Variability in Vehicle Turning Movement Ratios

Briefing Note

We conducted a study to see whether the volume of vehicles making specific turning movements behave the same as the total intersection volume. This was done by looking at the variability in the turning movement (TM) ratio, which is the proportion of vehicles making a specific movement compared to either a different movement or the total intersection volume. For instance, if the total intersection volume is reduced by 10%, do all of the turning movements also decrease by 10%? The variability in TM ratios can help determine if it is realistic to account for changes in total intersection volume by adjusting all intersection movements by the same amount.

Methods

Total pedestrian and total vehicle counts collected between 2013 and 2016 at controlled intersections were extracted from the traffic count database. The dataset was limited to standard 6 hr counts taken on weekdays, encompassing the periods between 07:00-09:00, 11:00-13:00, and 16:00-18:00, at locations with at least two counts. Turning movement ratios were calculated for each location using two methods:

- Total volume – the volume of each turning movement was divided by the total intersection volume across all turning movements; and
- Straight approach volume – the volume of each turning movement was divided by the volume of the North, South, East, or West straight turning movement volumes. A different set of TM ratios was created for each straight approach direction.

The median absolute deviation (MAD; 50th percentile of the differences from the median) of each TM ratio, using both methods, was calculated for each of the 273 locations. The MAD of the TM ratios were summarized using the median and 85th percentile to avoid being skewed by very high or low values.

The variability in TM ratio is reported as an <u>absolute value that gets added to/subtracted from the observed TM ratio</u>. If 100 vehicles made an eastbound-left (EBL) approach out of 500 total vehicles, then the calculated TM ratio is 100/500 = 20%. If the MAD of this TM ratio is 5%, then an expected observed TM ratio is 20% plus or minus 5%, or between 15% and 25%. In the example, between 75 and 125 vehicles would travel EBL when then total intersection volume is 500 vehicles; the same TM ratios are used for with volumes, so between 30 (15%) and 50 (25%) vehicles would make the movement if the total intersection volume decreased to 200 vehicles.

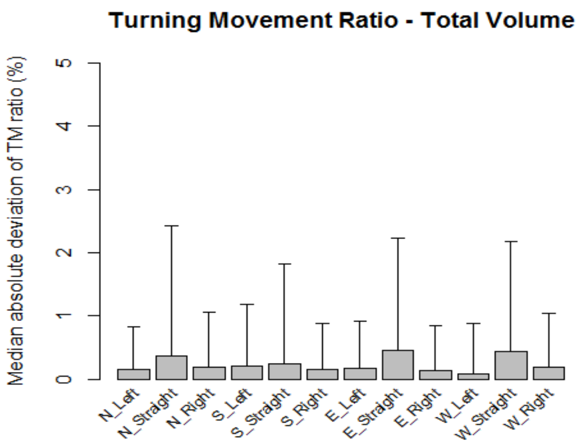
Results

The TM ratios calculated using total intersection volume varied by less than 1% (Figure 1). The 85th percentile of the MAD was less than 5%. The straight movements had slightly higher variability, likely because they contained higher proportions of the total volume and were more impacted by traffic changes (e.g., normal volume fluctuations, weather events, construction, accidents).

The TM ratios calculated using the straight approach volume varied by less than 5% (Figure 2). Turning movement ratios based on northbound (NB) or southbound (SB) straight approaches were mostly (85th percentile) below 20%. However, TM ratios were more variable (85th percentile = 30%) when standardized against the EB or WB straight approach volumes. **TM ratios based on approach volumes were more variable overall than TM ratios based on total intersection volumes.**

The highest median variability for TM ratios was associated with the straight movements. Moreover, the median variability was highest for straight movements that were in the opposite direction of the one used to standardize the volume (e.g., if TMs were standardized by the <u>NB</u> straight volume, the <u>SB</u> straight TM would have the highest TM ratios). The range of variability was highest for movements perpendicular to the direction used to standardize the volume.

Figure 1: Variability in turning movement (TM) ratios scaled by total volume

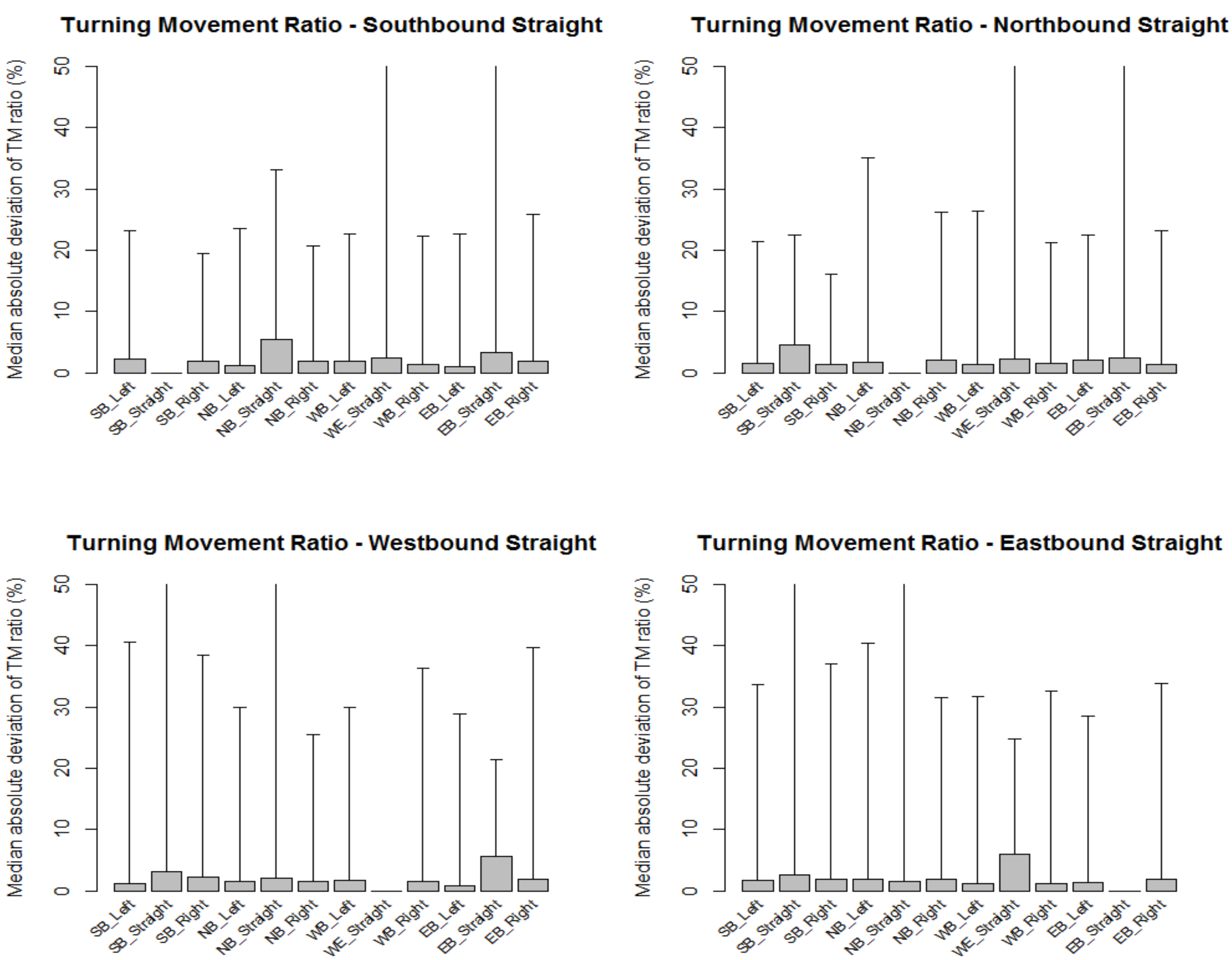


Conclusion

The low variability (<5%) in turning movement ratios suggests that vehicle volumes of individual turning movements can be scaled proportionally to changes in total intersection volume.

Although the same can be done using straight approach volumes instead of total intersection volumes, this approach is more variable as well as more dependent on the actual turning movement being considered.

Figure 2: Variability in turning movement (TM) ratios scaled by approach



Note: The median absolute deviation of the turning movement (TM) ratio is zero for the TM being standardized. For instance, if TMs are compared to the NB straight movement, then the NB straight TM ratio is zero. The bar heights indicate the median value; the error bars indicate the 85th percentile. If the error bar does not have an end cap, then the actual 85th percentile was above 50% (and is not visible in the plot).