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**RESEARCH PROJECT TITLE**

Evaluation of Messaging Techniques to Increase Vehicle Spacing at Work Zones

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The Smart Work Zone Deployment Initiative (SWZDI) is a transportation pooled fund that supports research investigations into better ways to improve the safety and efficiency of traffic operations and highway work in work zones. The primary objective is to promote and support research and outreach activities that focus on innovative policies, processes, tools, and products that enhance the implementation, safety, and mobility impacts of work zones. The fund is administered by Iowa State University's Institute for Transportation, and the lead agency is the Iowa Department of Transportation.

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# Evaluation of Messaging Techniques to Increase Vehicle Spacing at Work Zones

tech transfer summary

Messaging strategies designed to mitigate tailgating in work zones and the consequent risk of rear-end collisions can greatly improve work zone safety.

## Objectives

This project aimed to develop novel anti-tailgating messages for deployment in work zones, assess the emotional resonance and comprehensibility of the messages through user surveys, and evaluate the effectiveness of the developed messaging strategies in real-world work zones.

## Background

Following too closely—or tailgating—drastically reduces drivers' reaction time to sudden braking by the vehicle in front or unexpected changes in traffic flow, which can lead to rear-end collisions.

Tailgating can be particularly problematic in work zones, which are characterized by complex, dynamic, and unfamiliar driving environments and inconsistent speeds among vehicles. Perhaps unsurprisingly, rear-end collisions are the most common type of crash in work zones.

Maintaining sufficient car-following distances allows drivers enough time to react to unexpected and complex situations and thus can reduce the potential for rear-end collisions.

## Problem Statement

The unique challenges posed by work zones, coupled with the inherent dangers of tailgating, require proactive intervention. However, few studies have focused on strategies and interventions that specifically target tailgating in work zones.

Anti-tailgating messaging strategies are needed that can help mitigate tailgating tendencies in work zones and the consequent risk of rear-end collisions.

## Research Description

This research was conducted in two phases.

In the first phase, anti-tailgating signs and messages for both fixed signs and dynamic message signs (DMS) were devised by a panel of traffic safety professionals, traffic engineers, and academic researchers. The signs and messages were then evaluated for clarity and emotional response through a three-stage survey of potential users.

In the first stage, participants rated 8 signs designs and 12 messages for their comprehensibility and the emotional reaction they invoked. Messages that rated highly in terms of comprehension and positive sentiment were shortlisted for the subsequent surveys.

In the second and third stages, participants expressed their interpretation of each shortlisted message but were not provided with the survey's purpose or the messages' intent. The second stage featured a multiple choice survey, and the third stage featured an open-ended survey.

In all three stages, the surveys intermingled standard (in-use) and experimental signs and included five questions regarding the driving experience and linguistic background of the respondents.

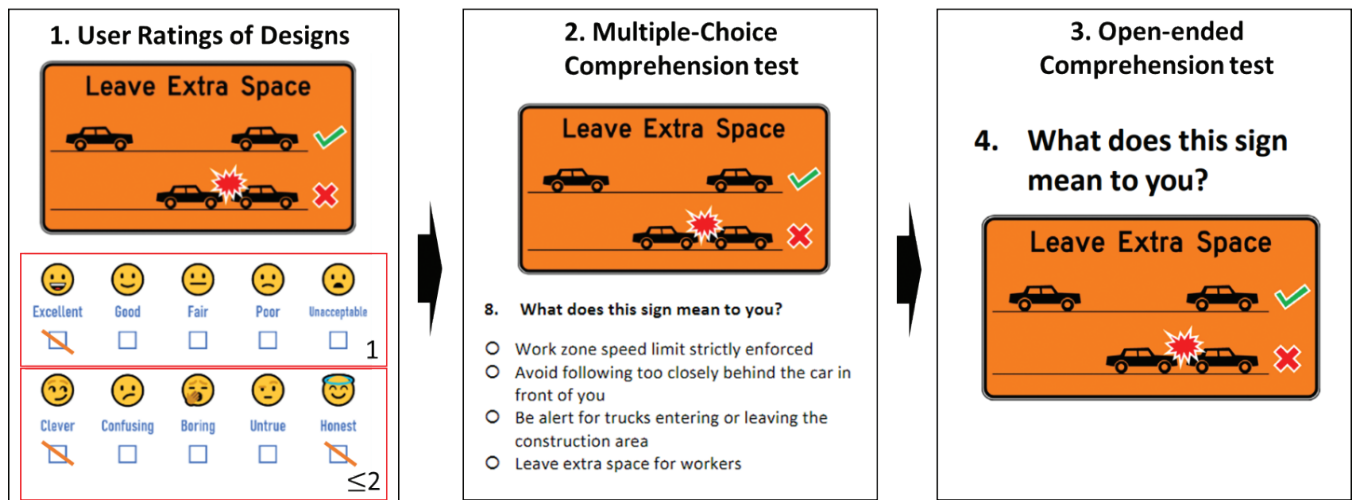
In the second phase, one fixed sign and a rotation of five daily anti-tailgating DMS messages were selected for field testing based on the survey results.

Field tests were conducted at two construction sites: a single-lane closure site on US 30 and a shoulder closure

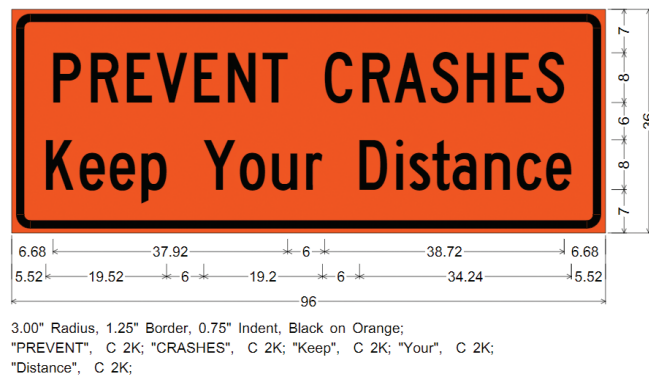
site on I-80 where lane changes were allowed. At both sites, traffic sensors were placed both upstream of and directly inside the work zone to record traffic volumes and two key performance metrics: average headway and probability of tailgating occurrence.

At the single-lane closure site, two fixed signs and an overhead DMS were placed upstream of the work zone at different times. Driver behaviors were measured in four periods: pre-installation, only DMS, overhead DMS and fixed signs, and only fixed signs.

At the shoulder closure site, two portable DMS (PDMS) and two fixed signs were placed upstream of the work zone at different times. Driver behaviors were measured in three periods: pre-installation, only PDMS, and only fixed signs.



Three-stage survey process



Fixed sign used in the field studies



Five DMS messages used in the field study

## Key Findings

- In the surveys of potential users, positive messages—such as PREVENT CRASHES and KEEP YOUR DISTANCE—demonstrated high intelligibility and evoked positive impressions.
- Negative-toned messages—such as NO TAILGATING—and specific numerical values for recommended following distances—such as STAY 200 FEET APART—were often perceived as confusing.
- Signs featuring graphics alone received lower comprehension scores than text-based signs, but this finding must be interpreted with caution. The survey participants were almost entirely native English speakers who were presumably comfortable reading signs in English, and the surveys did not capture the fact that graphical traffic signs typically have a much greater legibility distance than text-based signs.
- In the single-lane closure site on US 30, the use of overhead DMS, fixed signs, or a combination of both led to a significant increase in average headway within the work zone compared to upstream locations. Additionally, a marked decrease in severe tailgating events was observed with the installation of fixed signs.
- In the shoulder closure site on I-80, where lane changes were allowed, the implementation of both PDMS and fixed signs was found to have a positive impact on traffic safety. The average headway markedly increased in both lanes, and the probability of tailgating occurrences decreased in the right lane.

## Implementation Readiness and Benefits

Messaging strategies aimed at mitigating tailgating in work zones and the consequent risk of rear-end collisions can greatly improve safety in work zones, where rear-end collisions are the most frequent crash type.

The results of this study provide a foundation for improved work zone safety strategies. One fixed sign and five anti-tailgating messages that potential users found comprehensible and emotionally resonant were found to decrease tailgating when installed in active work zones.

Messaging strategies to reduce tailgating in work zones can be further refined through evaluating the effectiveness of graphical fixed signs in the field, optimizing the placement and configuration of DMS and PDMS, and creating mechanisms to target tailgaters specifically, potentially via vehicle alerts or precision-driven messaging.