

## **THE RELATIONSHIP BETWEEN DRIVING BEHAVIOR AND ENTROPY**

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**PAPER NOT AVAILABLE**

### **ABSTRACT**

#### **OBJECTIVES**

High variability in the lateral control of a vehicle may result in an increased likelihood of accidents. Boer (2000) proposed a method of quantifying variability in steering wheel position, termed “entropy” (scaled between 0 and 1). In this approach, the steering wheel position at each time point is predicted based on the position at the three preceding time points, and the discrepancies between the predicted and observed values are utilized to define a baseline distribution of prediction errors within a subject. This distribution is then used as a reference for calculating a summary “entropy” metric in follow-up segments of driving, such as when a driver may be distracted when using a cell phone. This same concept has also been applied to the lateral position of a vehicle (Dawson et al., 2006). The objective of this study was to ascertain whether entropy was affected by behavioral factors such as steering techniques and speed. We hoped to gain insight regarding the usefulness of entropy measures, and the appropriate interpretation of statistical tests based on entropy.

#### **METHODS**

We designed a simple driving route in a simulator known as SIREN (Rizzo, 2004), with a straight road segment of 3.7 km, followed by an S-curved road segment of 3.8 km. Using an expert driver familiar with the simulator, we performed a factorial experiment with different steering techniques (normal driving, swerving, and steering using a rigid grip and sudden “jerks”) and driving speeds (35 mph, 55 mph, and 75 mph). Data on steering wheel position and lane position were collected at 30 frames per second, and then reduced to 5-frame blocks of 167 msec each. Based on these blocks, we estimated the baseline parameter to characterize the prediction errors for each drive during the straight road section, and then applied this parameter to the straight and curved road sections in order to calculate entropy. This approach was used for both steering and lane position entropy. The data were analyzed using multiple linear regression to assess the affects of steering technique and speed, adjusting for road curvature. We also calculated Pearson correlation coefficients to measure the association between steering and lane position entropy.



negatively associated with entropy. Safe driving often involves making frequent minor steering adjustments, especially in curved sections of the road, which might lead to an increase in the entropy measure. If a driver rigidly holds onto the steering wheel and then makes large corrections when approaching or crossing a lane boundary, the fixed steering wheel position over several seconds may actually cause an apparent decrease in entropy. In summary, entropy may be a useful tool in quantifying vehicular control, but caution should be exercised when interpreting the results, as the associations involving entropy are not always in the anticipated direction.

## REFERENCES

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