OTREC
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EXPLORING THE EFFECTS OF ADAPTIVE TRAFFIC SYSTEMS

Researchers conduct an in-depth analysis of traffic performance and associated vehicular emissions, before and after the installation of a SCATS unit.

The Issue

In October 2011, a traffic signal management system called SCATS (Sydney Coordinated Adaptive Traffic System) was deployed on Southeast Powell Boulevard, a multimodal urban corridor connecting U.S. Highway 26 through Portland, Ore. The corridor is highly congested during morning and evening peak traffic hours.

The primary function of SCATS is to mitigate traffic congestion. Using sensors (usually inductive loops) at each traffic signal, the system tries to find the best cycle time and phasing along the corridor as traffic demand patterns change. In this integrated multimodal study, OTREC researchers looked at the corridor's traffic speed and transit reliability before and after the implementation of SCATS. In addition, a novel contribution of this study was to study the link between signal timing and air quality.

The Research

To determine the impact of SCATS on traffic and transit performance, researchers established and measured performance measures before and after SCATS. The researchers used data provided by TriMet, the Portland transit agency, to compare transit times before and after SCATS. They also used traffic volume data from two Wavetronix units that were installed by the City of Portland to collect traffic counts, speeds and classifications. For the air quality study, TriMet provided detailed vehicle characteristics (such as age and engine type) that proved to be important in locations near bus stops.

Overall, the traffic conditions before and after SCATS were significantly different in terms of speed and volume. SCATS did yield improvements in traffic speeds at one minor intersection even when traffic volumes showed an increase as well. The researchers found that the improvements brought about by SCATS vary depending on the time of day and the direction of travel.

THE ISSUE
A Sydney Coordinated Adaptive Traffic System (SCATS) was installed on a Portland, Ore. corridor. Researchers took advantage of its implementation to do a before-and-after study of the effects of SCATS on travel times and emissions.

THE RESEARCH
Researchers collected real-world detailed traffic signal timing data at 5 second intervals. They recorded:

- Traffic composition (heavier vehicles put out more emissions);
- Traffic speeds (travel times were measured at key intersections);
- Air quality (PM2.5 pollutant concentration data).

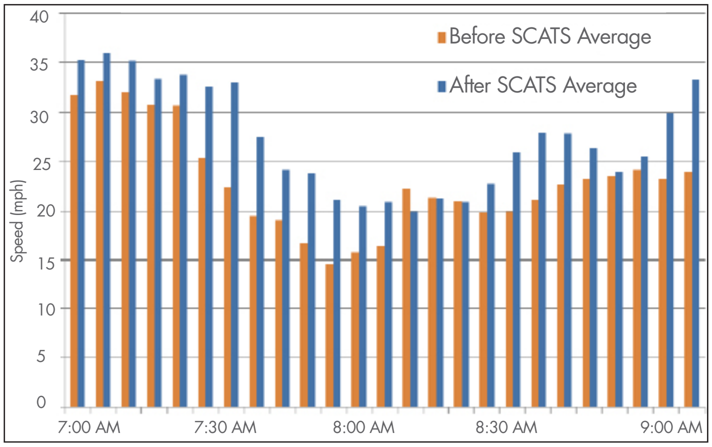
THE IMPLICATIONS
To a high degree, this research has shown that pedestrian exposure to fine particulate matter (less than 2.5 microns in diameter), which can pass through the small airways in a human lung, is related to traffic-signal timing, and can be considered as an outcome of traffic-signal timing decisions made by cities and counties.

Photo: Intersection near Powell Blvd in Southeast Portland, Ore.

Principal investigator Miguel Figliozzi and research assistant Courtney Slavin, both from Portland State University, set out to model for the first time the impact of signal timing and traffic volumes on air quality. This study is the first research effort to combine real-world detailed traffic signal timing data (at 5 second intervals) and PM2.5 pollutant concentration data. To determine the impact of traffic-signal timing on pedestrian exposure to particulate matter, a localized study was performed at the intersection of Southeast 26th Avenue and Powell Boulevard. A high school sits at the northeast corner of this intersection, and the intersection experiences high pedestrian, biking and transit activity during school start and release times.

The researchers also assessed how SCATS and transit signal priority, or TSP, affected each other. Powell Boulevard has been using TSP since 1994. TSP gives signal priority to buses in order to encourage the use of public transit by improving its travel time and reliability. Numerous studies have been conducted about SCATS or TSP, but none have addressed how SCATS functions simultaneously with TSP. Researchers Slavin, Feng, and Figliozzi found that TSP was not negatively affected by SCATS after controlling for both passenger demand and traffic conditions. Transit travel times were reduced in both directions during the off peak period, which covers most of the day. During the peak periods, improvements in travel time for the entire study corridor segment were observed in the afternoon eastbound direction, with mixed results in the morning westbound direction: some intersections showed improved travel times while others did not.

Implications



Difference in traffic speed during the AM peak period

This graph shows the average traffic speeds during the AM peak period before and after SCATS. The orange bars indicate the average speed before SCATS; the blue bars indicate the average speed following the installation of the SCATS unit.

Modeling results indicate that green time allocation and traffic volumes do have a significant impact on PM2.5 concentration levels. The impact of vehicle engine type is also clear. The model results show that reduction of bus idling time through more efficient operations and transit signal priority is likely to reduce pollution levels; in addition, the results show that TriMet initiatives to improve fuel efficiency by installing engine cooling devices not only improve fuel efficiency but also air quality. Researchers also found that bus-shelter design and orientation affects exposure levels for people waiting to catch the bus. In a shelter built facing away from the road, the levels of fine particulate matter are less than those in shelters facing the road.

PROJECT INFORMATION

TITLE: Integrated Multimodal Transportation, Air Quality, and Livability Corridor Study

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MORE INFORMATION
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