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Evaluating an intervention to improve belt fit for adult occupants: Promoting positive beliefs☆

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ABSTRACT

Introduction: Seat belt use provides significant public health benefit, however, most public awareness campaigns have generally focused on seat belt use rather than encouraging adults to improve seat belt fit with belt placement. This study provides an evaluation of a video-based intervention to improve adult belt fit assessing whether a video-based intervention can target beliefs and knowledge of seat belt placement and be perceived as relevant by the target audience. *Method:* An intervention group of 29 adults (15 women and 14 men) and a comparison group of 99 adults (41 women and 47 men) participated. *Results:* The intervention group had significantly more favorable beliefs around belt fit than the comparison group related to Health Belief Model constructs of higher self-efficacy, greater benefits, and fewer barriers. The intervention group was also significantly better at accurately drawing belt fit than the comparison group. The video intervention was described as relevant, interesting, and the intervention group favored the provision of a diverse sample of models in the intervention. *Conclusions:* Overall, the study provides insight into relevant target beliefs for an intervention focused on belt fit and suggests that a brief video-based intervention in the style of a public service announcement may be effective in promoting positive beliefs and knowledge around belt fit. Future efforts should confirm these findings with a larger sample size spanning multiple geographic and demographic areas. *Practical applications:* These findings can help better inform intervention initiatives to improve occupant belt fit.

1. Introduction

Seat belts were estimated to save as many as 13,941 lives among passenger vehicle occupants in 2015 (National Center for Statistics and Analysis, 2016). With use, a lap/shoulder seat belt reduces injury risk among front-seat passenger car occupants by 45% and the risk of a moderate-to-critical injury by 50% (Dunn, Holliday, & Vegega, 2016). Primary seat belt laws, high visibility enforcement, and fines have led to increased seat belt use in recent years (Nichols, 2010), with rates of observed use across the United States at 88.5% in 2015 (Chen & Webb, 2016). Despite the demonstrated effectiveness of seat belts, very few studies consider the "goodness" of seat belt fit.

Belt fit has an influence on occupant kinematics and injury risk in crashes. Suboptimal belt fit potentially diminishes the effectiveness of the belt restraint. In a frontal crash, the optimal performance of the belt system includes rapid loading of the lap portion by the bony pelvis and the loading of the shoulder belt to the bony landmarks at the sternum and clavicle. Placing the lap belt high or forward introduces slack by routing the belt further away from the underlying skeletal structures. Yet, Fong, Keay, Coxon, Clarke, and Brown (2016) characterized belt fit in participants' own vehicles and found only 35% achieved overall good fit (both lap and shoulder belt). Odds of poor belt fit were associated with greater body mass index (BMI) and being female. Such findings suggest a need for an effective intervention to raise awareness and motivate improved seat belt fit to promote maximal protection in the event of a crash that is relevant for individuals of varying demographics, body size, and shape. Also, laboratory data from repeated trials has suggested that some drivers might be able to place the belt lower, in a more optimal position (Reed, Ebert, & Hallman, 2013). Further, Poplin et al. (2015) recommend countermeasures to prevent hollow-organ abdominal injuries that focus on improved seat belt placement.

The use of Public Service Announcements (PSAs) that include combined video and audio messaging is a common and effective method to promote traffic safety behaviors (Delhomme et al., 2009). A meta-analysis of 228 studies conducted in 14 countries identified overall effectiveness of traffic safety campaigns including campaigns to increase seat belt use, reduce overall road crashes, and increase comprehension of risk (Phillips, Ulleberg, & Vaa, 2011). Review and meta-analysis studies have identified a number of planning steps that increase the

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likelihood such efforts are effective, including development using behavior change theories (Delhomme et al., 2009). The purpose of such theories is to provide a conceptual framework of the determinants of a health behavior. A behavioral theory is successful if it informs the design of and effective programs that engages the public with content that is meaningful and relevant (Coatsworth, Szapocznik, Kurtines, & Santisban, 1997; McCord & Tremblay, 1992). A theoretical construct that combines quantitative and qualitative understanding of how individuals may modify behavior gives campaign designers insight into the perceptions and perspectives of target audiences (Buckley & Sheehan, 2004).

The current study describes the development and testing of an intervention designed using a theory-based approach to health-behavior messaging. The intervention was a short video (with audio) that could be suitable for a PSA. Delhomme et al. (2009) highlight that theories that predict behavior and include elements from the Health Belief Model (HBM) are often used in traffic safety research and campaigns. The underlying concept of the HBM is that health behavior is determined by personal beliefs or perceptions including: recognition of harm (i.e., perceived susceptibility to, and perceived severity of, an injury due to poor belt fit) and that changing behavior reduces exposure to the harm with such reduction outweighing associated costs (e.g., inconvenience). The theory suggests that individual perception (*susceptibility, severity*), modifying factors (*environmental factors* that exacerbate threat), *self-efficacy*, and *cues to action* prompt behavior or *likelihood of action*. The *likelihood* of *action* is affected by the individual's perceptions of *benefits* and *barriers* to behavior (improved belt fit).

There is a lack of data about beliefs and motivations that affect seat belt fit (Fong et al., 2016). Although the HBM has not previously been applied to promoting seat belt fit, the HBM constructs have been applied to understanding and evaluating other transportation safety behaviors, including the use of a seat belt (compared with no use). While focusing on alternative theoretical frameworks, other studies have shown change in HBM constructs including self-efficacy and consideration of costs and/or benefits (akin to benefits and barriers) that promoted seat belt use (Brijs, Daniels, Brijs, & Wets, 2011; Nathanail & Adamos, 2013). Further research has shown barriers to seat belt use (e.g., being "user-friendly") and benefits (e.g., they decrease injury in the event of crashes) are associated with use (Fernandes, Hatfield, & Job, 2010; Şimşekoğlu & Lajunen, 2008). The salience of risk of injury from failure to wear seat belts has also been associated with increased use (Weinstein, Grubb, & Vautier, 1986). The study seeks to understand beliefs associated with seat belt fit as operationalized from the HBM as well as understanding design features such that they are relevant to the target audience. In order to meet this aim, both quantitative and qualitative research methods were employed to focus on understanding issues associated with design and to inform future intervention development.

The aim of the current study is to provide a preliminary investigation into the design and effectiveness of a PSA to promote improved seat belt fit. The study includes an intervention group who received a video-based intervention developed to target HBM constructs and principles of belt fit, as well as a comparison group who did not receive the intervention. The intervention was evaluated by examining differences in reported HBM constructs, as well as knowledge demonstrations of seat belt fit between the intervention and comparison groups. Further knowledge outcomes and perceptions of the value of a video-based intervention were explored qualitatively.

2. Materials and methods

The protocol was approved by the university's Institute Review Board and all participants provided informed consent prior to participation. All participants were licensed, adult drivers who owned a vehicle. The sampling and recruitment differed between the intervention and comparison group and the approaches are described below. Regardless of group, all participants undertook a pen-and-paper survey of demographics, a survey of the Health Belief Model (HBM) constructs, and a knowledge demonstration.

2.1. Intervention group

Intervention participants were recruited through local advertisements, including community noticeboards, and university study websites. Intervention participants were stratified based on gender, body mass index classification (obese and normal weight participants), and age (participants over and under age 65 years). All intervention participants completed the protocol in January 2016 and were compensated for their participation. To avoid drawing attention to the seat belt before the baseline measurement, participants were told only than they were volunteering for a study evaluating vehicle components, specifically safety devices in the vehicle (e.g., air bags). Standard anthropometric measures were taken on each participant to characterize overall body size and shape. Participants viewed the intervention on a hand-held tablet as part of a quantitative belt-fit study (Jones et al., submitted for publication). Belt fit was measured before and after the intervention in participants' vehicles and in a laboratory mockup. Immediately after viewing the video intervention, participants were also instructed to self-report their thoughts and considerations while they donned a seat belt in the laboratory setting. Specifically, they were also asked to verbally describe the points of placement of their belt as they donned the belt. Participants then undertook the pen-and-paper survey of HBM constructs, knowledge demonstration, and perceptions of the intervention. The intervention group included 29 adult drivers (15 women and 14 men); 15 were obese (BMI $\geq$ 30 kg/m^2) and 14 were 65 years or older (mean age = 62 (SD = 14)).

2.2. Comparison group

Participants in the comparison group were recruited from flyers and surveys placed in the waiting room of offices and at a stall that was part of an exhibition for university facilities that could be used for automated vehicle testing. Beside the flyers were consent forms and surveys which enabled participants to complete the survey immediately. They were not compensated for their time. Comparison group participants completed the pen-and-paper survey of HBM constructs and knowledge demonstration between January and April of 2016. The comparison group comprised 99 adult drivers (41 women and 47 men); 13 were obese (BMI > 30 kg/m^2) and 23 were 65 years or older (mean age = 44 (SD = 21)), based on self-report.

2.2.1. Intervention

An inter-disciplinary team of experts, including automotive safety experts, injury biomechanics researchers, behavior psychologists, and communication and video production specialists were consulted to develop short video that presented the most important aspects of good belt fit. The objective of the video was to increase knowledge about the benefits of seat belts and how to wear them correctly and provide the motivation to wear their belt optimally (as operationalized from HBM constructs). The three key belt fit concepts conveyed in the video were:

1) Lap belt low on hips, touching the thighs.
2) Shoulder belt crossing middle of collarbone.
3) Belt snug, as close to bones as possible.

Fig. 1 shows stills of the video that illustrate these concepts.

Multiple revisions of the script for the video-based intervention were undertaken and reviewed by the experts. A pilot test was conducted to assess terminology for the anatomical reference of the belt position, to consider the video tutorial script, and consider proposed graphics. A convenience sample of 24 community participants provided

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