

2011
Optics +
Photonics
21-25 August 2011



Driving experience and special skills reflected in eye movements

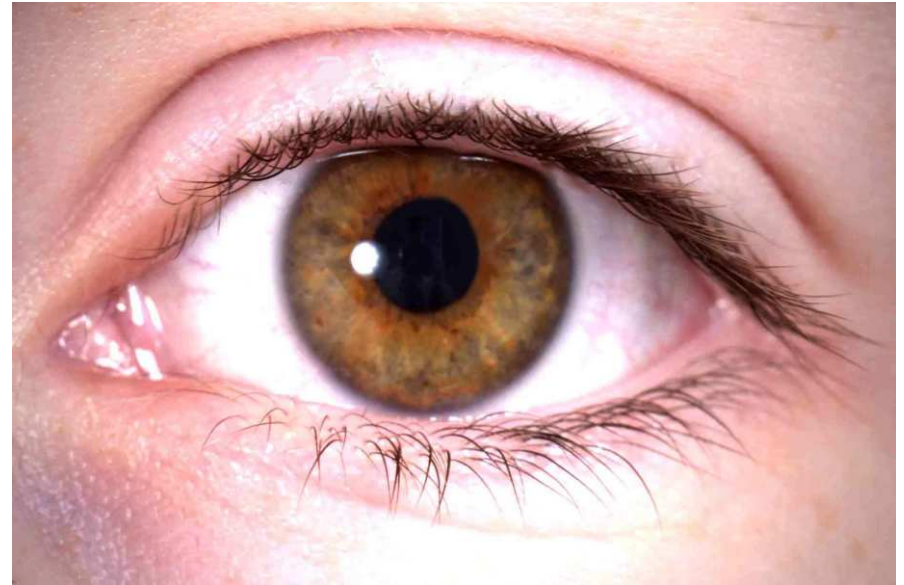
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Institute of Physical Research and Biomechanics,
Latvia
SPIE Conference, USA, San Diego, 21-25.08.2011.

Presentation Plan

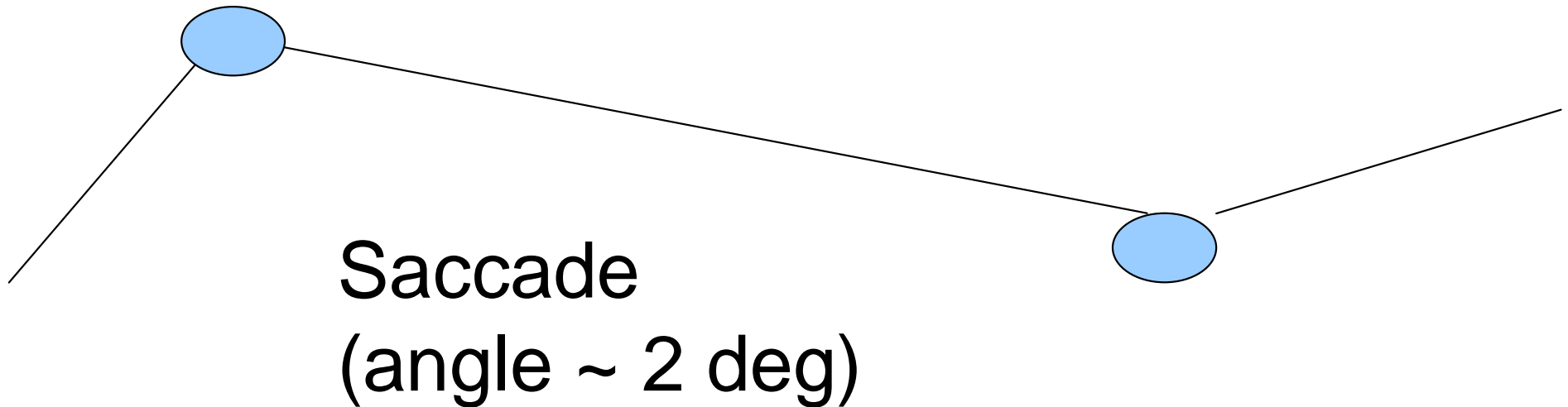
1. Eye movement basis
2. Research on driving
3. Idea of a current research
4. Experiments
5. Results
6. Discussion

Eye movement basis (1)

In stable scene
(for example, reading)

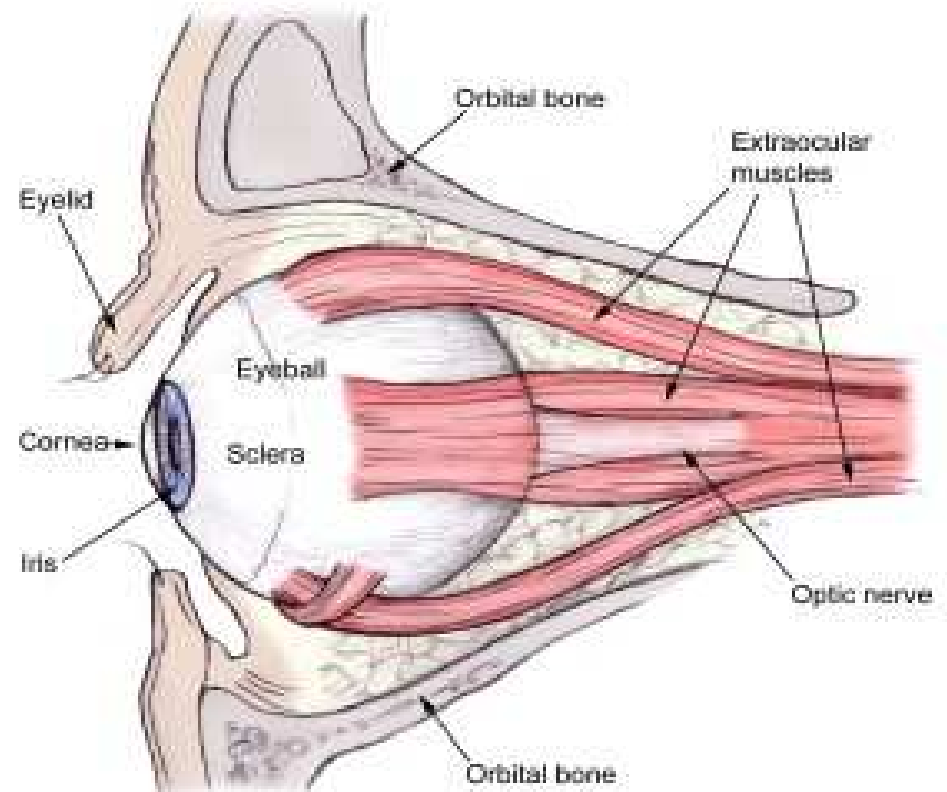


Fixation (~ 200 ms)



Eye movement basis (2)

For object,
who are moving



Eye is following these
objects
(to keep this scene stable)

Eye movement basis (3)

Eye tracking Equipment 1 - iViewX RED



250 Hz, time between measurements – 4 ms, average eye fixation – 300 ms,

Eye movement basis (4)

Eye tracking Equipment 2 - iView X™ HED



250 Hz, time between measurements – 4 ms, average eye fixation – 300 ms,

Eye movement basis (5)

(Eye tracking Data Analyses – BeGaze Software)



Research on driving (1)



Research of driving (2)

1. Eye movements - Task oriented than object oriented
2. Sight visits an object 1 s before manipulation starts and leave before it is completed.
3. Eye movements on locating targets, guiding and checking actions.

Research of driving (3)

4. Dealing with road itself, other traffic participants, signs inside and outside vehicle
5. Eye provides information about the vehicle location in lane
6. Vision carries the feed-forward information 2 seconds or typically 27 m ahead

Research of driving (4)

7. Feedback information to maintain the right position of the lane
8. On winding roads a driver follows the inside bent or tangential point of an upcoming curve
9. The angle of eye turn supplies hands with information about steering wheel turn.

Research of driving (5)

10. Monitoring others on the road nearby and thus vision switch between the road and the traffic.
11. Driving may be coordinated in part by the stored information.

Idea of a current research

1. To research **drivers** – how they look when they drive;
2. Use people with **different driving skills** and compare their behaviour;
3. Observe drivers' behaviour by showing them a **movie** on driving;

Experiments

iViewX RED - equipment



250 Hz, time between measurements – 4 ms, average eye fixation – 300 ms,

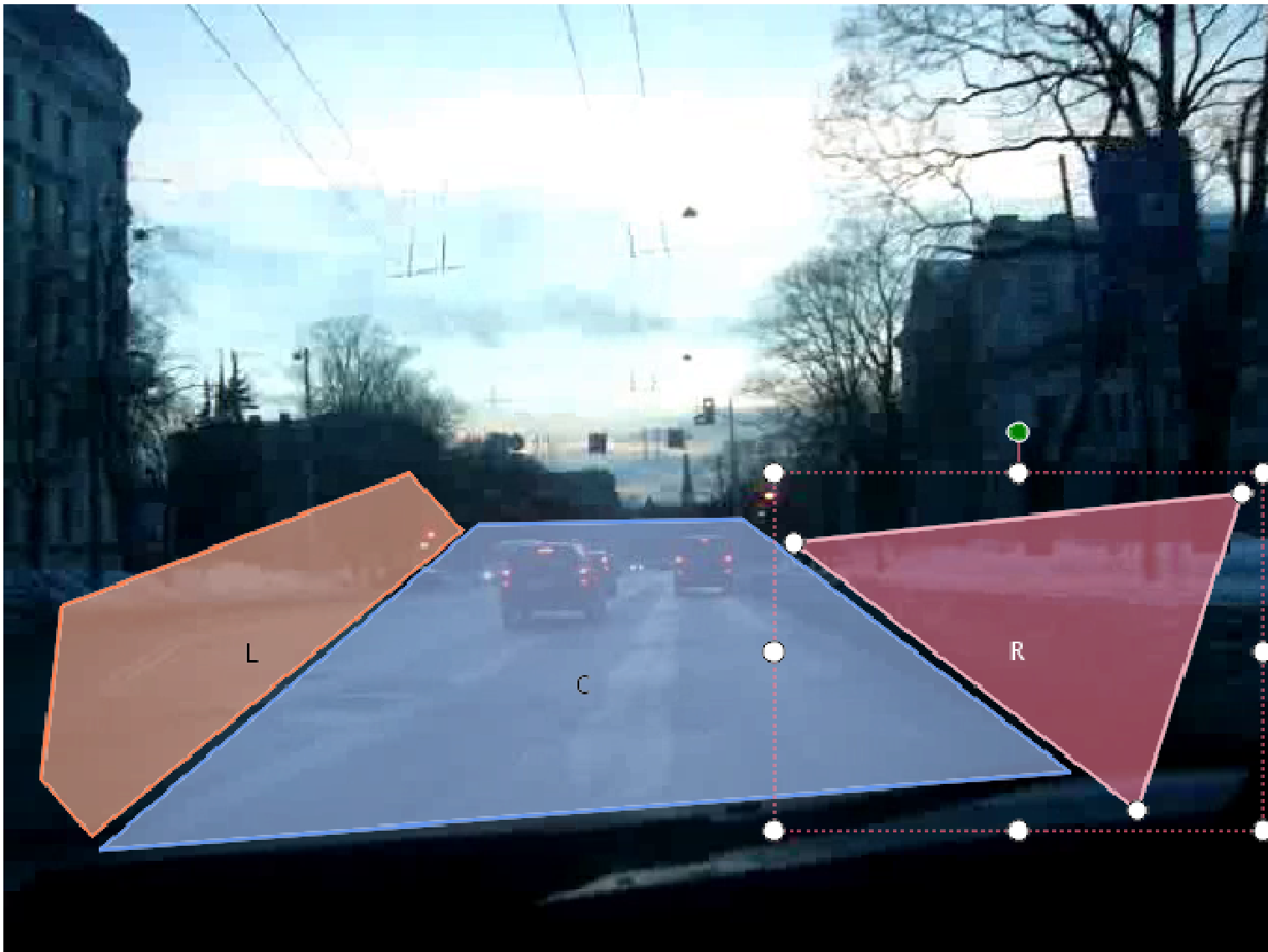
10 minutes video on driving
exposed on computer (previously
recorded)



4 different participants used

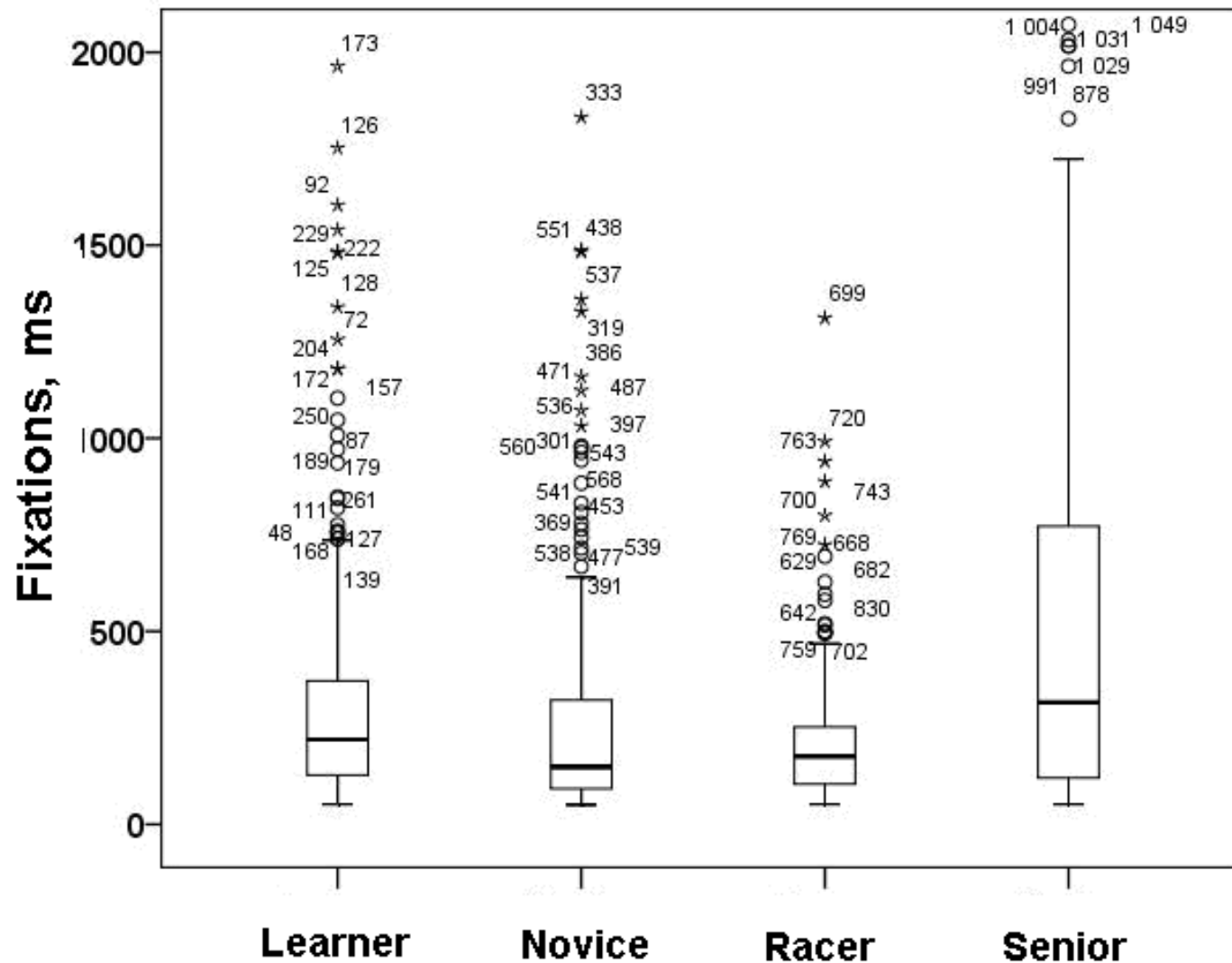
1. **Learner** (18 years old) – a person attending a state approved driving school;
2. **Novice** (19) – a licensed driver with one year driving experience;
3. **Racer** (30) – Eastern Europe car drift champion;
4. **Senior** (68) – a person with 50 years of intense driving.

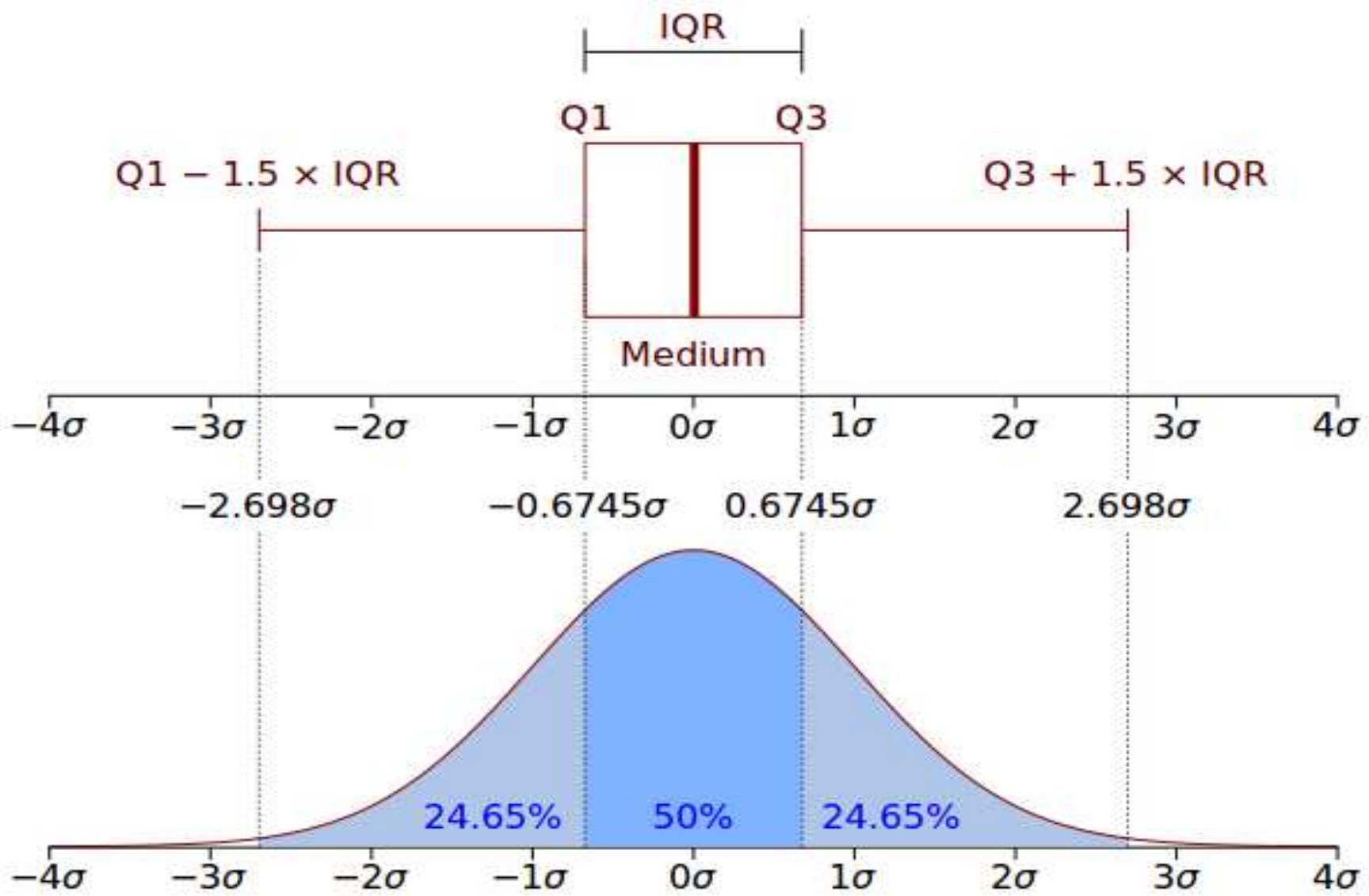
Defined 3 region – Left (L), Central (C) and Right (R).

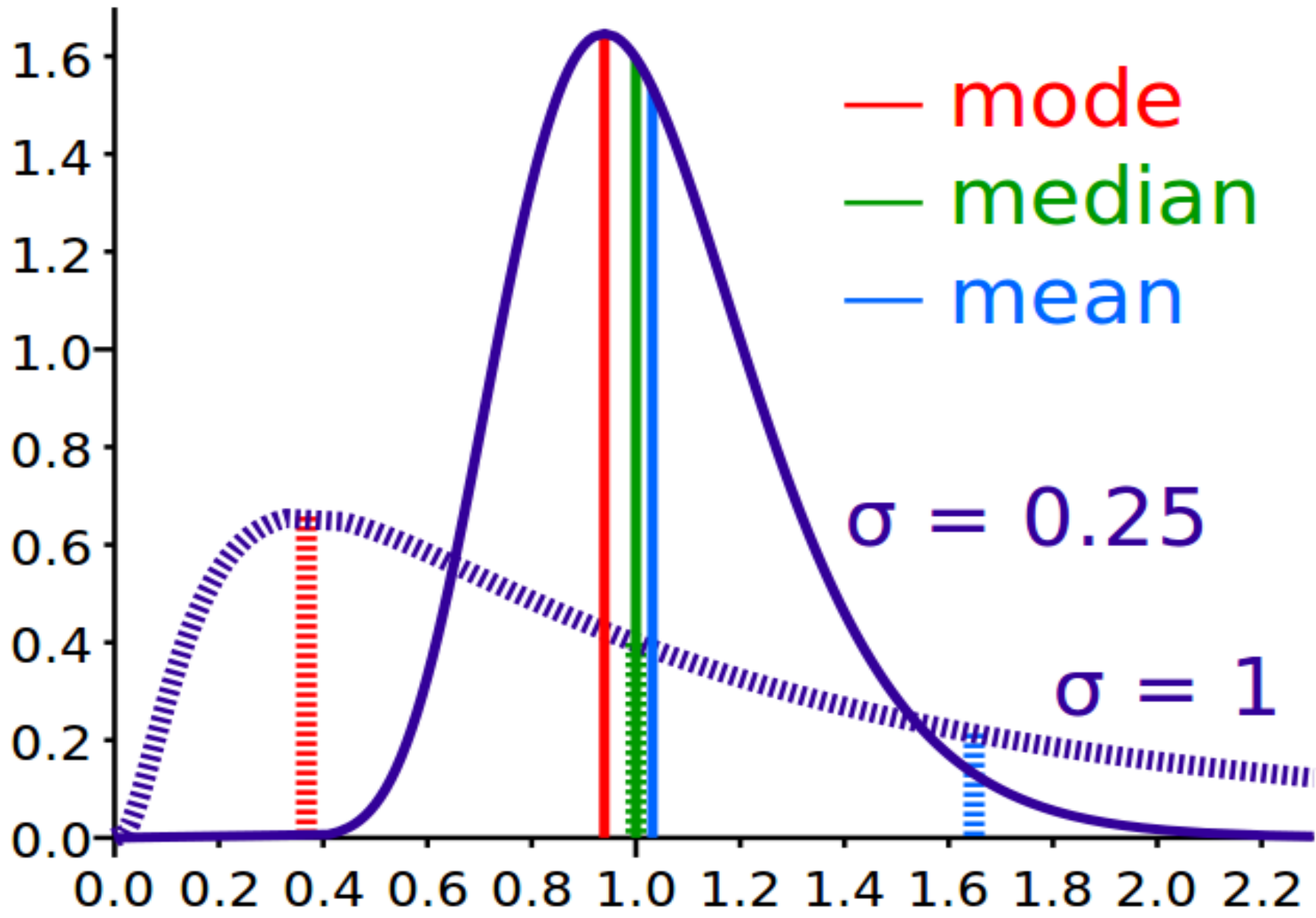


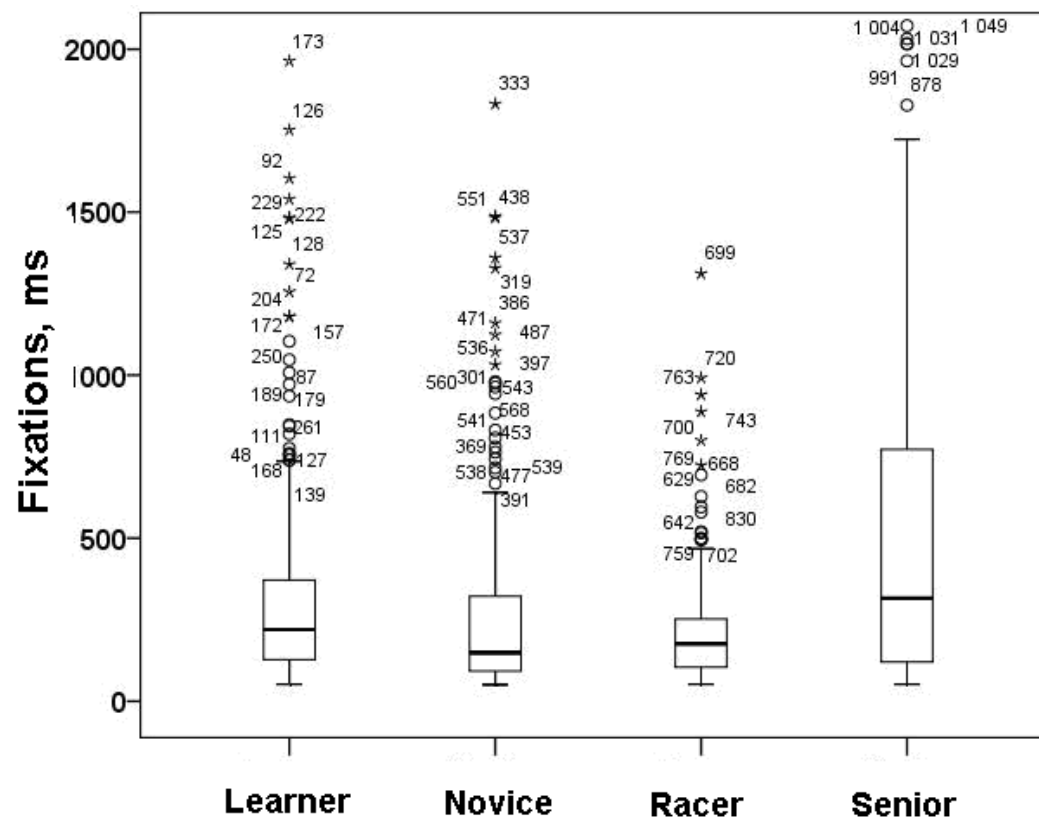
Results

Eye fixations during 2 minutes video scene



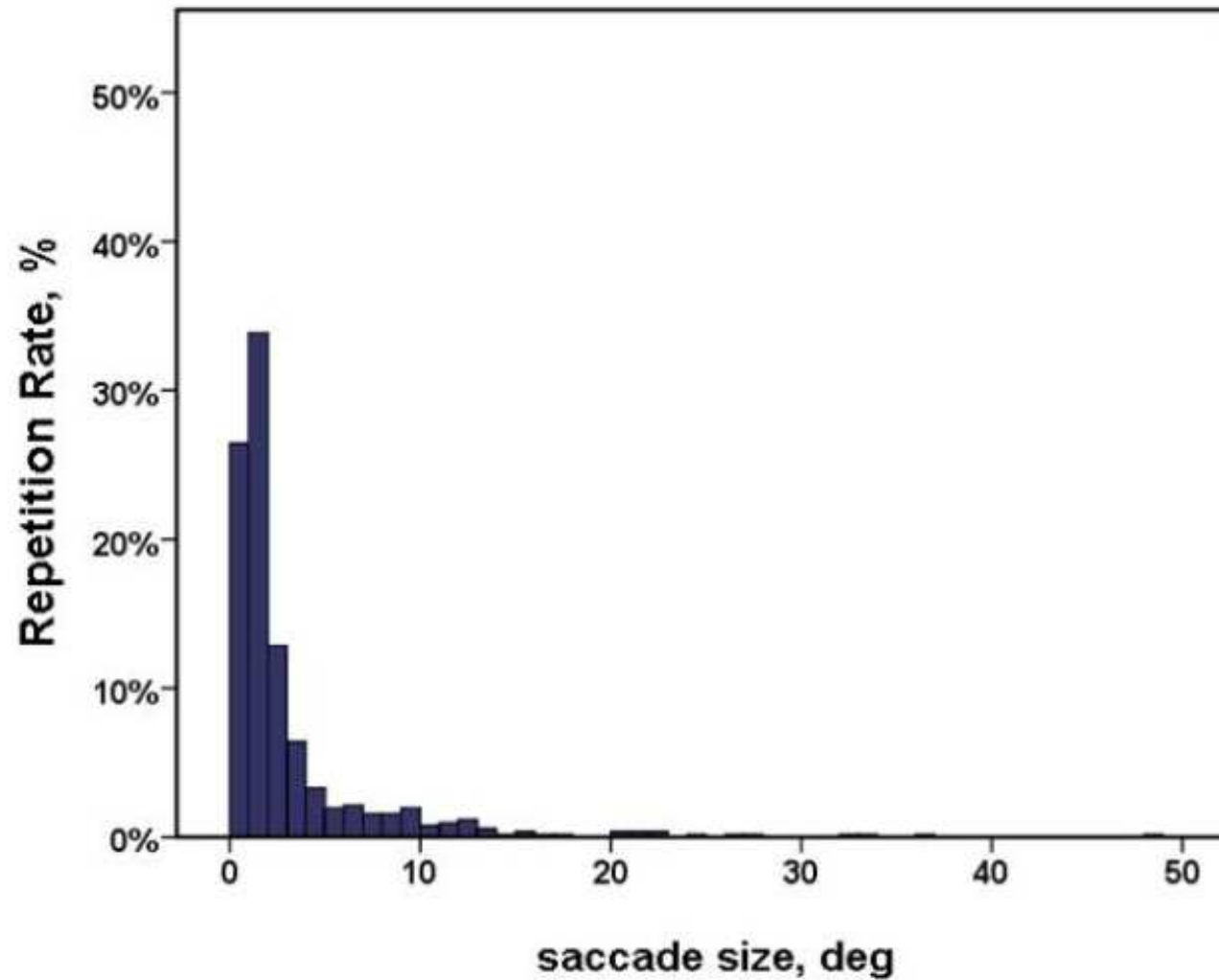




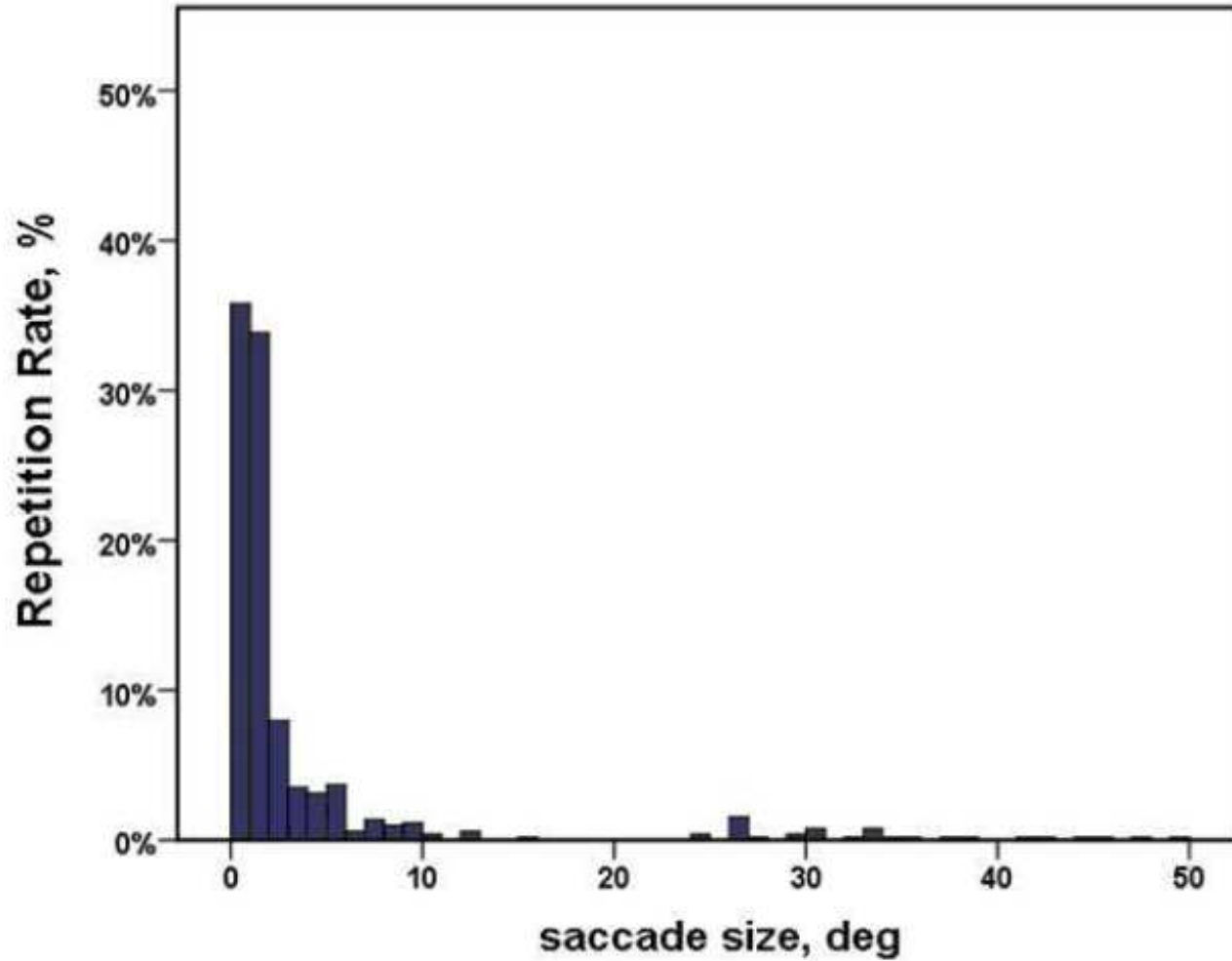


Driver	Average fixation (SE), ms
Learner	312 (18.0)
Novice	334 (41.5)
Racer	209 (9.5)
Senior	620 (53.2)

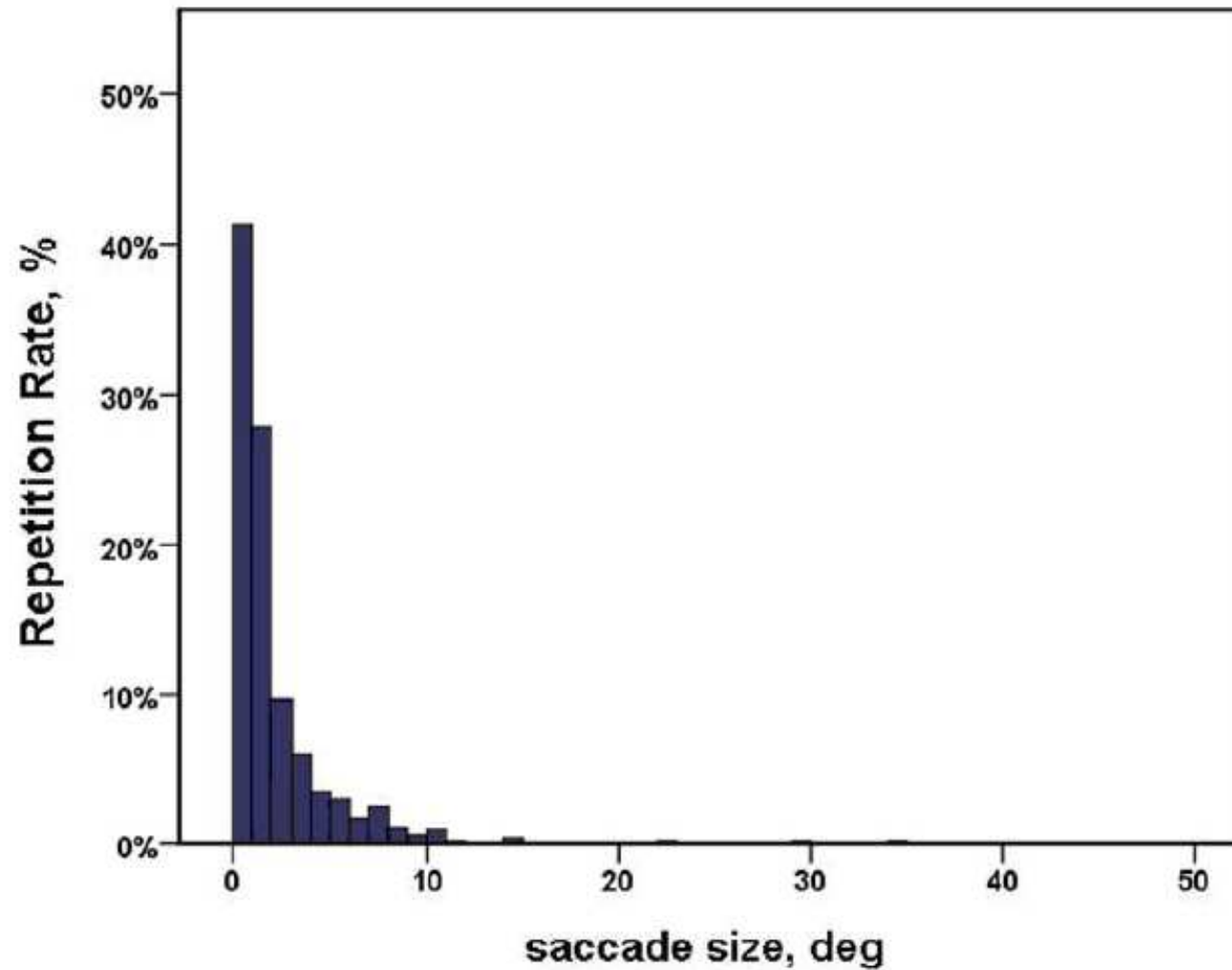
Saccade size, Learner



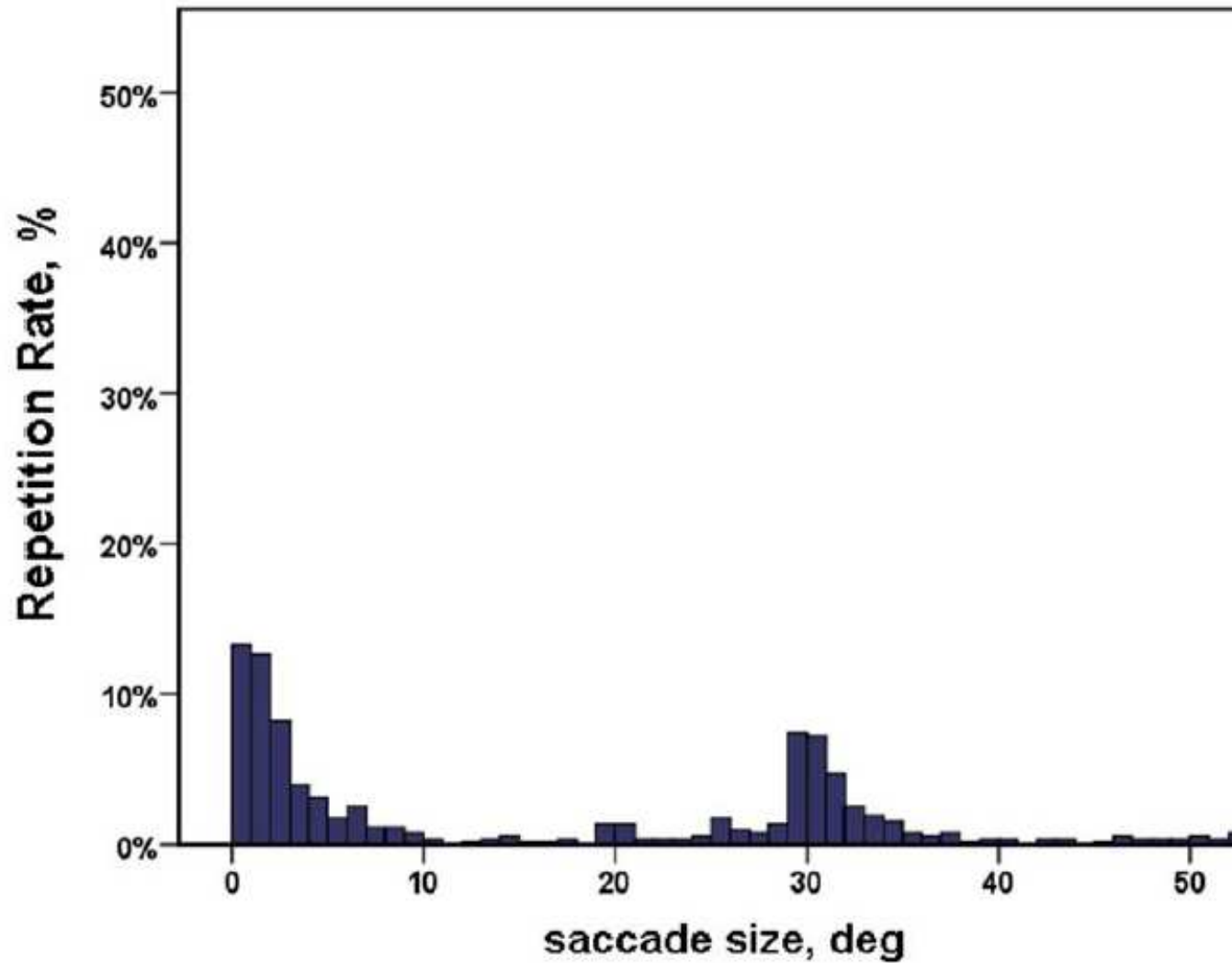
Saccade size, Novice



Saccade size, Racer



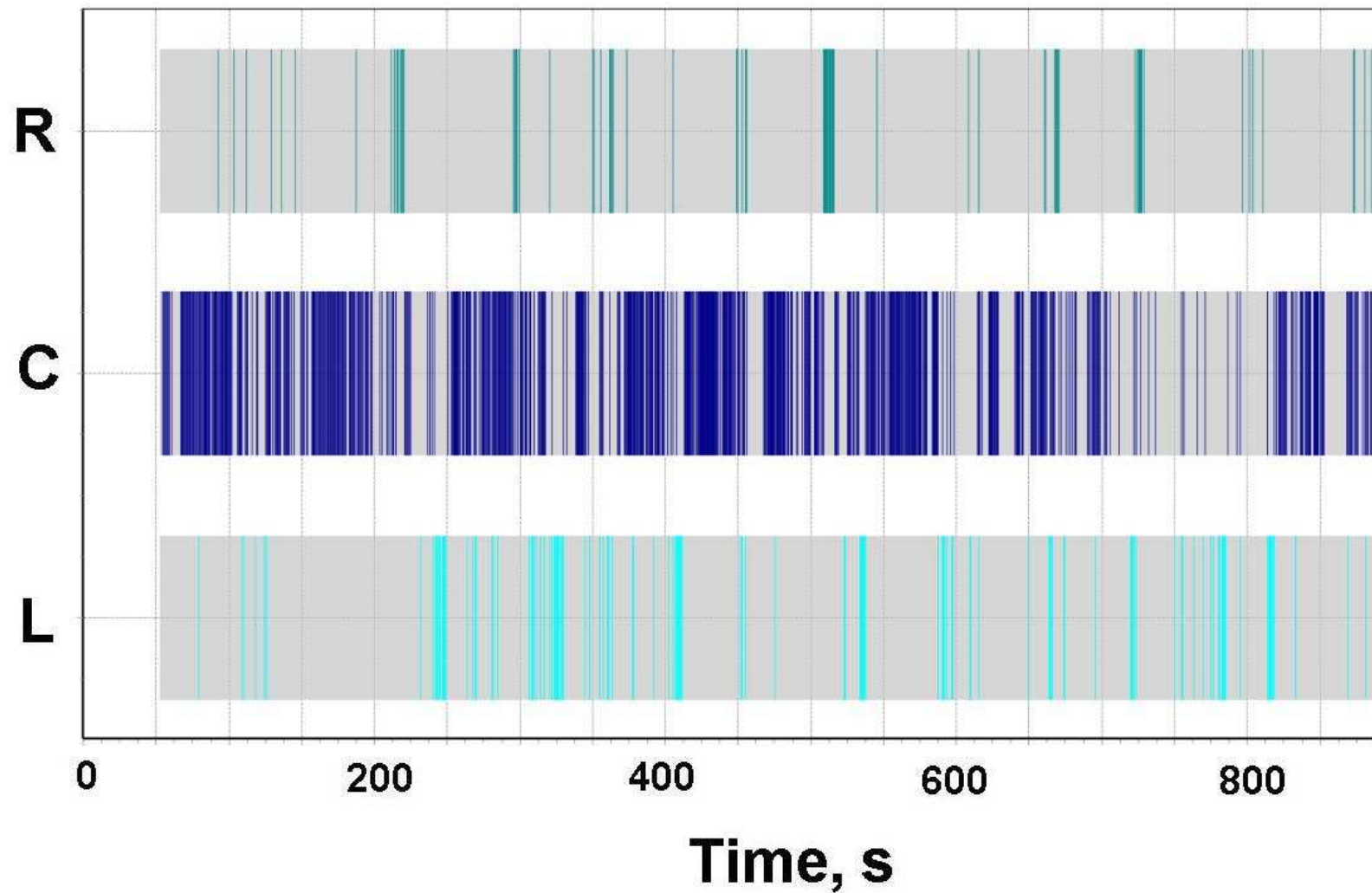
Saccade size, Senior



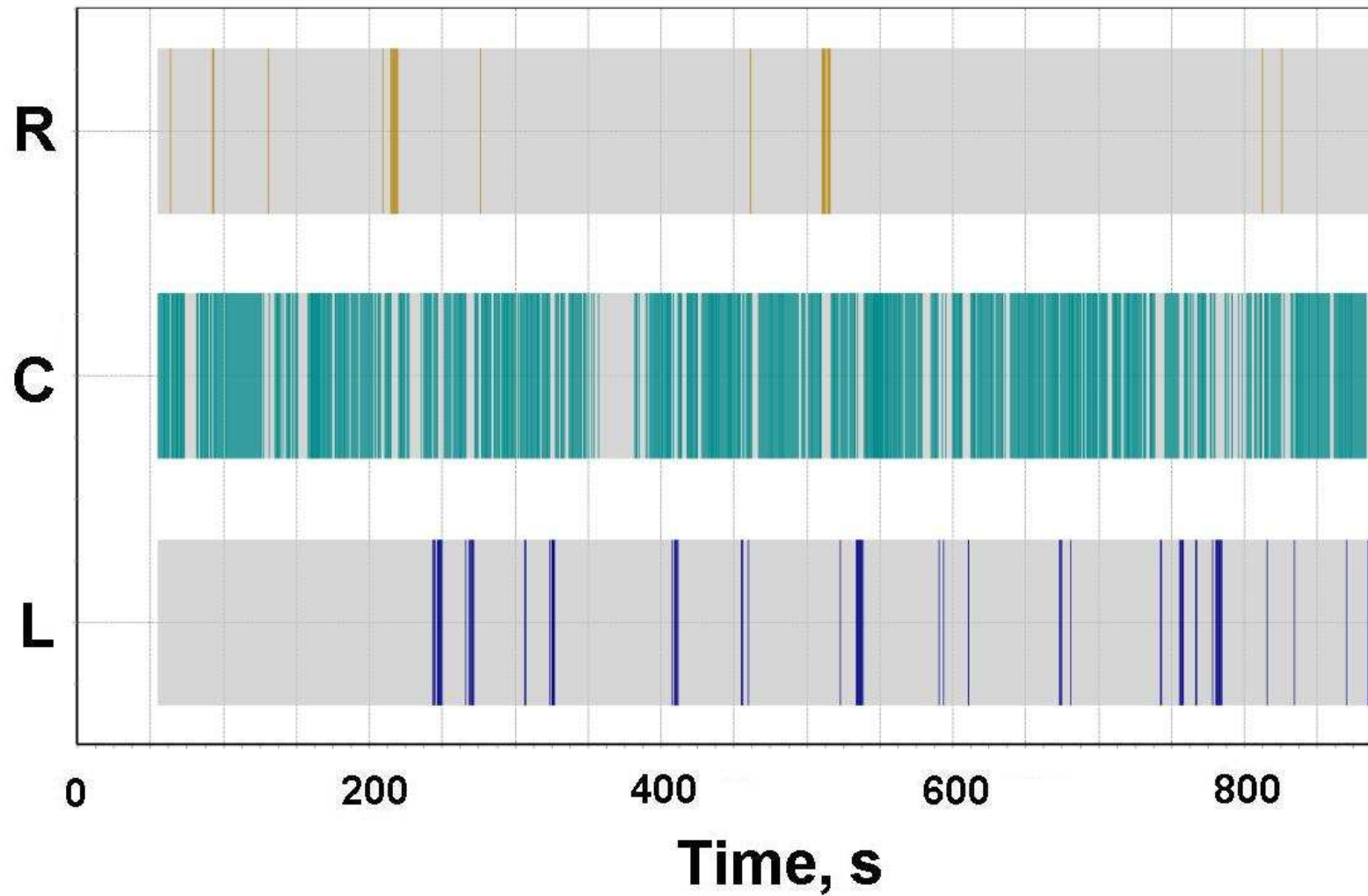
Defined 3 region – Left (L), Central (C) and Right (R).



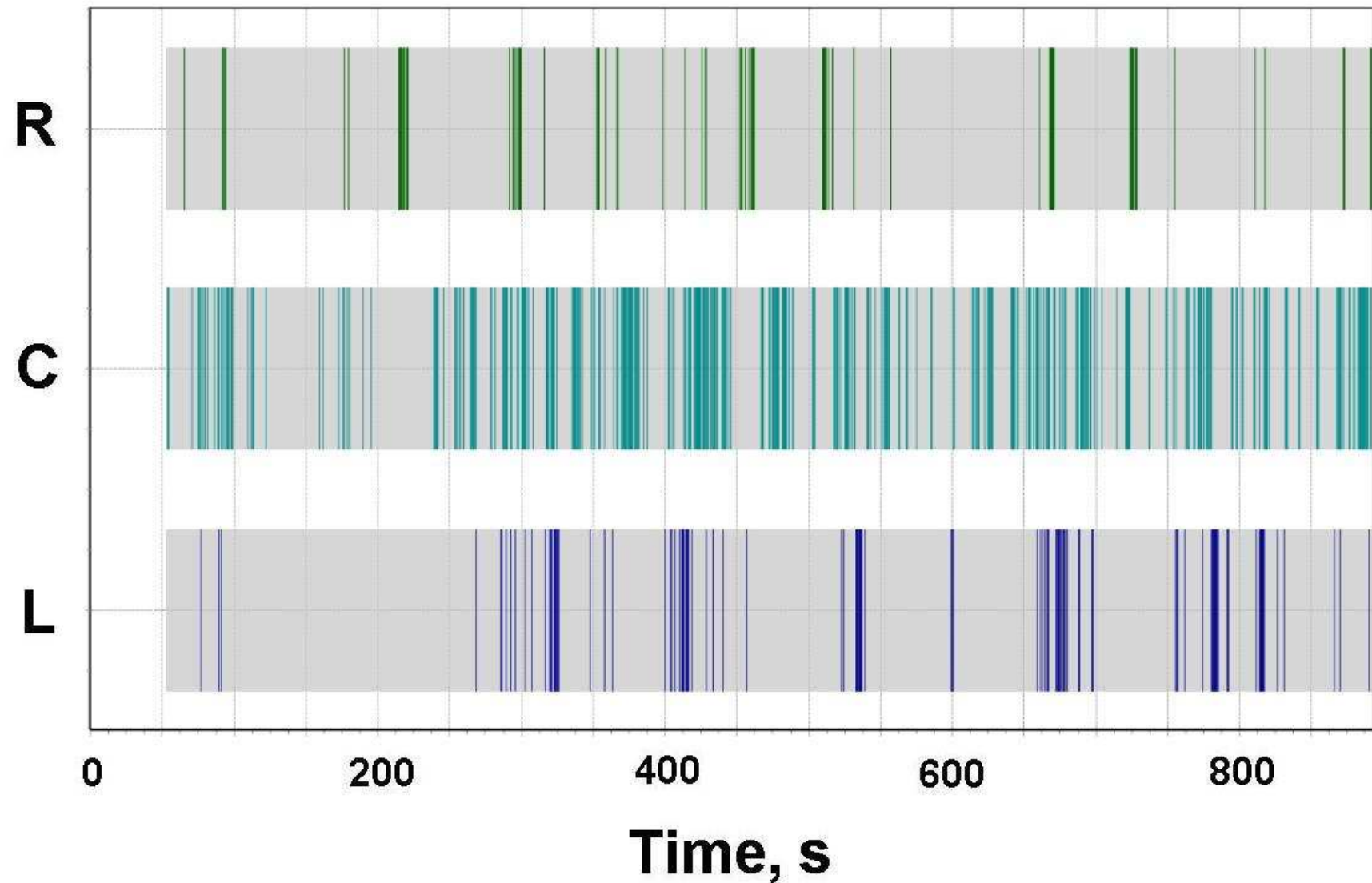
Sight position, Learner



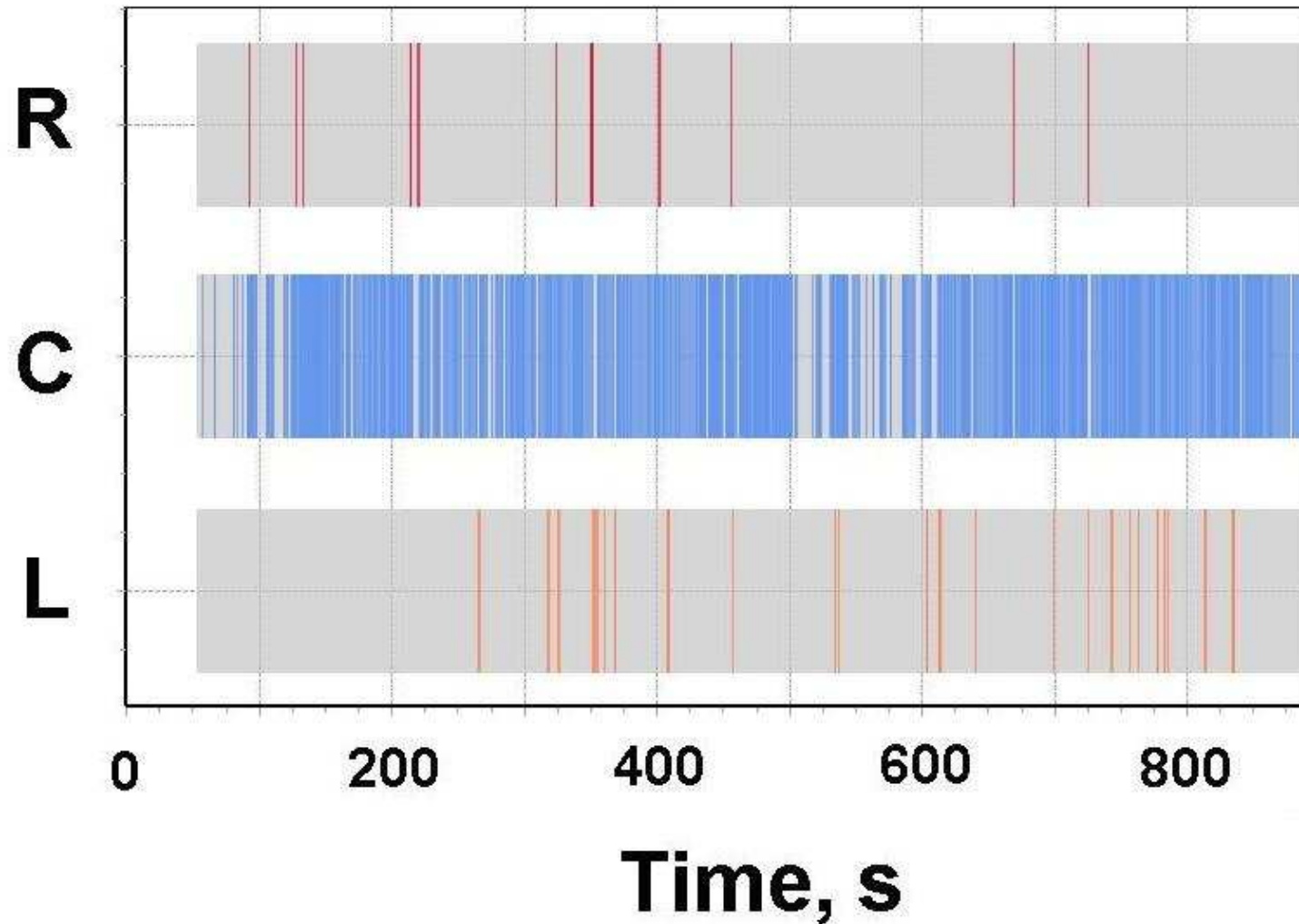
Sight position, Novice



Sight position, Racer

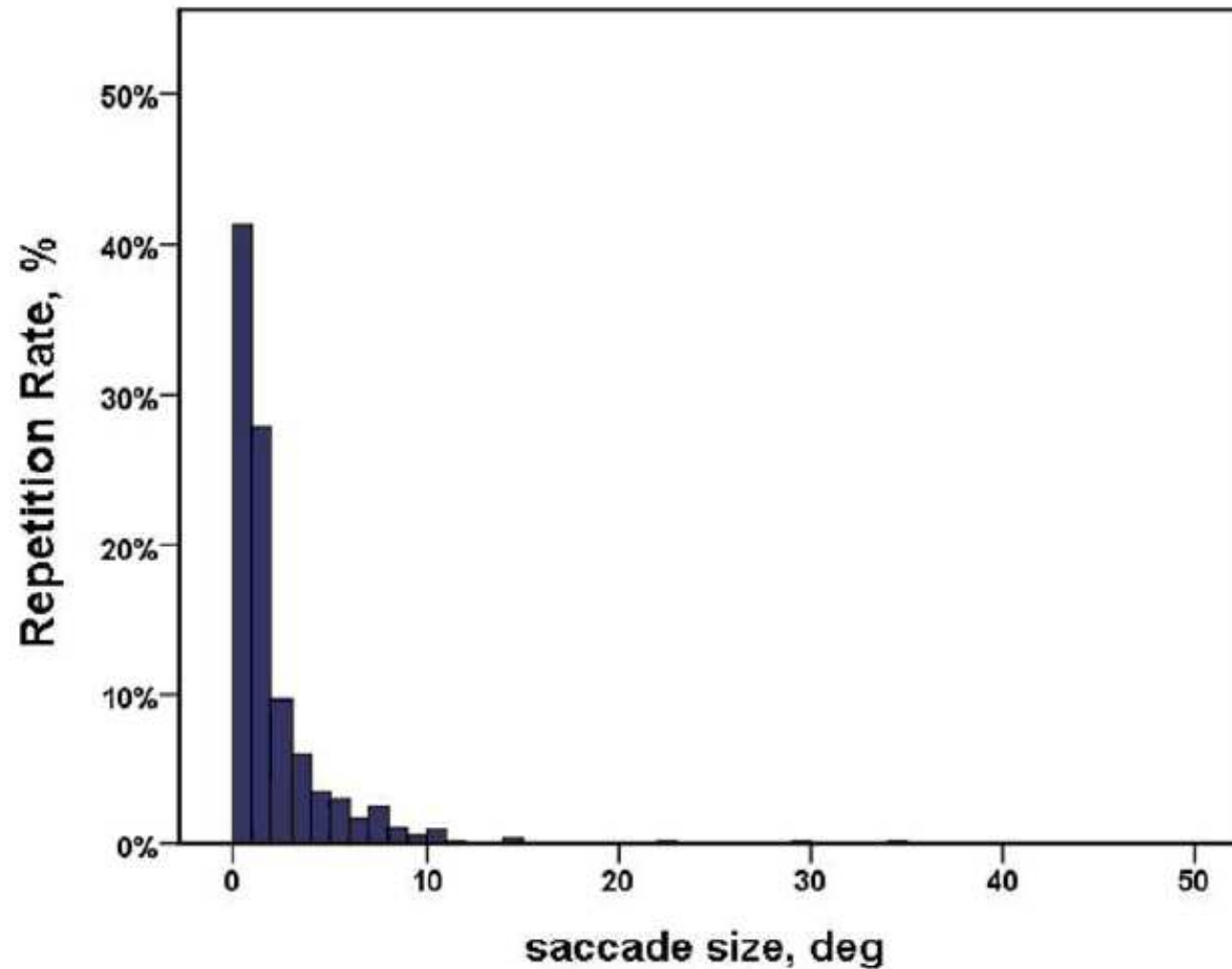


Sight position, Senior

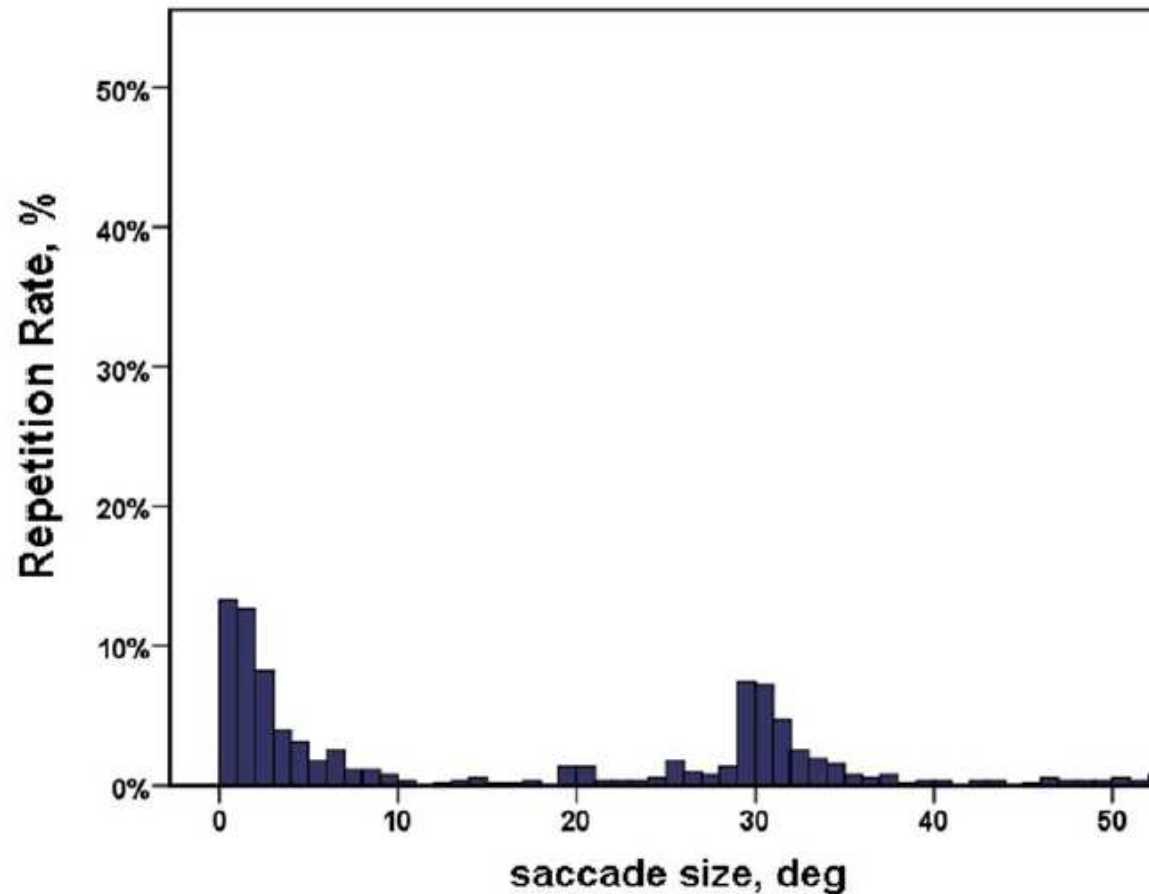


Discussion

1. Racer – peak in short shifts



2. Senior – 2 peaks in sight shifts



(head movement mixed with eye movements-?)

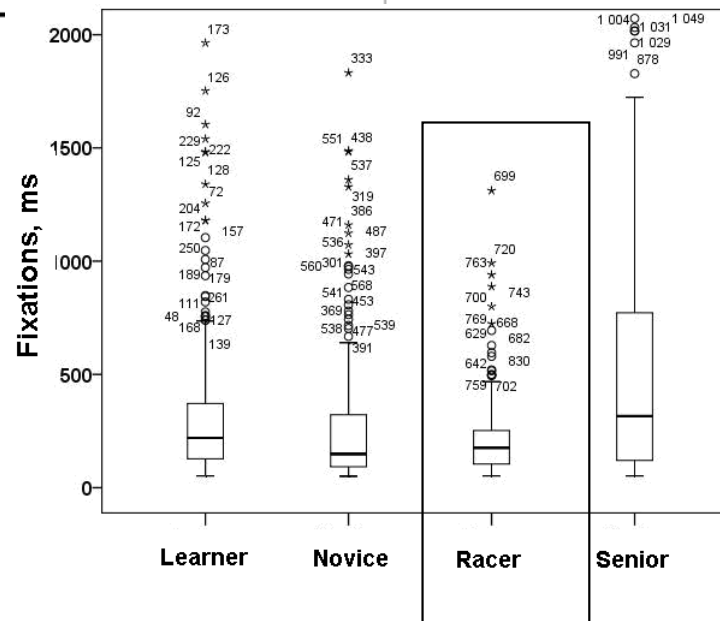
3. Senior – longer fixations

Driver	Average fixation (SE), ms
Learner	312 (18.0)
Novice	334 (41.5)
Racer	209 (9.5)
Senior	620 (53.2)

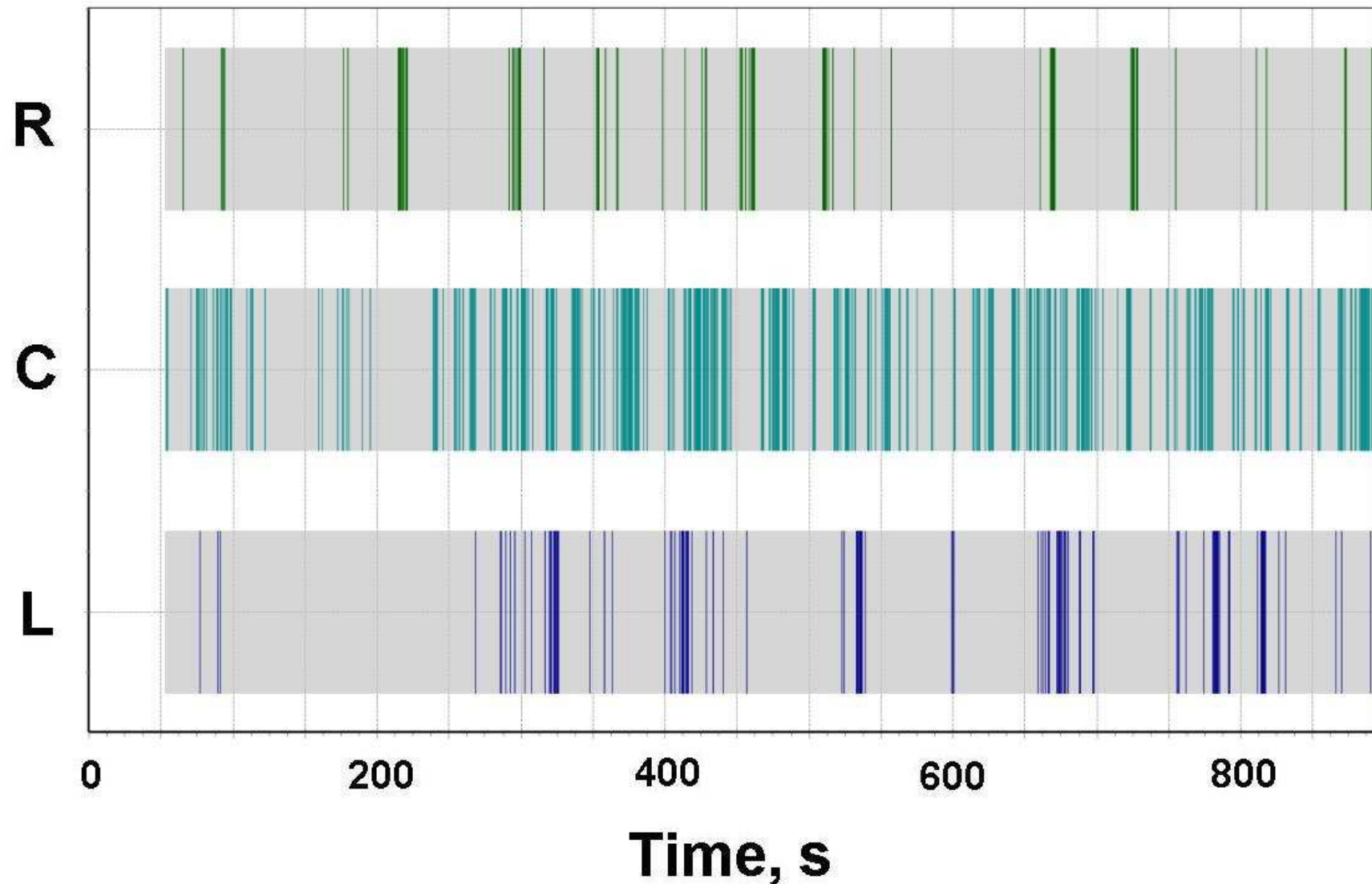
(Senior commented that he usually navigates by the driver in front, Once their behaviour is found to be safe)

4. Racer -short and less spread fixations

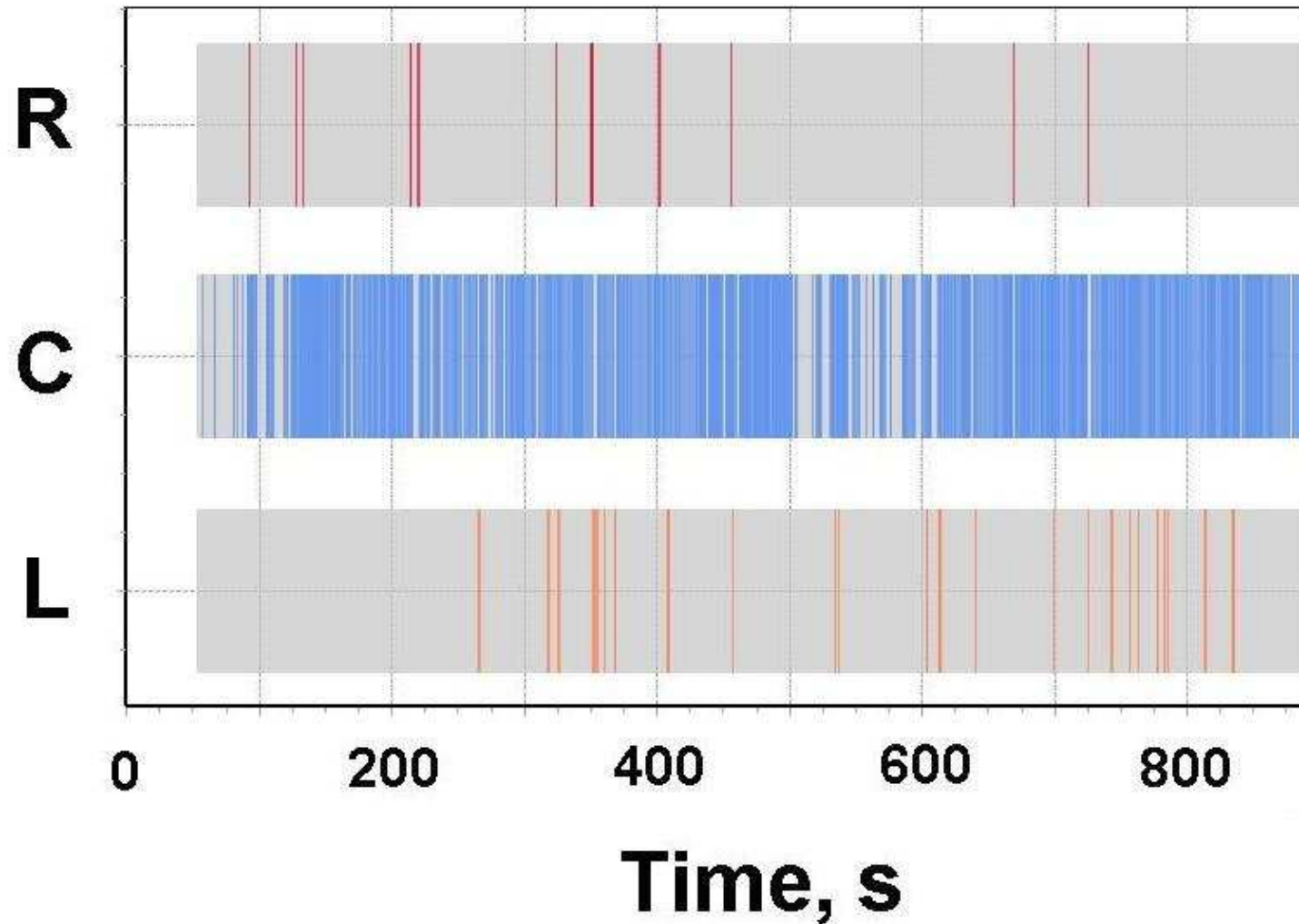
Driver	Average fixation (SE), ms
Learner	312 (18.0)
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Racer	209 (9.5)
Senior	620 (53.2)



5. Racer – spread sight around (Right, Central, Left)



6. Senior – sight more on central area



5. Guidelines to driving instructors

To get the best result of driving (drive faster or more safe),

use observations of a

Racer and a Senior driving skills:

a) Racer – short fixations, look around (central, left, right);

b) Senior – long fixations, look centrally, follow a car driving in front.

Our Research group



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