The slowest to respond: reaction time, accidents and driving errors in neurology patients in rural simulated driving

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BACKGROUND & AIMS

Reaction time to unexpected events is a critical driving parameter that is associated with crashes, yet it has been neglected in driving simulation studies.

The study examines the proportion of drivers with different neurological disorders showing extreme RT; the association of diagnostic category and extreme RT with number of accidents at unexpected incidents; and driving errors associated with diagnostic category.

METHODS

Participants

- 90 healthy control drivers 22-78 years of age
- 128 patients with different diagnoses (for comparisons: 49 mild cognitive impairment (MCI) drivers; 23 mild Alzheimer's disease (AD) drivers; 22 Parkinson's disease (PD) drivers)
All participants were regular drivers

Driving simulator experiment

- Data from **Distract and DriverBrain** research projects
- All participants underwent a neurological, neuropsychological and ophthalmological assessment
- **Driving simulator assessment**: all drivers drove a quarter-cab FOERST driving simulator (3 LCD wide screens 42'', full HD: 1920x1080pixels - total field of view 170 degrees, validated against a real world environment) in **4 rural conditions**, counterbalanced across participants:

moderate traffic
without (R1) & with distraction (R3)

high traffic
without (R2) & with distraction (R4)

- A practice drive (10-15 minutes) preceded the driving assessment
- The rural drive took place in a single carriageway route, zero gradient, with mild horizontal curves

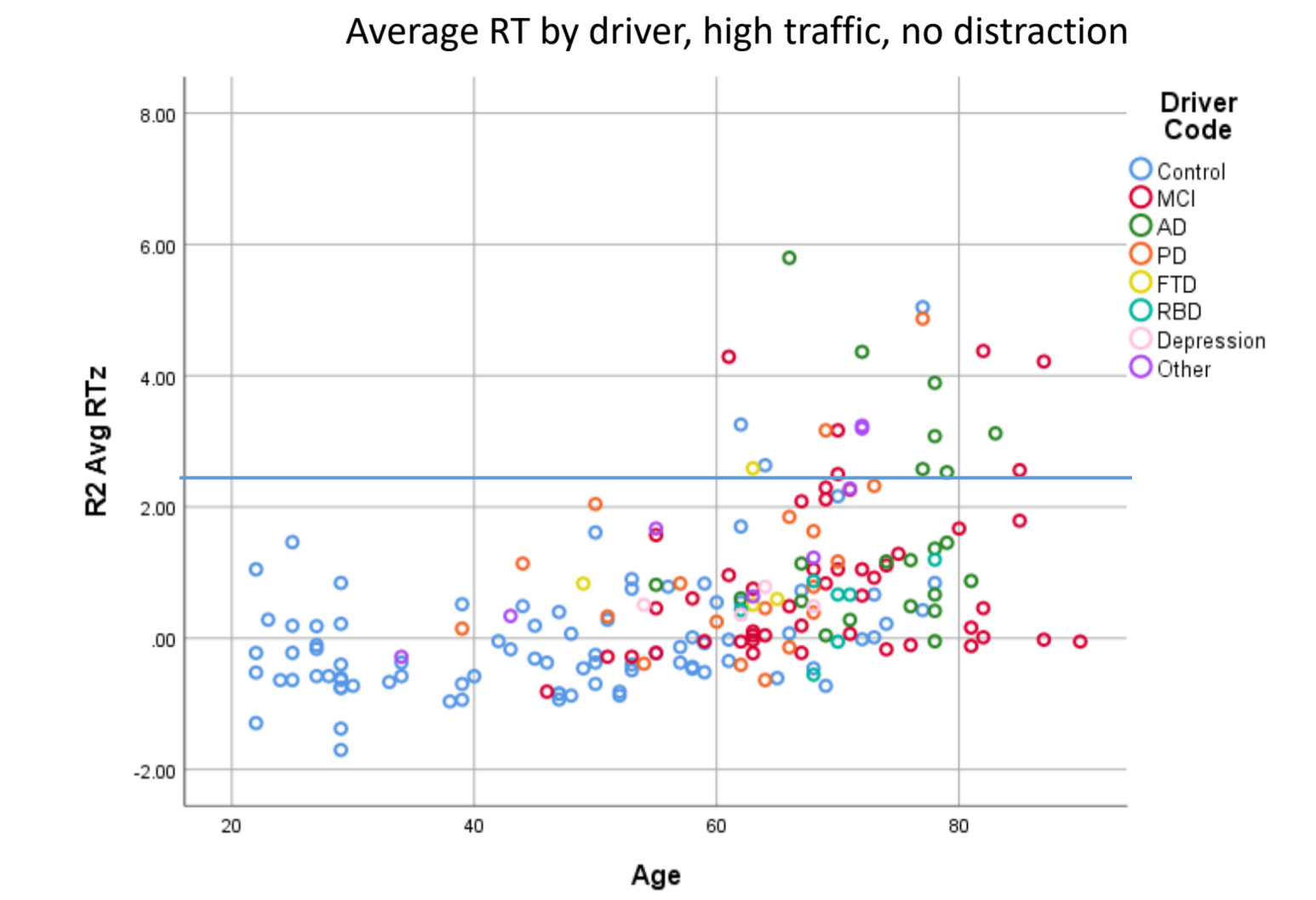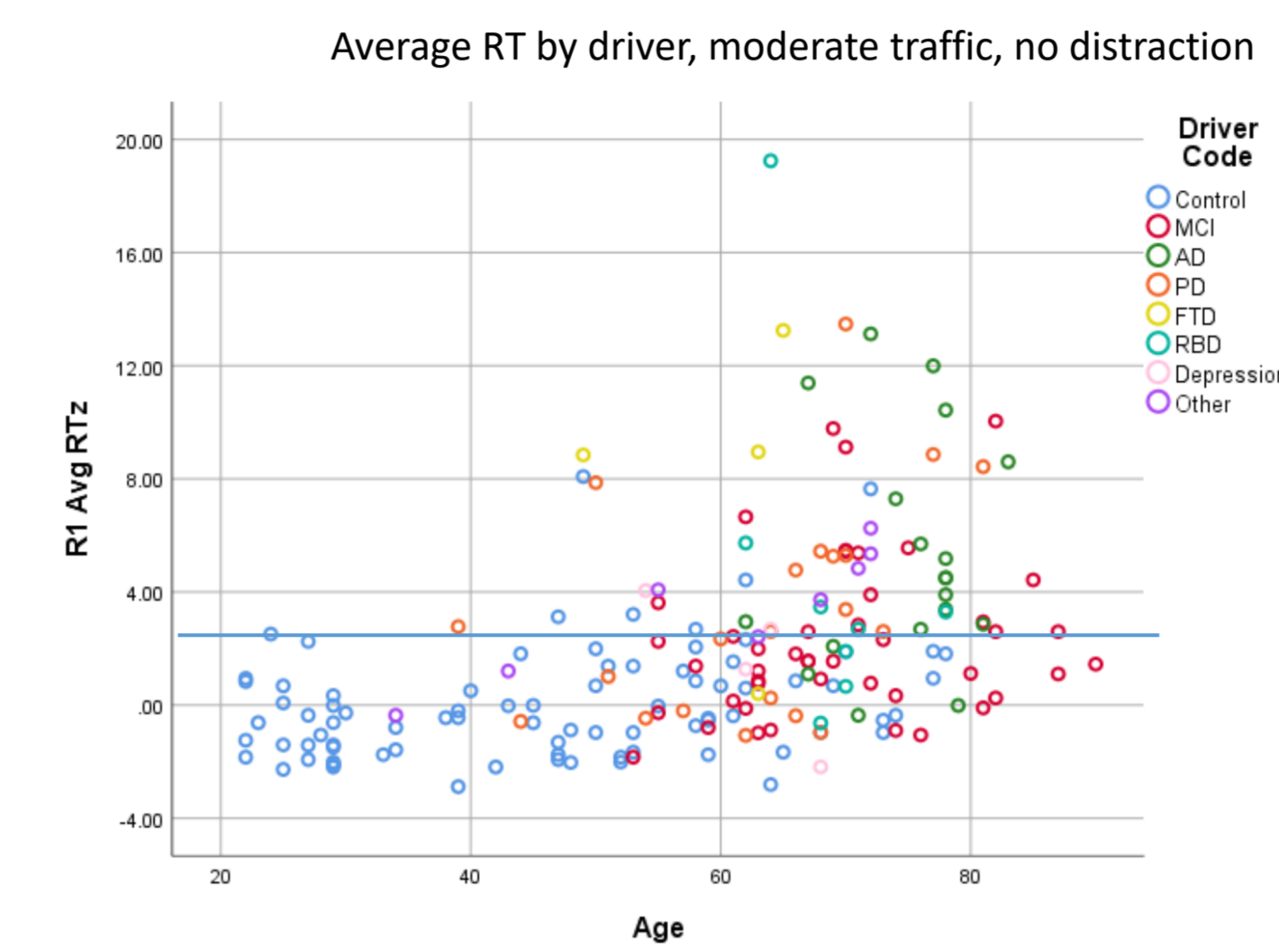**Distraction condition**: conversation with passenger
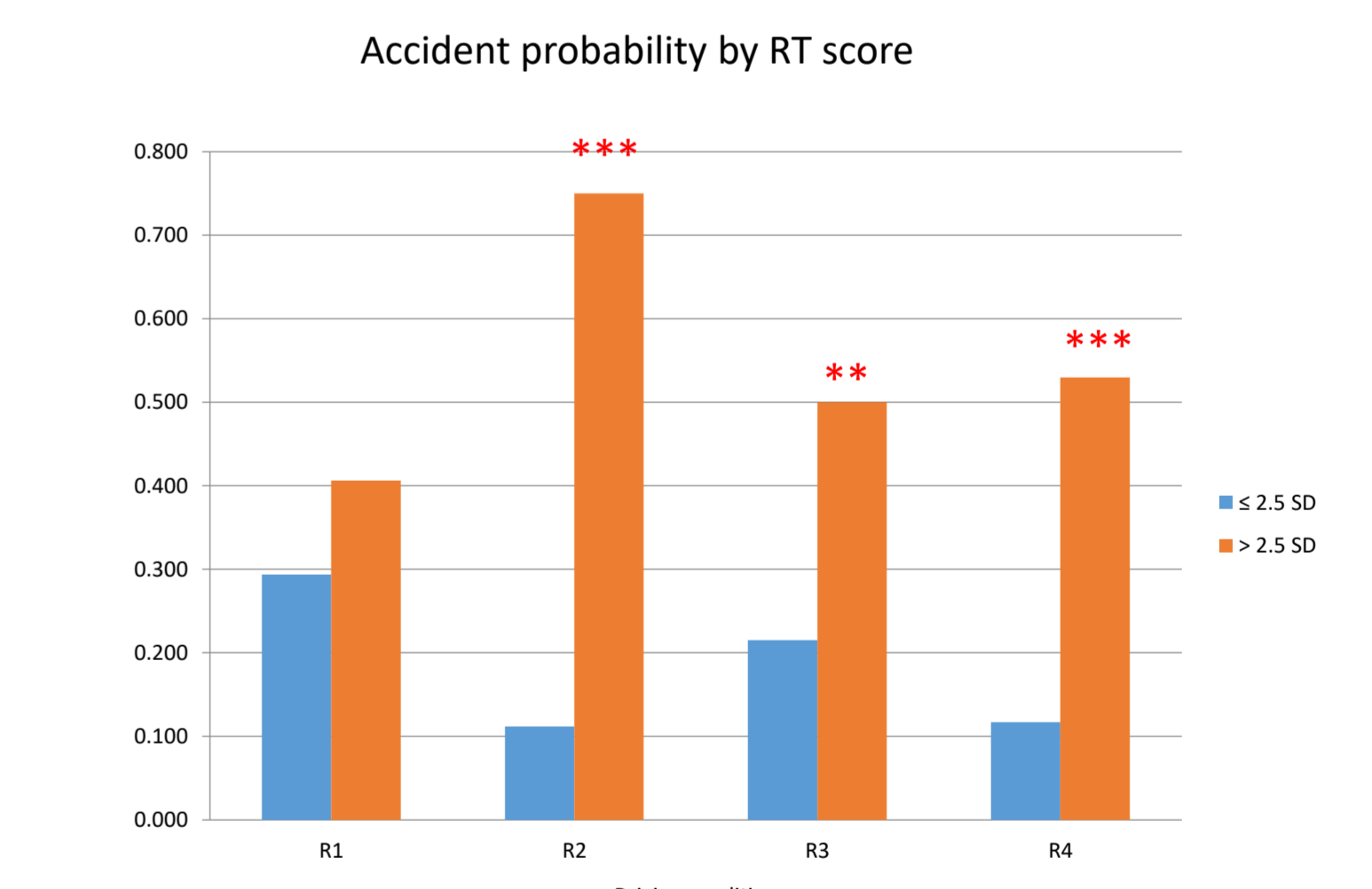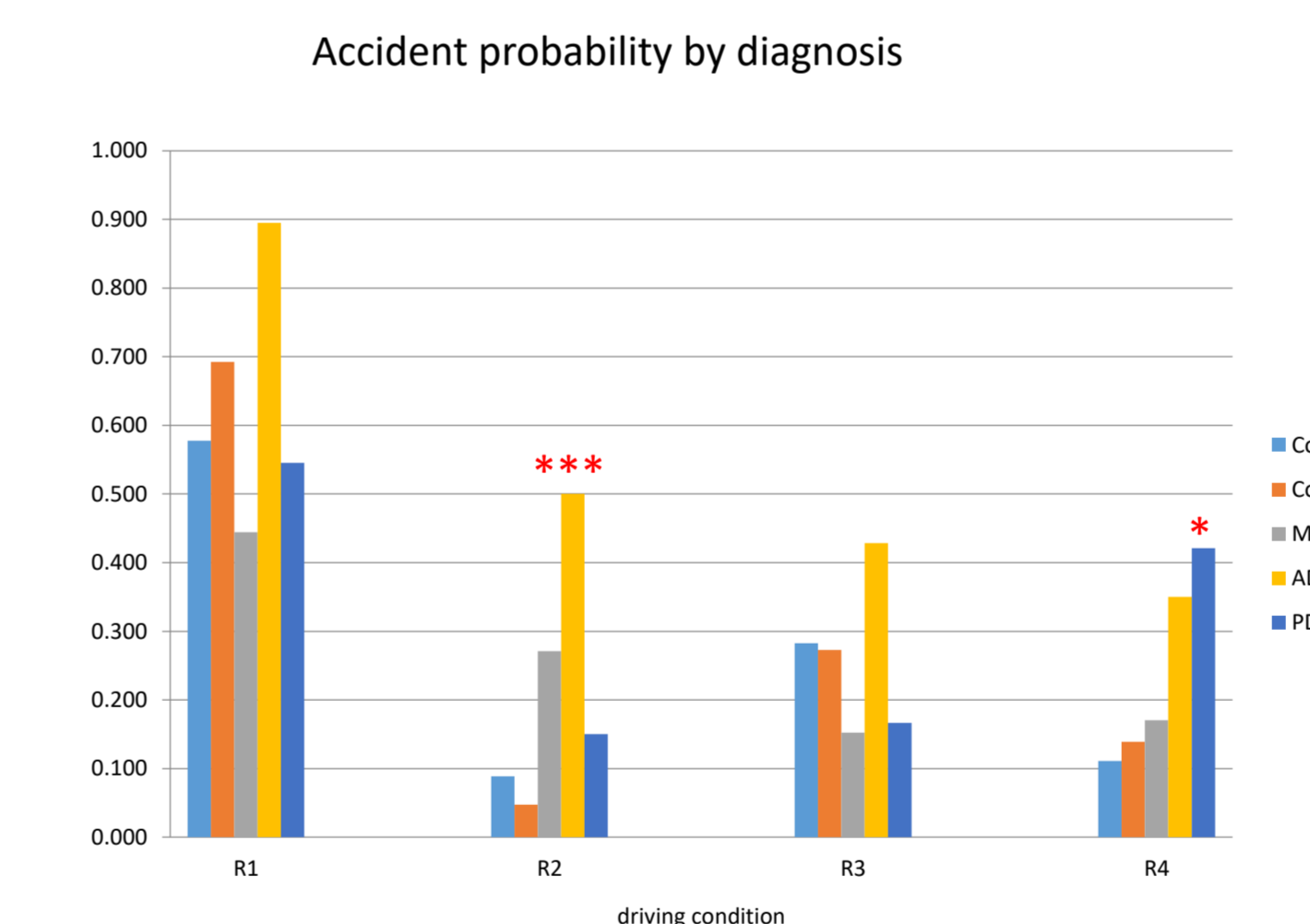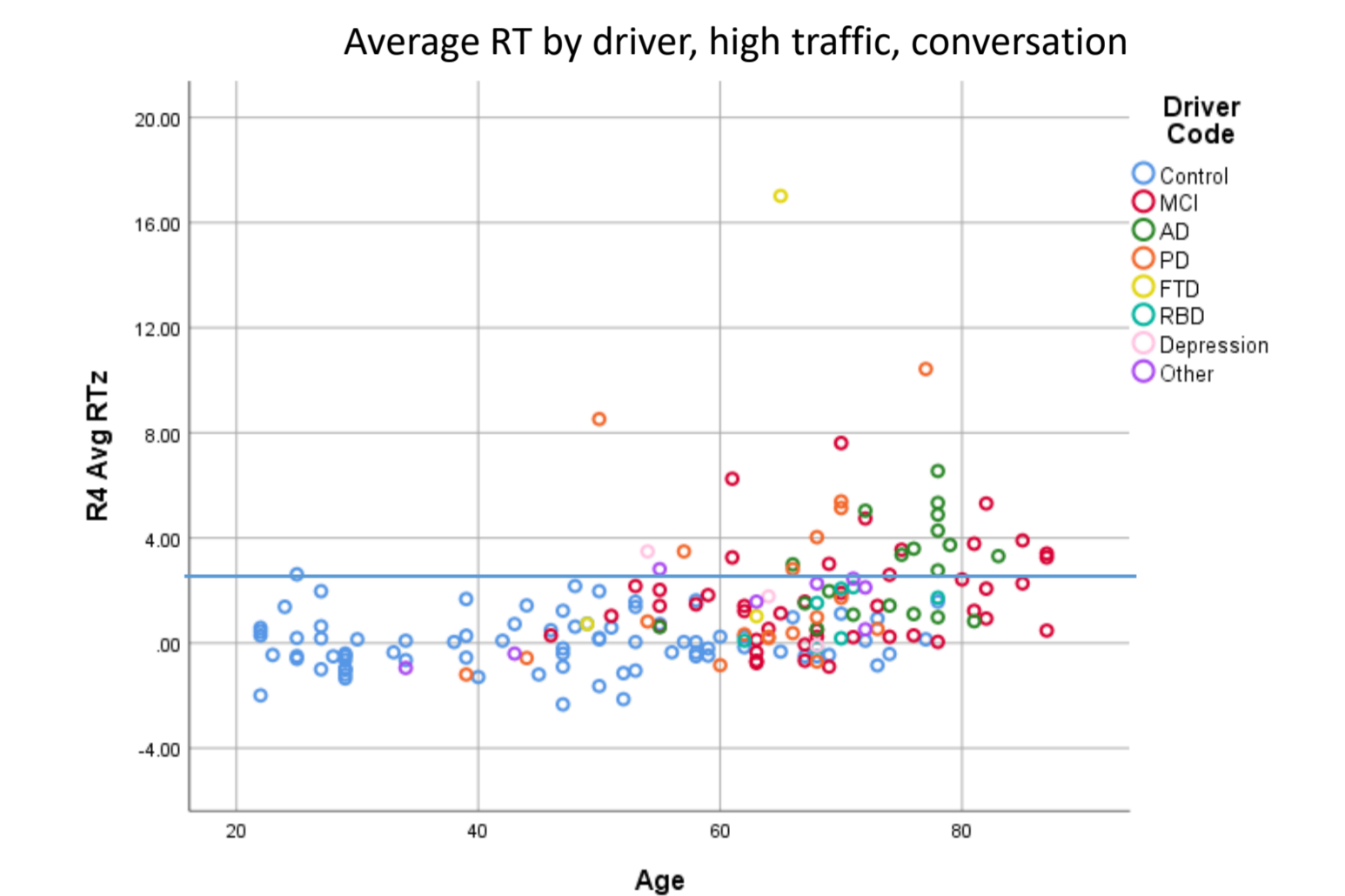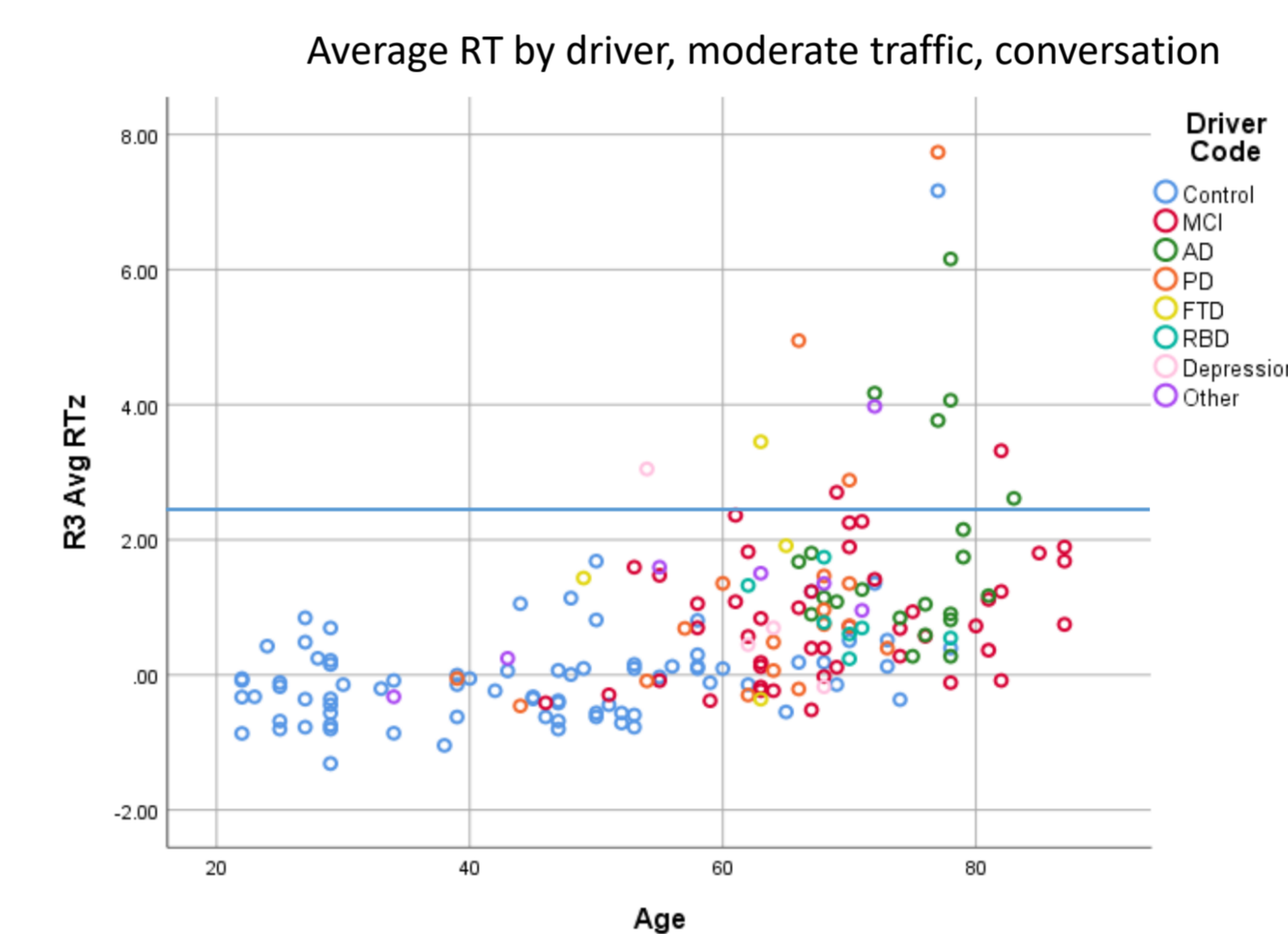

Unexpected incident

Measures

- **Average braking reaction time (RT)** at unexpected incidents (in ms)
- **Accident probability:** number of accidents divided by number of unexpected incidents (2 incidents per condition)
- **Driving errors**: number of hits of the sidebars (HS); number of times outside of road lines (ORL); number of sudden brakes (SB)

- RT was z-transformed based on the performance of the control drivers in each of the driving conditions and the number of drivers deviating by > 2.5 SD from the mean was computed.
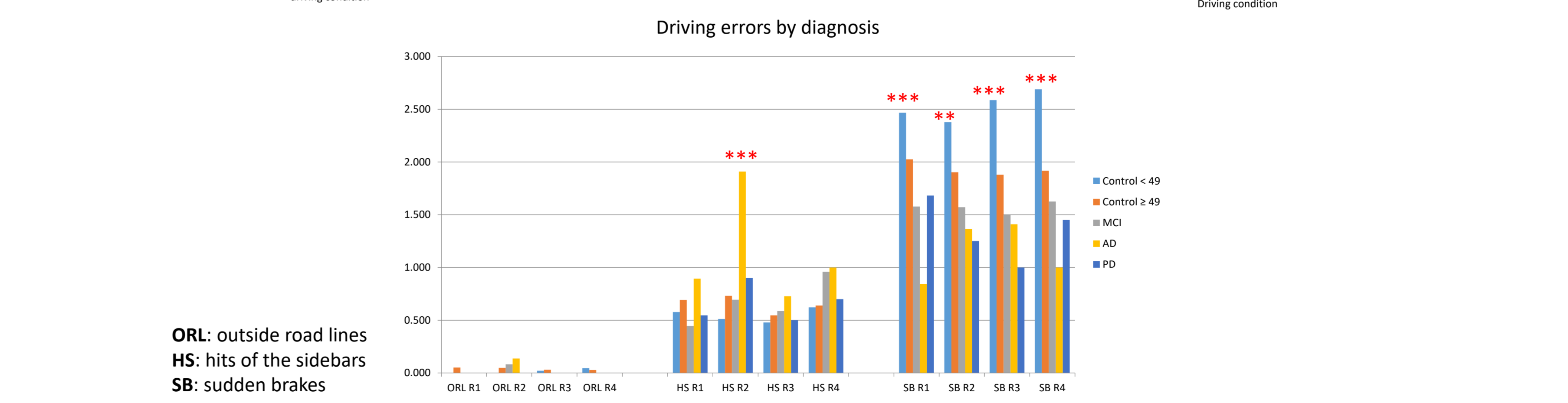
RESULTS

Average RT by driver, moderate traffic, no distraction

Average RT by driver, high traffic, no distraction

Line at 2.5 SD

Average RT by driver, moderate traffic, conversation

Average RT by driver, high traffic, conversation

Accident probability by diagnosis

Accident probability by RT score

Reference: < 49

* p<0.05
** p<0.01
*** p≤0.001

Driving errors by diagnosis

ORL: outside road lines
HS: hits of the sidebars
SB: sudden brakes

CONCLUSION

- Outliers in RT are frequent in patients.
- Outliers are more strongly associated with accidents than patient group.
- Driving errors are differentially affected by driver type: mild AD drivers made more hits of sidebars in one condition; younger controls made more sudden breaks than patient drivers in all conditions.