



A quantitative approach to assessing the efficacy of occupant protection programs: A case study from Montana



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ABSTRACT

Quantitative evaluation of vehicle occupant protection programs is critical for ensuring efficient government resource allocation, but few methods exist for conducting evaluation across multiple programs simultaneously. Here we present an analysis of occupant protection efficacy in the state of Montana. This approach relies on seat belt compliance rates as measured by the National Occupant Protection Usage Survey (NOPUS). A hierarchical logistic regression model is used to estimate the impacts of four Montana Department of Transportation (MDT)-funded occupant protection programs used in the state of Montana, following adjustment for a suite of potential confounders. Activity from two programs, Buckle Up coalitions and media campaigns, are associated with increased seat belt use in Montana, whereas the impact of another program, Selective Traffic Enforcement, is potentially masked by other program activity. A final program, Driver's Education, is not associated with any shift in seat belt use. This method allows for a preliminary quantitative estimation of program impacts without requiring states to obtain any new seat belt use data. This approach provides states a preliminary look at program impacts, and a means for carefully planning future program allocation and investigation.

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1. Introduction

Vehicle occupant protection is a critical component of public health (Subramanian, 2005), and seat restraint has been well documented as a major contributor to occupant protection (e.g., Houston and Richardson, 2005; Park et al., 2010). Despite the widely accepted efficacy of seatbelts in preventing automobile-related mortalities, improvement in occupant protection use rates in the United States has slowed in the last 15 years (NHTSA, 2015). Seat belt use among adults nationwide was 87% in 2013 (NHTSA, 2014), with compliance exceeding 90% in 19 states while compliance in Massachusetts, Mississippi, Montana, and South Dakota was below 75% (NHTSA, 2014). This variation across states is often attributed to differences in state-specific laws. In 2014, states with primary enforcement laws averaged 90% seat belt use; in contrast, states with secondary laws had 79% use overall. All states with compliance in excess of 90% had a primary seat belt law except for Nevada, whereas three of the four states with the lowest compliance did have a primary seat belt law (NHTSA 2014).

However, states also vary in their use of state-run occupant protection programs like selective traffic enforcement allocations, media campaigns, buckle-up coalition structure, and driver education.

Beyond enacting and enforcing statespecific laws, state and federal transportation agencies have confronted the stagnation in seat belt compliance rates with a suite of programs designed to increase seat restraint use, including selective traffic enforcement programs (Williams and Wells, 2004; Vasudevan, 2009), education (Shin et al., 1999; Snowdon et al., 2009), media campaigns like “Click It or Ticket” (Preusser Research Group, 2002; Solomon et al., 2004; Vasudevan and Nambisan, 2009), and local organizations and demonstrations (Nichols et al., 2009). However, while some programs like the Click It or Ticket campaign seem very effective (e.g., Insurance Institute for Highway Safety, 2010; Nichols et al., 2009), performance of an ensemble of programs operating together remains unclear. Thoughtful and rigorous program evaluations are necessary to identify efficient financial and time resource allocation among the competing programs and to guide further program development. Many existing examples of rigorous program evaluation hinge on acquisition of new data that isolate program effects (e.g., Pulugurth and Repaka, 2008; Rice et al., 2009

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Here we present an analysis using the nationally available National Highway Traffic Safety Administration (NHTSA) seat belt survey data to evaluate the impacts of local occupant protection programs on seat restraint use in the state of Montana from 2010 to 2012, a period of time for which all necessary records were available and state occupant protection program activities were relatively consistent. Although seat restraint use was on the rise in Montana prior to 2002 (Montana Department of Transportation, 2011), it has since stagnated at between 75% and 80% compliance, reaching a peak of 79.2% in 2009 before declining to 74.6% in 2013; NHTSA, 2014). In 2013, the Montana Department of Transportation (MDT)'s stated goal was to increase annual observed compliance rates to 89.3% by 2015.

MDT runs a mixture of occupant protection programs intended to complement the state's secondary seat restraint law. Education, outreach and enforcement are all key to increasing seat belt usage (Williams and Wells, 2004; Vasudevan and Nambisan, 2005; Houston and Richardson, 2006; Vasudevan, 2009), and MDT programs target each of these strategies. The Montana Office of Public Instruction (OPI) provides voluntary driver education instruction throughout the state. State-sponsored media campaigns are enacted at regular intervals throughout the year. MDT's Selective Traffic Enforcement Program (STEP) provides financial resources to applicant enforcement agencies which allow for additional targeted enforcement efforts as deemed necessary by enforcement personnel. Buckle up Montana (BUMT) coalitions operate throughout the state disseminating information and raising seat belt awareness. In this investigation, we present a statistical model evaluating the efficacy of each of these programs at increasing seat restraint use in Montana.

2. Materials and methods

2.1. Data preparation

Our analysis hinges on the assumption that "effective" programs lead to increased seat belt use in the surrounding area. Our dependent variable in this analysis was seat belt use at a set of sites throughout Montana from 2010 to 2012, as measured through NHTSA's National Occupant Protection Usage Survey (NOPUS). NOPUS sampling is conducted at sites across the United States. Survey events are controlled for time of day and day of week, and are conducted at the same sites every

late-April/early-May and every June. In Montana, there are 120 NOPUS sites (12 interstate highway sites, 24 National Highway System (NHS) sites, 20 secondary/county sites and 64 city sites; Fig. 1). These sites are located in 30 of Montana's 56 counties, and in 19 cities/towns throughout the state. Fifty-five of the 120 sampling sites are in regions the U.S. Census Bureau classifies as rural (U.S. Census Bureau, 2010). Data came from six different NOPUS sampling events in April and June of 2010–2012. Sample sizes and compliance rates for each sampling event are summarized in Table 1. Because NOPUS is collected at numerous sites throughout the state and each site is subject to a unique ensemble of occupant protection program activities, NOPUS data provided a means of comparing program influences on compliance rates.

A covariate set containing independent variables quantitatively describing local activity for each MDT program (e.g., OPI driver education activity, media campaign activity, STEP activity, BUMT coalition presence) was constructed for each NOPUS site, as well as relevant confounding variables (e.g., road type, local socioeconomic and demographic metrics, weather condition).

To measure driver education "effort" associated with each NOPUS survey site, we compiled school-district-level information on driver education completion rates using the Montana Office of Public Instruction's Growth and Enhancement of Montana Students (GEMS) tools. (Montana Office of Public Instruction 2010–2012). MDT's Selective Traffic Enforcement Program (STEP) is a grant-based program that provides resources for additional officer-hours aimed at targeting high-traffic or high-risk events (for example, holidays, college football games, arts festivals, etc.). STEP activity occurs at three spatial scales, municipality, county, and Department of Justice region, and most specific decisions about STEP allocations are left to the jurisdiction awarded the grant. STEP hours were summed over the municipality, county, and Department of Justice region overlapping each NOPUS site in each study year to reflect overall local STEP activity. BUMT coalition presence was incorporated as an indicator variable: if a NOPUS site was located in a county with an active BUMT coalition, the BUMT variable was set to 1; otherwise it was set to 0. Media effort was measured as the sum of all paid and earned media expenditures in the media area into which a particular NOPUS site fell. MDT concentrates its media effort during the month of May in a major pre-summer media campaign. Therefore, compliance improvements between April surveys and June surveys were attributed to

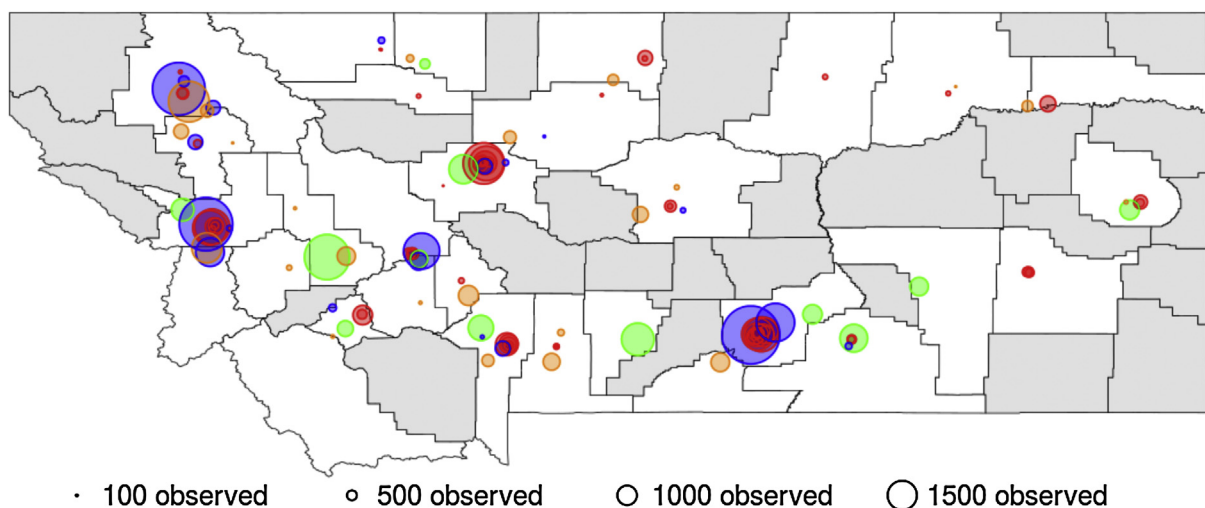


Fig. 1. NHTSA seat belt survey sites and average number of responses observed for 2010–2012. Point size gets larger as the average number of individuals observed at each sampling site increases. Red points are city road sites, green points are Interstate sites, blue points are secondary/county road sites, and orange points are US highway sites (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.).

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