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A meta-analysis of the effects of texting on driving

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ABSTRACT

Text messaging while driving is considered dangerous and known to produce injuries and fatalities. However, the effects of text messaging on driving performance have not been synthesized or summarily estimated. All available experimental studies that measured the effects of text messaging on driving were identified through database searches using variants of "driving" and "texting" without restriction on year of publication through March 2014. Of the 1476 abstracts reviewed, 82 met general inclusion criteria. Of these, 28 studies were found to sufficiently compare reading or typing text messages while driving with a control or baseline condition. Independent variables (text-messaging tasks) were coded as typing, reading, or a combination of both. Dependent variables included eye movements, stimulus detection, reaction time, collisions, lane positioning, speed and headway. Statistics were extracted from studies to compute effect sizes (r_c). A total sample of 977 participants from 28 experimental studies yielded 234 effect size estimates of the relationships among independent and dependent variables. Typing and reading text messages while driving adversely affected eye movements, stimulus detection, reaction time, collisions, lane positioning, speed and headway. Typing text messages alone produced similar decrements as typing and reading, whereas reading alone had smaller decrements over fewer dependent variables. Typing and reading text messages affects drivers' capability to adequately direct attention to the roadway, respond to important traffic events, control a vehicle within a lane and maintain speed and headway. This meta-analysis provides convergent evidence that texting compromises the safety of the driver, passengers and other road users. Combined efforts, including legislation, enforcement, blocking technologies, parent modeling, social media, social norms and education, will be required to prevent continued deaths and injuries from texting and driving.

1. Introduction

Texting while driving has attracted considerable media attention and intense public interest. Media stories typically describe crashes that result in deaths or injuries of drivers who may have been texting at the time of a collision. For example, the pain and suffering of friends and family following texting-related crashes is shown in the video *One Minute to the Next* by Werner Herzog (New York Times, 2013). Other stories typically cite a well-known study that found drivers are 23 times more likely to crash while texting (Ritchell, 2009), drawing on work from the Virginia Tech. Transportation Institute (VTTI) who found that text messaging increased the odds of being involved in crash, near miss or incident for truck drivers (Olson et al., 2009).

Attention to this issue is justified. At any given time in the U.S., an estimated 1.0% (or 135,300) of all drivers are observed manipulating a handheld device, which includes texting and dialing (NHTSA, 2009). As a category of distraction, texting and driving is increasing. Year over year increases in text messaging while driving were related to increases in the number of fatalities in the Fatality Accident Reporting System (FARS, U.S.) from 2002 to 2007 (Wilson and Stimpson, 2010). Based on regression analysis, an estimated 16,141 *additional* fatalities resulted from texting while driving over this time period.

In 2011, distraction was a contributing factor in about 10% of all driver fatalities and 17% of injuries in the U.S. (NHTSA, 2013), with drivers 15–19 years of age representing the highest proportion of distracted drivers (WHO, 2011). Among U.S. high school students,

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45% reported texting and driving in 2012 (Olsen et al., 2013), which is an increase from 26% of 16 and 17 year olds in 2009 (Madden and Lenhart, 2009). In certain college samples, 92% of respondents reported reading texts while driving (Atchley et al., 2011). Of all adults in 2010 in the U.S., 31% said they have "sent or read a text while driving" (Centers of Disease Control and Prevention, 2011), while in Europe, the self-reported frequency of texting "regularly or fairly often" or "at least once" in the past 30 days ranged from approximately 15 to 31%.

Understanding the impact of texting on driving performance and, in turn, on traffic safety and public health, remains an important area of research. A number of studies have examined how texting adversely affects driving performance, with a modest body of experimental research involving driving simulation and on-road studies. The general consensus is that those drivers who look away from the road for prolonged periods of time do not control their vehicles sufficiently (Hosking et al., 2009; Owens et al., 2011). However, there has not yet been a thorough examination of the empirical research to expand on how texting affects the specific tasks necessary for safe driving, which driving behaviors are most adversely affected, how effects vary across studies and populations, and where changes might be implemented to reduce harm. Toward these ends, the aim of this meta-analysis is to systematically characterize the impact of reading and typing text messages on driving with the overarching goal of improving traffic safety.

2. Method

The format and content of this paper are in accord with the PRISMA meta-analysis guidelines including: title, structured abstract, introductory rationale, methods (i.e., information sources, selection strategy, inclusion criteria, coding, measures and statistics), results (i.e., synthesis and consideration of bias), discussion (i.e., summary, limitations and conclusions), and funding sources (Moher et al., 2009).

2.1. Data sources and search strategy

Using key word variants of "driving" and "text messaging" (e.g., driv*, messag*, text*, sms*), a number of databases were searched for studies without restriction on year of publication through January 2014, including Embase, PubMed, MEDLINE, and Web of Science. In addition, targeted journals (*Accident Analysis and Prevention*, *Human Factors*, *Traffic Injury Prevention*), conference proceedings (e.g., Human Factors and Ergonomics Society, Transportation Research Board, Driving Assessment), and government web sites (e.g., National Highway Traffic Safety Administration, NHTSA) were also searched for 'grey' literature (e.g., technical reports, proceedings papers). A backtracking or *ancestry* approach from reference sections was also used to identify additional studies.

2.2. Study selection

The selection of studies for inclusion in the meta-analysis is illustrated in Fig. 1. Abstracts returned from searches and backtracking ($N = 1476$) were screened by applying general criteria that a study must focus on text messaging and driving. Complete publications ($n = 82$) were further analysed to determine whether a study met the a priori criteria for inclusion. First, a study had to measure driving performance, which was defined as controlling a vehicle, simulation or proxy task. Second, study participants had to be driving and reading or writing text messages compared to a baseline or control condition. Texting was defined as reading and/or typing messages as well as associated device manipulation and interface

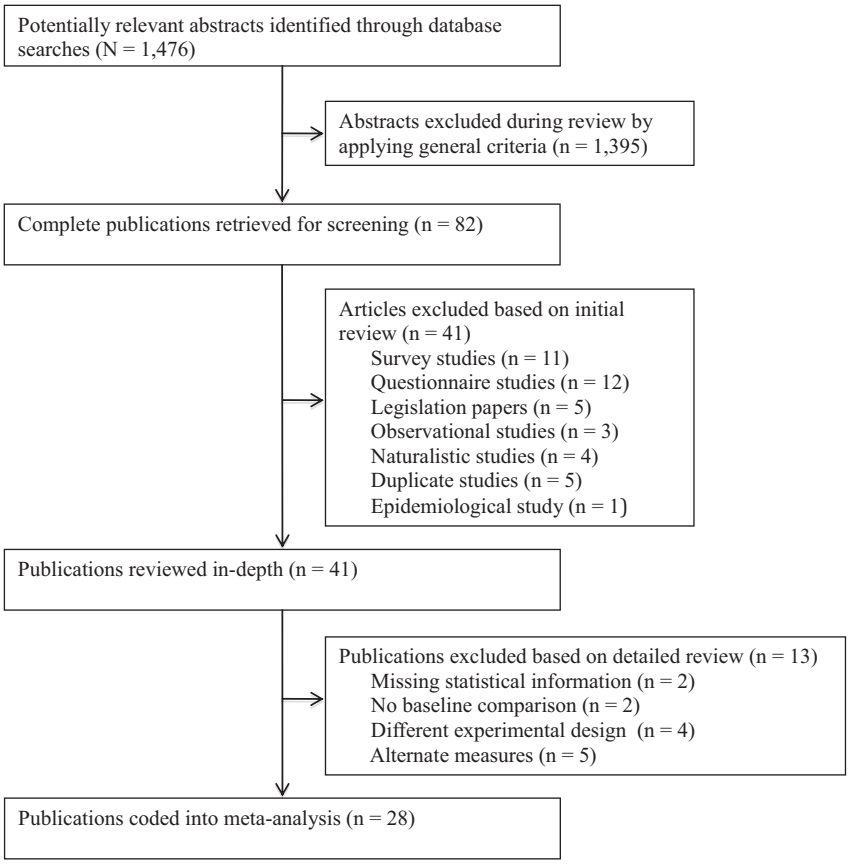

Fig. 1. Search flow and selection of publications included in the meta-analysis.