A-C) Upper: Driver A, middle: Driver B, and lower: Driver C. (A) The same as Figure 2A. Two-Dimensionally estimated density of vehicle acceleration by three drivers throughout driving (left) and at eyeblink timing (right) during faster (< median of the lap times) laps. (B) Similar to (A), but the data were from the slower (>= median of the lap times) laps. (C) Eyeblink frequency (the number of eyeblinks generated / number of samples in each acceleration Region 1-3) during faster/slower laps. We normalized eyeblink frequency to each driver's eyeblink frequency in Region 3. The left panel is the same as Figure 2B.

Predictors	*Incidence Rate Ratios*	*CI*	*p*
driver [Driver B]	4.46	2.82 – 7.22	**<0.001**
driver [Driver C]	22.61	14.10 – 36.95	**<0.001**
driver [Driver A] * acc region [region 2]	5.03	2.95 – 9.02	**<0.001**
driver [Driver B] * acc region [region 2]	7.73	4.86 – 12.89	**<0.001**
driver [Driver C] * acc region [region 2]	4.95	3.11 – 8.24	**<0.001**
driver [Driver A] * acc region [region 3]	50.17	30.30 – 87.83	**<0.001**
driver [Driver B] * acc region [region 3]	34.93	22.29 – 57.54	**<0.001**
driver [Driver C] * acc region [region 3]	10.65	6.81 – 17.52	**<0.001**
acc region [region 1] * lap speed slow	3.70	2.39 – 5.97	**<0.001**
acc region [region 2] * lap speed slow	1.43	1.25 – 1.65	**<0.001**
acc region [region 3] * lap speed slow	0.91	0.86 – 0.98	**0.007**

Table S1. Factors of generalized linear model predicting eyeblink probability at a moment, related to Figure 3. Values in bold indicate significance at the 0.05 level.