Traffic Signal Change and Clearance Intervals: Research Still Needed!

By Jeff A. Lindley, P.E. (F)

Yellow change and red clearance intervals have been a topic of research for at least the last 60 years. It would be easy to assume that we now know all we need to know about the subject and that the remaining challenge is merely to put what we know into practice. But there is still much about driver behavior at intersections during traffic signal changes that we don’t know with certainty or completely understand. During the development of the ITE Guidelines for Determining Traffic Signal Change and Clearance Intervals Recommended Practice, current knowledge, research, and practice in this area was documented, but the following 11 areas of interest were identified where additional study or new research is needed to expand the body of knowledge. Research in these areas would be useful in further refining the concepts and procedures in the ITE Recommended Practice.

- **Safety benefits of yellow change and red clearance intervals.** Additional study of driver compliance rates with and their sensitivity to signal timings set for yellow change and red clearance intervals across different vehicle types would be helpful. This work should incorporate left-, through- and right-turn movements as well as the impact on instances of red-light running. Additionally, the analysis should employ an approach that can quantify safety benefits related to fatality and injury reduction. Supporting analysis incorporating non-motorized modes of pedestrian and bicycle movement would be beneficial as well.

- **Impact on driver behavior and safety of yellow change intervals greater than 5 seconds.** It is widely thought that longer change intervals can lead to unsafe behavior once drivers are aware of and familiar with them. However, this understanding is very anecdotal in nature and available literature is not definitive on this issue. Continued research in this area would be improve the body of knowledge.

- **Perception-reaction time and deceleration for alerted drivers for turning movements.** Additional data and analysis, for both right- and left-turning vehicles, of the effect of a planned choice of movement by an alerted driver on perception-reaction time and deceleration rate. Similarly, whether information from countdown pedestrian signal indications affect perception-reaction time and deceleration rate. The effect of different age groups, vehicle types, and approach speeds on these two parameters would need to be incorporated. The recent availability of high-resolution driver behavior data sets would add value to this type of research.

- **Approach and passage speed variations with different left-turn lane characteristics.** Left-turn lanes have a variety of geometric and operational characteristics potentially affecting their approach and passage speeds that would benefit from additional research, including (for example): speed limits less than 30 miles per hour (mph) (50 kilometers per hour [km/hr]), turn-lane length, number of lanes, signal phasing, and movements where U-turns are allowed in addition to left turns on single- or multi-lane approaches. This research should also examine the significance of these potential effects and whether they could be practically applied to change and clearance interval calculations.

- **Approach and passage speed variations for different right-turn lane characteristics.** Right-turn lanes have a variety of geometric and operational characteristics potentially affecting the approach and passage speeds that would benefit from additional research, including: driver behaviors, speed limits less than 30 mph (50 km/hr), turn-lane length, number of lanes, signal phasing, driveway access, and conflicting bicycles and pedestrians. While characteristics of right-turns are analogous to left turns, how they affect application of the calculations may be different. This research should also examine the significance of these potential effects and whether they could be practically applied to change and clearance interval calculations.

- **Passage speed variation on the path through an intersection from left or right-turns.** The approach to estimating the passage speed for a turning path through an intersection in the ITE Recommended Practice is based on the 85th percentile intersection entry speed. Additional empirical analysis of field data in comparison to theoretical values for small radii and the curvature of complex paths, along with guidance for application, would enhance understanding of these relationships.

- **Data collection methods for approach speeds of through movements compared to posted speed limits.** With the expansion of automated traffic signal performance measures programs, the ability to collect and archive intersection detection data, including vehicle speeds, is rapidly increasing. Supporting research would examine processes to use data from detector infrastructure to provide an expanded data set.
of approach speeds by lane, roadway classification, speed limit, under- and over-saturated traffic conditions, and area type.

- **Approach speeds on “non-posted” roadways and on roadway with speed limits of 35 mph (56 km/hr) or less.** There is need for development of supporting information to determine approach speeds for driveways, alleyways, short approaches, entrances to new developments, and other “non-posted” roadways. The proposed research should determine values and guidance for practical application for these types for roadways. Research should also examine the significance of these potential effects and measures of effectiveness associated with approach speeds and intersection entry under yellow or red signal indications.

- **Easy-to-implement method to determine the length of travel path through intersections for turning movements and complex intersection geometries.** Vehicles making turning movements or moving through complex intersection geometries typically do not follow circular paths. Research should also examine the significance of these potential effects and whether they could be practically applied to change and clearance interval calculations.

- **Effect of weather conditions.** Many jurisdictions implement special timing plans for inclement weather situations. An additional study opportunity could examine the significance of these potential effects and whether they could be practically applied to change and clearance interval calculations or assumptions.

- **Detectors.** Additional study would be useful on the effect of detector configuration in determining approach speeds in such cases as multi-detector designs for high-speed approaches, advance end-of-green warning, or dynamic red clearance extension.

If you are an educator or student in a university looking for a good research topic or a research sponsor seeking useful research to fund, the list above offers a wide range of ideas that would be valuable to both the transportation profession and the safety of the traveling public. 

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