

Special issue on warnings: Advances in delivery, application, and methods



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ABSTRACT

This special issue of *Applied Ergonomics* concerns the topic of warnings, safety communications designed to decrease harm to people and property. The field has evolved over time, and with it there has been advancement in knowledge and application. The current special issue contains 14 articles that reflect three distinguishable areas within the warnings literature where such changes are taking place in the laboratories and workplaces of our international colleagues: (1) multimodality of warning delivery, (2) emerging application areas, and (3) new methodology. This special issue brings together a set of studies investigating various factors that might impact safety behavior in diverse settings and domains where warnings are likely to be encountered. It is our hope that the special issue will motivate to development and exploration of new ideas regarding warning design and their use in a variety of applications that improve safety.

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As the field of human factors/ergonomics (hf/e) has matured over the last several decades, a large body of research has been published on warnings. In general, warnings are safety communications designed to decrease harm to people and property. The topic of warnings has been explored in hundreds of research articles written in various journals as well as several comprehensive books (e.g., Lehto and Miller, 1986; Edworthy and Adams, 1996; Rogers et al., 2000; Laughery and Wogalter, 2006; Wogalter, 2006a).

This special issue of *Applied Ergonomics* concerns the topic of warnings. The field has evolved over time, and with it there has been advancement in knowledge and application. The current special issue reflects three distinguishable areas within the warnings literature where such changes are taking place in the laboratories and workplaces of our international colleagues: (1) multimodality of warning delivery, (2) emerging application areas, and (3) new methodology.

To assist in organizing the fourteen articles that comprise this special issue, we used the most recent iteration of the communication-human information processing (C-HIP) model (see Wogalter, 2006b). The C-HIP model depicted in Fig. 1 has two main sections each with several component stages. The first section of the framework uses a communications framework to focus on a warning message being sent from one entity (i.e., the source) to

another (i.e., the receiver) through some channel(s). The second section of the model focuses on the receiver and how people internally process information. This section interfaces with the first through effective delivery of the warning to individuals who are the target audience. When warning information is delivered to the receiver, processing may be initiated, and if not blocked in some way, will continue across several stages: from attention switch, attention maintenance, comprehension and memory, beliefs and attitudes, motivation, and possibly ending in behavior.

At first glance the 14 articles included in this special issue may seem to address widely diverse topics. However, closer inspection reveals that each article fits into three broad topic areas as described above: (1) multimodality of warning delivery, (2) emerging application areas, and (3) new methodology. According to the C-HIP model, effective warnings must be delivered to the at-risk receiver via sensory channels. Much of the past research on warning modality has focused on visual and auditory channels (Cohen et al., 2006), yet recent research published in *Applied Ergonomics* has highlighted the complex interactions that impact task performance when cross-modal warnings such as combinations of visual, auditory, and tactile cues are used to warn users (Lees et al., 2012).

1. Multimodality of warning delivery

The first five articles introduce research efforts that explore the utility of single and dual modes of warnings to communicate safety

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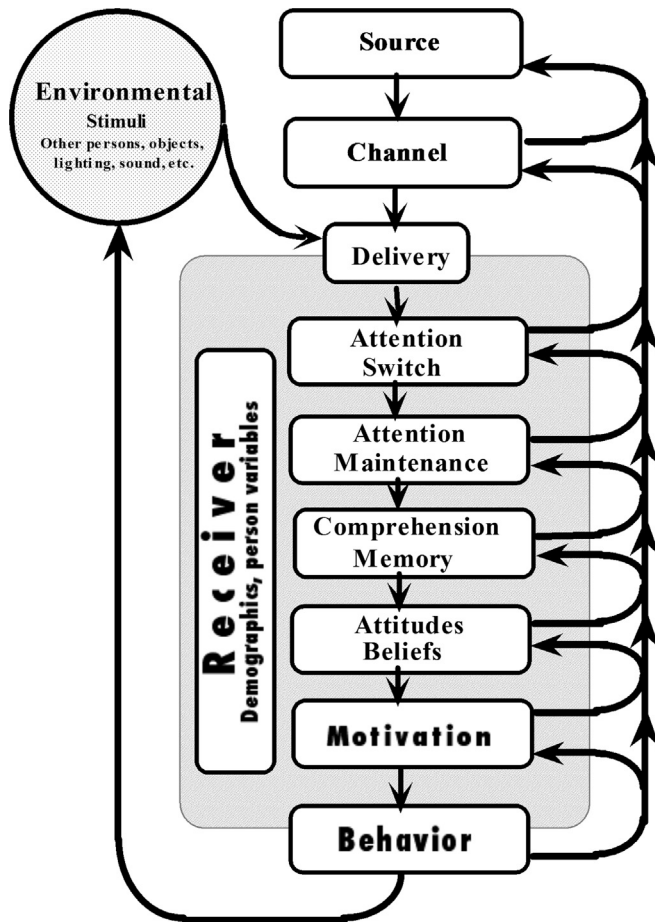


Fig. 1. Communication-Human Information Processing (C-HIP) Model (from Wogalter, 2006a). Cindy Carrelli contacted at Taylor and Francis on 1/7/14. Permissions pending from Copyright Clearance Center.

information. Baldwin and Lewis map hazards across modalities to create an effective driver interface. Bliss and Chancey describe two laboratory experiments that explored whether various types of training influenced user response to visual warnings delivered by a computerized interface designed to mimic building security systems. McDougald and Wogalter investigate whether highlighting of pictorial cues delivered as visual warnings can facilitate warning comprehension. Edworthy et al. assessed the utility and learnability of a number of auditory alarms used in international medical equipment. Schmunzsch, Sturm, and Roetting describe the development and usability testing of a multi-modal warning prototype that delivers visual, auditory, and tactile feedback.

2. Emerging application areas

Although the first five papers address mode of delivery, they also entail a variety of delivery applications. Thus, there is some overlap with the second section of the special issue concerning emerging application areas. Six articles describe new application areas where warning research is used. Wogalter, Lim, and Nyeste describe research with quiet electric vehicles where the lack of auditory cues poses a hazard to pedestrian safety. Turner, Wylde, Langham, and Morrow address another aspect of traffic safety: how the visual flash patterns of emergency service vehicles can be manipulated to convey enhanced urgency. Also related to

emergency situations, Hellier and colleagues evaluate an emergency preparedness leaflet that targets the public and they present a set of research-based design guidelines that can be used to improve message memorability and comprehension in these mass-produced safety messages. Wogalter, Shaver, and Kalsher examine how multimodal direct-to-consumer (DTC) televised prescription drug advertisements can affect comprehension and attention. Carpenter, Zhu, and Kolimi elaborate how the use of warnings can serve a protective function in computerized environments where socially engineered attacks such as phishing scams might prompt users to put personal identity information at risk. Oron-Gilad, Hancock, and Helmick-Rich describe how warnings can be utilized in military environments where working memory demands tend to be high due to multi-tasking.

3. New methodologies

Although all the aforementioned studies use recognized experimental methodologies to explore warning effectiveness, the third section includes three articles that use rare or underutilized approaches to warnings research. As the C-HIP model and previous literature suggests, individual differences are important to consider when warning messages are being designed (see McLaughlin and Mayhorn, 2014). Unfortunately, there has not been much research that investigates how warnings should be designed to protect some of our most vulnerable users: children (Kalsher and Wogalter, 2008). Waterson uses qualitative methods to assess the warning needs of young children (aged 5–11 years) and provides a list of topics to spur research involving young children as receivers of safety messages. Jiamsanguanwong and Umemuro explore how affective state can influence the comprehension and hazard perception of industrial pictorials. Duarte, Rebelo, Teles, and Wogalter describe the use of a virtual reality (VR) system that enables measurement of behavioral compliance to warnings without placing users at risk.

This special issue brings together a set of studies investigating various factors that might impact safety behavior in diverse settings and domains where warnings are likely to be encountered. These studies are important in that they address a relatively under-explored area of multimodal warning delivery in a variety of applications. Moreover, a number of methodological innovations that highlight the need for diverse receiver samples and warning variable manipulation are described. Although there is considerable diversity of methods and findings across the specific articles, they generally fit within the global C-HIP model. It is our hope that the special issue will motivate to development and exploration of new ideas regarding warning design and their use in a variety of applications that improve safety.

Finally, we wish to make a few acknowledgments. All of the articles in this special issue originated from a public call for proposals initiated at the forward-thinking request of the late Editor-in-Chief of *Applied Ergonomics*, Professor John Wilson. Following the recent loss of our esteemed colleague, Dr. Pascale Carayon stepped up to serve as the Co-Editor-in-Chief for the journal which allowed for a seamless progression of tasks that allowed the special issue to progress to completion. Moreover, we wish to acknowledge the efforts of our reviewers who volunteered their time (with a minimum of reminding) and assisted in making excellent suggestions for improving the articles from the time they were originally submitted as manuscripts to their final acceptance. To avoid a conflict of interest, the editors of the special issue did not take part in the review process (beyond assigning manuscripts for blind review). We would also like to thank the journal's administrative staff including Ms. Lynne Mills and Elsevier staff members including

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