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COGNITIVE ABILITIES ASSOCIATED WITH CHANGING RISK PERCEPTIONS OF DISTRACTED DRIVING

By

Blair R. K. Shevlin

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Chairperson, Thesis Committee Signature	Kerri Goodwin Type Name	4/27/17 Date
Committee Member Signature	Geoffrey D. Munro Type Name	4/27/17 Date
Committee Member Signature	Rick Parente Type Name	4/27/17 Date

Janet V DeLany Dean Graduate Studies May 10, 2017

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Abstract

Cognitive Abilities Associated with Changing Risk Perceptions of Distracted Driving

Blair R. K. Shevlin

Distracted driving is a major threat to traffic safety, especially among young drivers. One way to discourage this behavior is to target young drivers' perceptions of the risks associated with distracted driving behaviors. However, risk-related information is too-often presented using unintuitive content in difficult-to-comprehend formats, which negatively impacts those with low levels of cognitive ability. The objective of this study was to examine the impact of utilizing visual aids as a means of improving young drivers' comprehension of statistical information related to texting while driving. This study also evaluated how different informational content and format could alter young drivers' perceptions, attitudes, and intentions towards the decision to text while driving. This study found that the visual aids that were used were generally ineffective in improving viewers' comprehension of the material; though, in some contexts improved comprehension among those with high levels of cognitive abilities. Furthermore, providing risk-related information in any format was not an effective means of altering perceptions, attitudes, or intentions. However, a mediating relationship of past behavior on the influence of attitudes on intentions was discovered, in which more positive attitudes predicted intentions to abstain from distracted driving – except where individuals had extensive prior exposure to the behavior.

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Introduction

Distracted driving is an increasing threat to road safety. Whether drivers are using cell phones, personal GPSs, or in-vehicle entertainment systems, new technologies can represent a major source of distraction. In 2014 alone, 3,179 people were killed and approximately 431,000 were injured in crashes involving distracted driving. During the same period, mobile phone use was reported in 18% of fatal car accidents (National Highway Traffic Safety Administration, 2016).

Previous research has tenuously linked perceptions of risk while driving to decreases in self-reported likelihood to drive while using a cell phone (Atchley, Atwood, & Boulton; 2010; Benson, McLaughlin, & Files, 2015; Nelson, Atchley, & Little, 2009; Struckman-Johnson, Gaster, Struckman-Johnson, & May-Shinagle, 2015). However, Nelson et al. and Atchley et al. did not show that perceptions of risk reduced the frequency of distracted driving. Moreover, research on cell phone use while driving has not evaluated the ability of drivers to adequately comprehend risk-relevant materials. This study extends the research by examining how risk comprehension influences the intent to engage in distracted driving. This study evaluates the capability of young drivers to process statistical information regarding the likelihood of getting into a car crash caused by cell phone use influences intentions to refrain from texting while driving. The study will incorporate research that has demonstrated the benefits of visual aids in enabling behavior change by facilitating risk comprehension (Garcia-Retamero & Cokely, 2011, 2013, 2014; Garcia-Retamero, Cokely, & Hoffrage, 2015). To model the impact cognitive ability has on risk comprehension, the proposed study will examine cognitive abilities previously found to be relevant to risk literacy (Garcia-Retamero & Cokely, 2011; Lesage, Navarrete, & De Neys, 2013). Ultimately, this study seeks to elaborate how to best develop materials that will alter young drivers' driving behavior while taking into account how various cognitive abilities contribute to risk literacy.

Distracted Driving: Risk and Prevalence

Distracted driving is generally defined as any activity that diverts a driver's attention from the act of driving (World Health Organization, 2011). Organizations such as the National Highway Traffic Safety Administration (2016) and the World Health Organization (2011) categorize three main types of distraction: visual, manual, and cognitive. Visual distractions take a driver's visual attention from the road. Manual distractions take a driver's hands away from the steering wheel. Finally, cognitive distractions take a driver's psychological focus off the task of driving. While any of the three types of distractions can contribute to a motor vehicle crash, the use of cell phones combines all of the above. When drivers operate cellular devices, their eyes, hands, and cognitive resources are all taken away from driving their vehicle.

Psychological research has primarily focused on the attentional aspects of distracted driving, demonstrating that driving is significantly impaired by cell phone use (see Overton, River, Hecht, Shafi, & Gandhi, 2014 and Ranney, 2008 for reviews). Using a driving simulator, Strayer and Johnston (2001), showed that drivers using either hand-held or hands-free devices are twice as likely to fail to detect traffic signal changes and have significantly slower reaction times when these changes are detected. In a simulated driving experiment, Drews, Yazdani, Godfrey, Cooper, and Strayer (2009) found that reading and/or receiving text messages nearly doubled the time it took drivers to initiate breaking and increased the likelihood of a crash six-fold. Additionally, talking on a cell phone has been linked to deficits in reaction times, visual scanning, hazard prediction, and object identification (see Strayer, 2015 for review). Even minor cell phone related activities, such as speech-based text entry (He et al., 2014) and receiving a cell phone notification (Stothart, Mitchum, & Yehnert, 2015), have been found to disrupt a driver's attention enough to significantly impair response times. This evidence strongly suggests that cell phone use is major safety liability, impairing motorists' abilities to direct attention towards driving.

Young adults are particularly prone to engage in risky driving behaviors involving cell phone use (Harrison, 2011; Hill et al., 2015; National Highway Traffic Safety Administration, 2016). Cell phone use while driving is most prevalent among drivers ages 20-29 (National Highway Traffic Safety Administration, 2016). Most young drivers acknowledge that texting while driving is dangerous and support legislation making it illegal (Harrison, 2011). However, multiple studies have shown that over 90% of students surveyed report having used their cell phones to send text messages while driving, even with passengers in their vehicle (Harrison, 2011; Hill et al., 2015). In one study, only 2% of sampled drivers reported not texting while driving under any circumstances (Atchley et al., 2010). Additionally, Hill et al. found that 46% of those surveyed felt very capable of talking on a cell phone while driving. Using a multivariate model, Hill and her colleagues reported that the four strongest predictors of engaging in cell phone use while driving were confidence in multitasking while driving, perceptions of safety while multitasking and driving, observing others multitasking while driving, and having a history of vehicle crashes due to multitasking while driving. As noted by Domigan, Glassman, Miller, Hug, and Diehr (2015), as young adults repeatedly use cell phones driving, the more normal this behavior becomes. This could lead to a rise in distracted driving related motor vehicle crashes in this already vulnerable population.

In order to decrease the prevalence of distracted driving among college students, efforts are needed to develop materials and tailor messages to target one's understanding of the risks involving driving and cell phone use. Generally, public health experts recommend messaging aimed at increasing perceptions of self-efficacy so that the target population feels empowered to make a behavioral change (Cismaru & Lavack, 2007; Cismaru & Nimegeers, 2016). A key element to increasing perceived self-efficacy is to provide the audience with information regarding the reduced risks of behavior change (Cismaru & Lavack, 2007). However, many campaigns focus on the legalistic impacts of distracted driving, such as fines and jail times, instead of the decreased likelihood of vehicle crashes (Domigan et al., 2015). Public information campaigns that focus on punishments instead of changing behaviors takes control away from its intended audience. Instead of empowering individuals to make a change, these campaigns cause individuals to respond with fear and become less likely to follow the recommendations (Cismaru & Nimegeers, 2016).

Contextualizing the risks associated with distracted driving is an important part of changing attitudes about safety as college students are especially overconfident in their ability to drive distracted. Hill et al.'s (2015) survey of college students found that 66% of participants reported believing that they were better drivers than their peers and more capable to drive distracted. Additionally, those who were more confident in their ability to text while driving were also more likely to report doing so. Despite this confidence, simulator studies have found that reaction times are up to 35% slower when texting and driving compared to a control condition (Reed & Robbins, 2008), and the risk of collision is six times higher (Drews et al., 2009). Providing young drivers with information about how their driving performance is impaired while using a cell phone may change their attitudes towards distracted driving. In their review of anti-texting public health messaging, Cismaru and Nimegeers (2016) found that only 4% of campaigns attempted to communicate safety risks of distracted driving. New messaging needs be developed to fill this gap, and focus on changing young adults' perceptions of distracted driving risks.

Risk Literacy

Studies surveying young adults' attitudes towards distracted driving have found that perceptions of risks have a minor impact on self-reported driving behaviors (Atchley et al., 2010; Nelson et al., 2009). Nelson et al. found that drivers were less likely to make or answer a call the more they perceived doing so to be risky. However, the effect size was small and risk perceptions did not impact the frequency with which they reported using a cell phone while driving. Similarly, Atchley et al. reported that the more drivers perceived texting while driving be dangerous, the less likely they were to initiate a text message conversation. Nonetheless, these drivers did not report replying or reading text messages any less frequently.

Assessments of distracted driving risk perception have thus far failed to take into account the cognitive nature of the perceived risk. Studies have typically measured risk perception by asking participants to rate how dangerous an activity is using self-report, Likert-type scales (Atchley et al., 2010; Nelson et al., 2009; Reed & Robbins, 2008), or to affirm whether they believe the behavior is dangerous (Benson et al., 2015; Harrison, 2011). Research has not evaluated the quality of risk perceptions, nor individuals' capacity to comprehend the risks associated with distracted driving. It could be the case that individuals know abstractly that driving while using a cell phone increases their likelihood of causing a car crash, but they may not appreciate how much their risk increases.

One way to approach this problem is to explore the cognitive factors that contribute to decision making and risk literacy. Studies have linked the tendency to text and drive to performance on delay discounting tasks (Atchley & Warden, 2012; Hayashi, Russo, & Wirth, 2015). Delay discounting refers to the preference for smaller, immediate rewards over larger, delayed rewards. While delay discounting typically follows a similar pattern (Mazur, 1987), individuals with higher levels of cognitive ability, such as cognitive reflectivity, are more capable of inhibiting the impulsive selection for an immediate, smaller rewards and choose the delayed larger reward (Frederick, 2005). As demonstrated by Hayashi et al., college students who reported frequently texting while driving delayed monetary rewards at a greater rate than those who reported seldom texting while driving. Hayashi et al. suggested that distracted driving behaviors are similar to delay discounting, in that the smaller, immediate reward of putting oneself at risk by responding to a text message while driving is preferred over the larger, delayed reward of waiting to respond until one is no longer driving. This provides behavioral evidence that texting while driving is indicative of an impulsive decision making style.

Processing Risk

Research that investigates the cognitive factors that influence decision making when driving incorporate different theoretical models and theories, such as dual-process theories (Evans & Stanovich, 2013; Kahneman & Frederick, 2002; Stanovich & Toplak, 2012) and Nested Sets Theory (NST; Barbey & Sloman, 2007). Dual-process theories describe how there are two sets of cognitive processes that contribute to decision making: Type 1, which accounts for impulsive decisions; and Type 2, which represents analytical processing. Related to dual-process theories, NST describes the way in which individuals process statistical information, specifically as it relates to part-to-whole relationships. Both theories posit that those with greater cognitive abilities, such as fluid intelligence, cognitive reflectivity, and numeracy, will be more competent processors of decision-relevant information (Johnson & Tubau, 2015; Kahneman & Frederick, 2002). Thus, individual differences in cognitive abilities may contribute to how the risks related to distracted driving are processed.

Dual-process theories (Evans & Stanovich, 2013; Kahneman & Frederick, 2002; Stanovich & Toplak, 2012) are useful for understanding the link between distracted driving and impulsive decision making. According to dual-process theories, impulsive decision making belongs in the category of heuristic processing classified as Type 1 processing. Type 1 processing is considered to be automatically triggered, based on both innate processing and prior experiences. Independent of working memory, Type 1 processing is not taxing on central processing capacities, and therefore yields quick responses. Dual-process theories also describe a second, more reflective route designated as Type 2 processing. Dependent on working memory, Type 2 processing requires cognitive resources and takes additional time. Additionally, Type 2 processing is thought to be responsible for monitoring and updating judgements produced by Type 1 processing. In dual-process theories, Type 1 processing quickly proposes intuitive answers to judgment problems as they occur. Type 2 processing evaluates the quality of these proposals, which it may correct, endorse, or override (Kahneman & Frederick, 2002). For instance, impulsive decisions such as choosing the smaller, immediate reward in delay discounting or responding to a text message while driving, are examples of Type 1 processing. Accepting a delay to receive a larger reward, or inhibiting the desire to respond to a text message while driving would be indicative of Type 2 processing.

Since individuals have different processing capacities it is important to consider individual variations in cognitive abilities when developing materials targeting behavior change.

The problem, as outlined in Johnson and Tubau (2015), is that most people are not effective at statistical reasoning or processing statistical inferences, also referred to as Bayesian inferences. In the case of distracted driving, the correct estimate of risk is calculated by integrating the probability of getting into a car crash overall with the increased likelihood of such an event if the driver is using his or her cell phone. The successful calculation of this information depends on high levels of cognitive ability and general mathematical ability (Johnson & Tubau, 2015; Lesage et al., 2013; McNair & Feeney, 2015; Sirota & Juanchich, 2011; Sirota, Juanchich, & Hagmayer, 2014). For example, McNair and Feeney investigated the relationship between Bayesian statistical reasoning and cognitive abilities using the Raven's Advanced Progressive Matrices (RAPM, 1958) and the Cognitive Reflection Test (CRT; Frederick, 2005). The RAPM are a commonly used measure of fluid intelligence, which refers to general problem solving abilities, and the CRT measure cognitive reflectivity, which is the ability to inhibit impulsive Type 1 processing in favor of more analytical Type 2 processing. Additionally, the researchers evaluated mathematical ability, also called numeracy, with the Berlin Numeracy Test (BNT; Cokely, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012). McNair and Feeney found that cognitive ability was uniquely associated with Bayesian responses, especially among those with high levels of numeracy.

Dual-process theories suggest that errors associated ineffective statistical reasoning occur due to Type 1 processing's computationally limited nature (Kahneman & Frederick, 2002). The impulsive judgments Type 1 processes endorse, when not adequately monitored and inhibited by Type 2 processing, will lead to predictable errors. Individuals with limited resources – such as limited information, time, motivation, or cognitive ability – tend to rely on Type 1 processing (Kahneman & Frederick, 2002). In doing so, they use heuristics that produce predictable, sometimes biased, responses. In contrast, when an individual's resources are not limited, they should be able to engage in Type 2 processing, decreasing their reliance on these heuristics and decreasing biased responses (Kahneman & Frederick, 2002). Thus, individuals with limited cognitive abilities, such as working memory capacity or cognitive reflectivity, will provide incorrect estimations when given probabilistic questions because they lack the requisite resources to engage in Type 2 processing.

Building upon this dual-process framework, Barbey and Sloman (2007) proposed Nested Sets Theory (NST) to explain errors in statistical processing. Nested Sets Theory articulates why statistical information presented as a natural frequency (e.g., 7 out of 10), instead of as a probability (i.e., 70%) reduces cognitive biases. According to NST, a key element to solving statistical reasoning problems is the fact that some sets of events are nested, or that some statistical information represents the relationship between a whole unit and a part contained in that whole unit. For example, the number of car crashes caused by cell phone use is nested within the number of all distracted driving-related car crashes, which itself is nested within the number of all car crashes. According to Barbey and Sloman, natural frequencies trigger a quick representation of nested sets that prime the cognitive resources necessary for analytical Type 2 processing. Standard probabilities, in contrast, obscure the set representation of the problem, which does not activate Type 2 resources, causing errors associated with heuristic Type 1 processing.

Individual differences in cognitive abilities also play an important role in the relationship between Type 1 and Type 2 processing. Lesage et al. (2013) found that performance on reasoning problems increased when the information was displayed as natural frequencies instead of probabilities; however, those with higher levels of cognitive ability showed the largest improvements. Furthermore, only those with greater cognitive abilities were unaffected by cognitive load in a dual-task condition. In three experiments, first-year college students and secondary school students solved Bayesian reasoning problems and took an assessment of cognitive ability using the CRT (Frederick, 2005). The CRT predicts performance on a host of decision making tasks independent of measures of intelligence (Frederick, 2005; Toplak, West, & Stanovich, 2011). In the first two experiments, the reasoning problems were formatted either as a probability or a natural frequency. Lesage et al. found that those with higher scores on the CRT performed better on the reasoning task, and that the relationship between reasoning performance and cognitive abilities was stronger when the problems were presented as natural frequencies. Furthermore, in the third experiment, Lesage et al. compared performance on the reasoning task while under cognitive load, in which participants were required to keep in mind a complex dot pattern while solving the reasoning problems. While those with low CRT scores performed worse under cognitive load, those with high scores were unaffected. These results suggest that natural frequency manipulations may benefit those with higher levels of cognitive abilities more than the general population. Therefore, alternative techniques are required to assist those with lower working memory capacity or less cognitive reflectivity.

Improving Risk Literacy with Visual Aids

Visual aids – graphical representations of numerical expressions of probability – may be effective in communicating the risks of distracted driving to those with lower levels of cognitive abilities. For example, visual aids have been found to be an effective means of risk communication in medical decision making (Garcia-Retamero & Cokely, 2011; Garcia-Retamero & Cokely, 2013; Garcia-Retamero, Cokely, & Hoffrage, 2015; Petrova, Garcia-Retamero, & Cokely, 2015). In their review of 24 studies that used graphs of quantitative health risks, Ancker, Weber, Kukafka, and Starren (2006) determined that visual aids have three beneficial features. First, graphic displays helped people estimate nested sets by showing how a smaller object is part of a larger object. Second, people tended to have strong perceptual abilities when it comes to discriminating based on heights, angles and slopes, but not volumes or color-densities. Third, visual aids can use natural frequencies that, as mentioned previously, are easier to comprehend than probabilities. By visually depicting natural frequencies of heights, angles, or slopes, visual aids were easier to comprehend because they make explicit the nested sets that are typically obscured when the information is presented probabilistically.

In their work on sexual health, Garcia-Retamero and Cokely (2011) investigated how visual aids can impact behavior. The researchers designed a brochure to describe information regarding the prevention and detection of sexually transmitted infections (STIs) in three formats: written text, written text and statistics, or written text and visual aids. Participants answered questions on their initial perceptions of risk, read the brochure, and then reported their attitudes towards the recommended behaviors and behavioral intentions. Additionally, participants had a 6-month follow-up where they reported if they performed any of the recommended behaviors. Compared to those in the other two conditions, participants exposed to the brochure with the visual aids reported more positive attitudes towards detecting and preventing behaviors. The researchers also found that participants' positive attitudes, such as the belief that condom use effectively prevented STIs, influenced intentions, which in turn increased their reported behaviors 6 months later. In sum, this study provided evidence that visual aids are capable of influencing attitudes and intentions to promote healthy behaviors.

Visual aids may also benefit those with low levels of cognitive ability. In a follow-up study to their 2011 study, Garcia-Retamera and Cokely (2014) found that those with low numeracy and low graph literacy did not benefit from the use of icon arrays and were biased by message framing. However, they found that visual aids using grids were particularly effective in increasing the accuracy of diagnostic inferences among participants with low numeracy. Garcia-Retamero and Cokely compared the ability of hospital patients to make inferences about the likelihood of a cancer diagnosis when viewing relevant information as probabilities only or as probabilities with a grid-based visual aid. While overall accuracy increased among those in the visual aid condition, those with low levels of numeracy benefited the most and increased their inferential accuracy from under 20% to nearly 50%. Garcia-Retamero and Cokely suggested that properly designed visual aids are beneficial because they facilitate the understanding of numerical information among those with low levels of numeracy.

While numeracy has been shown to predict reasoning ability in a variety of studies (e.g., Garcia-Retamera & Cokely, 2011, 2014; Sirota et al., 2014), inferential reasoning has been linked to several other cognitive abilities, such as fluid intelligence and cognitive reflectivity (Johnson & Tubau, 2015). Although superior inferential abilities have been seen among those with higher levels of fluid intelligence and cognitive reflectivity (for example, Lesage et al., 2013; Sirota et al., 2014), these abilities have not been assessed in relation to use of visual aids to improve risk literacy. Therefore, research is needed to evaluate how visual aids can benefit even those with lower levels of cognitive abilities, such as cognitive reflectivity, fluid intelligence, numeracy, and working memory capacity.

The Present Study

This present study seeks to address three goals. The first goal is to apply the benefits of visual aids to the problem of distracted driving. Following studies that compared the effectiveness of visual aids to communicate the impact of health-related information (Garcia-

Retamero & Cokely, 2011, 2013, 2014; Garcia-Retamero et al., 2015), the present study will examine how visual aids impact people's comprehension of two types of distracted driving risks, perception of those risks, attitudes towards those risks, and intentions regarding those risks, relative to standard statistical descriptions. A leading hypothesis is that compared to statistics-only information, messages containing visual aids will increase participants' comprehension of risk-relevant information regarding distracted driving and will result in higher perceptions of risk, more positive attitudes towards abstaining behaviors, and more intentions to abstain from distracted driving.

The second goal of this proposed study is to investigate how the content of risk-relevant information impacts perceptions, attitudes, and intentions regarding distracted driving among college-age adults. Examining the content of risk messaging about cell phone use while driving could have important implications. The proposed study will test the effect of message content, comparing risk perceptions based on information regarding the likelihood of a fatal car crash related to cell phone use to risk perceptions based on information regarding performance deficits caused by that behavior. Information regarding a specific behavior may give participants a better sense of self-control, which is linked to more successful outcomes related to behavioral change (Cismaru & Nimegeers, 2016). It is therefore hypothesized that performance-related content will be related to more positive attitudes and intentions towards abstaining from distracted driving behaviors.

Lastly, this study will examine the relationship between risk comprehension and individual differences in cognitive ability. As mentioned previously, there are several cognitive abilities that have been linked to successful Bayesian reasoning, such as cognitive reflectivity and numeracy (Lesage et al., 2013). However, there is some overlap between some these measures, such as cognitive reflectivity and numeracy. Sirota and Juanchich (2011) evaluated the relationship between the CRT and numeracy scales on reasoning tasks that utilized natural frequencies. They found that those with high scores on the numeracy scale performed better on the reasoning tasks than those with low scores; likewise, high CRT-scorers demonstrated superior performance relative to their low scoring counterparts. Nonetheless, the Sirota and Juanchich did not find a mediating relationship between numeracy and cognitive reflectivity on the reasoning tasks, leading them to conclude that numeracy scales and cognitive reflectivity evaluate related, but separate processes. Therefore, the third goal of the proposed study is to evaluate the relationship between cognitive abilities the risk comprehension. Following previous research that has linked superior cognitive abilities to better inferential competence (Sirota & Juanchich, 2011; Lesage et al., 2013; Sirota et al., 2014; Garcia-Retamero et al., 2015), it is predicted that those with higher levels of cognitive reflectivity, fluid intelligence, numeracy, and working memory capacity will perform better on both conditions. Additionally, this study anticipates that those with lower levels of cognitive abilities will experience the greatest gains in performance on the risk comprehension task among those exposed to messaging containing visual aids.

Chapter 2:

Method

The present study was conducted using a 2 x 2 between-subjects factorial design. The independent variables to be manipulated were Risk Format (statistical information only versus statistical information with visual aids) and Risk Content (prevalence versus deficits). The dependent variables were risk comprehension scores, changes in risk perception, attitudes towards risk, and intentions towards risk. The current study also examined several non-manipulated independent variables related to cognitive abilities.

Participants

The G*Power statistical software was used to calculate necessary the sample size needed to reach $\beta = .80$, $\alpha = .05$, with an ANOVA with the effect size of $\eta^2 = .04$. The effect size of $\eta^2 = .04$ was chosen as it was the effect size of the interaction between numeracy and message format (Garcia-Retamero et al., 2015). Therefore, 191 participants recruited from the Towson University's Psychology Research Pool. Participants received college course credit for participating.

Data was collected from 162 participants, of which 77.84% were women ($N = 130$). The average age of the sample was 19.60 years ($SD = 2.06$, range = 18-33). Participants had completed an average of 1.32 years of college ($SD = 1.33$). A majority of participants ($N = 98$, 58.68%) described themselves as Caucasian, followed by 29 (17.37%) African Americans, and 16 (9.58%) Asian Americans. An additional 7 participants (4.19%) described themselves as having more than one race and 12 participants (7.19%) described their race as "Other." Additionally, 11 participants (6.59%) described their ethnicity as Hispanic. Five participants did not complete the demographic section of the survey so this information is not reported.

Materials

Demographic questions included: gender, age, race, and ethnicity. An additional six questions related to driving were included related to license ownership, vehicle ownership, distracted driving crash history, and distracted driving citation history (see Appendix A).

Fourteen questions were posed to assess prior exposure to the topic of distracted driving (see Appendix B). Distracted driving habits were evaluated using the Distracted Driving Survey (DDS; Bergmark, Gliklich, Guo, & Gliklich, 2016). This 11-item measure assessed cell phone use related distracted driving, focusing on behaviors related to texting, email, and other viewing and writing activates. The DDS has a Cronbach's alpha of 0.92, and was validated on a sample of those ages 18-24. Bergmark et al. found that DDS scores were significantly correlated with self-reported crash rates. Three additional questions were added to assess a wider range of distracted driving behaviors.

In the risk assessment section of the experiment, participants were presented with materials providing information about the risks associated with cell phone while driving. This involved making inferences about risk assessments involving distracted driving. Participants were provided with background information about distracted driving adapted from the website of the U.S. Department of Transportation's Distraction.gov webpage (available online at http://www.distraction.gov/stats-research-laws/facts-and-statistics.html), and statistical information about the harms of cell phone use while driving (adapted from Simons-Morton, Guo, Klauer, Ehsani, & Pradhan, 2014, see Figure 1). The information was presented using either statistics only or statistics in conjunction with a visual aid. For example, in one version of this task, the visual aid was a grid representing the number of distracted driving-related crashes in general, overlapping with a grid representing the number of young driver-related crashes, with the overlapping portion highlighted to represent the number of car crashes involving cell phone use (see Figure 2).

Risk comprehension was assessed using a separate questionnaire for each of the two risk content conditions. The questionnaire included six randomly presented items intended to evaluate comprehension of the material. For each set of question, four items required mathematical calculations. In the risk prevalence conditions, one such question read, “Drivers over the age of 29 were involved in what percentage of cell phone-related fatal crashes?" In addition, two items in each question set required participants to make broader inferences about the data. In the risk performance conditions, one such question read, “"Comparing distracted driving in general to cell phone use while driving, are the odds of a car crash at one second of distraction more likely, less likely, or just as likely?" The full set of these questions can be found in Appendix C.

The original intent was to derive a total comprehension score by summing the number correct answers. However, none of the participants provided accurate responses to the comprehension questions that required mathematical calculations. Instead, relative accuracy, or how close a participant’s response was to the correct answer, was calculated taking the absolute value of the difference between a participant’s response and the correct answer. Overall relative accuracy, also called answer calibration, was then assessed by summing the relative accuracy across these questions. Therefore, participants had two scores for evaluating risk comprehension: answer calibration and the number of correct inferences.

Risk perceptions, attitudes, and intentions regarding distracted driving were measured using 9-point Likert scales. These measures were adapted from Cokely and Garcia-Retamero’s (2011) study on risk perceptions, attitudes, and intentions regarding sexual health education.

Risk perception was evaluated with three questions. One question asked participants to indicate how likely they believe they are to get into a car crash if they continue to behave as they have in the past, and the other questions had them rate how worried they are about getting into a car crash and how serious the consequences of such a crash would be for them (Cronbach's $\alpha = .91$). Four questions assessed attitudes towards distracted driving, in which participants indicated the effectiveness in avoiding distracted driving (i.e., cell phone use while driving) in reducing their risk of an accident, how important it is for them to avoid distracted driving, how beneficial it is to avoid distracted driving, and how favorable they felt towards avoiding distracted driving (Cronbach's $\alpha = .79$). One question measured intentions towards distracted driving. Participants indicated how likely it is that they will avoid distracted driving in the next few weeks (see Appendix D).

The original version of the Cognitive Reflection Test (CRT; Frederick, 2005) is comprised of three, open-ended, math-based questions (see Appendix E). This measure is designed to evaluate participants' reflective reasoning abilities, as each question tends elicit an intuitive response that must be inhibited before the correct answer can be calculated. The CRT has been linked to successful performance on a range of tasks related to cognitive biases (Toplak, West, & Stanovich, 2011). However, a major limitation of the CRT is its difficulty, which often leads to floor effects. Therefore, the expanded version of the CRT was used (CRT-L; Primi, Morsanyi, Chiesi, Donati, & Hamilton, 2015), which includes an additional three items. Scores on the CRT-L range from 0-6, with higher scores indicating an elevated level of reflective reasoning. In Primi et al. (2015), Cronbach's alpha was found to be .79 for adolescents and from .65 to .76 for adults.

The Berlin Numeracy Scale (BNT; Cokley, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012) was used to gauge a participant's numeracy, which is their capability and fluency with manipulating numbers. Specifically, this task focuses on the ability to perform probabilistic calculations. The BNT is comprised of four questions of varying difficulty (see Appendix E). Scores on the BNT range from 1-4, with higher scores indicating more proficient numerical abilities. Cronbach's alpha was found to be .59 in Cokely et al. (2012).

Participants also completed a shortened version of the Raven's Advanced Progressive Matrices (RAPM; Raven, 1958). The RAPM task consists of 12 items from the larger, 36-item RAPM (Author & Day, 1994). In the RAPM, participants see a 3×3 grid of shapes with the bottom right shape missing (see Appendix E). The shapes themselves follow a logical pattern from left to right, and from top to bottom. The participants' task is to choose, from a list of eight possible choices, the shape that logically fits in the missing corner. The RAPM assessed participants' spatial reasoning skills, which is a component of fluid intelligence. According to Author and Day (1994), Cronbach's alphas range from .58 to .66.

In order to evaluate working memory capacity, participants completed a shortened version of the Operation Span (OSPAN; Foster, Shipstead, Harrison, Hicks, Redick, & Engle, 2015) and Reading Span (RSPAN; Foster et al., 2014). For the RSPAN, participants view a set of sentences of approximately 10–15 words in length and were asked if the sentence is sensible (selecting either "True" or "False"). In the OSPAN, instead of judging the sensibility of sentences, participants determined if simple arithmetic operations are correct (for examples of the task, see Figure 3). Approximately half of the sentences/operations are sensible/correct. After each sentence, participants viewed an element (a letter) for 500 milliseconds. At the end of the set, participants are asked to recall the elements in the order in which they were presented. Set sizes range from 4–6, with two trials administered for each set size. For each task, scores were calculated by summing the number of letters correctly recalled in the correct order, with partial credit for correct letters provided out of order (see Conway et al., 2005). Subsequently, final scores from each task were averaged.

Procedure

Participants were tested individually at computers in groups of up to six students per session. First, participants were given an informed consent form (see Appendix F). They indicated consent by signing their name, thereby agreeing to participate in this study. They also needed to indicate that they were at least 18 years old.

All materials except for the OSPAN and RSPAN were administered using Qualtrics on computers in a computer lab on Towson University's campus. Participants were instructed to click a button to start the experiment. After responding to each question, participants used the mouse click on buttons to proceed to the next question. Instructions for the study were as follows (each individual section had their own specific instructions):

"Please read and respond to each question before moving on to the next one. Make sure to read the directions to each question carefully as they are not all the same type."

The study was split into six sections: pre-risk assessment questionnaire, the risk assessment, the post-risk assessment questionnaire, the assessment of cognitive abilities (CRT, BNT, and RAPM), demographic questionnaire, and the assessment of working memory capacity (OSPAN and RSPAN). All participants completed the sections in this order.

During the pre-risk assessment questionnaire, participants first answered questions regarding demographics, distracted driving exposure, initial perceptions of risk, initial attitudes towards distracted driving, and initial intentions regarding distracted driving.

For the risk assessment task, participants were randomly assigned to one of four conditions based on a 2 (Risk Format: statistics only versus statistics + visual aids) x 2 (Risk Content: prevalence versus performance) between-subjects factorial design. For Risk format, the information in the statistics-only conditions was displayed as numbers without a visual aid. In the other condition, the information was displayed with a visual aid. For Risk content, in the prevalence condition, information was about the likelihood of car crashes involving cell phone use. In the performance condition, information was about performance deficits associated with distracted driving. Participants were asked to make six inferences regarding the likelihood of car accidents (see Appendix C). Correct answers were summed to determine risk comprehension.

After completing the risk assessment, participants answered the same questions regarding distracted driving risk perceptions. They also answered questions regarding their attitudes and intentions towards distracted driving. This section included an attention check, which instructed participants to select a predesignated answer.

The order of the cognitive assessments (RAPM: Author & Day, 1994; CRT: Frederick, 2005; BNT: Cokely et al., 2012) was randomized. Participants completed each assessment according to the instructions provided for each test.

Participants then completed the demographic questionnaire. After completing these questions, participants saw instructions informing them to contact the researcher. Upon being notified, the researcher entered the participant's ID number and submitted the survey. This concluded the portion of the study using Qualtrics.

The shortened OSPAN and RSPAN (Foster et al., 2015) were administered using E-Prime software. Participants first completed the OSPAN, and then the RSPAN. Before each task, participant ID numbers were entered, allowing researchers to connect data from E-Prime to that from Qualtrics.

Once the testing was completed, participants were debriefed, thanked, and dismissed.

Chapter 3:

Results

Demographics

Of the 167 participants, 9 (5.39%) failed both attention checks and were therefore eliminated from further analyses. An additional 27 participants (16.17%) failed one of the two attentional lures. However, independent samples *t*-tests comparing those who failed one check to those who passed all checks did not reveal any significant differences on any of the dependent measures ($ps > .05$). Therefore, these participants were included in the subsequent analyses. The final sample included data from 158 participants. There were 37 participants in the prevalence visual aid condition, 37 in the prevalence no visual aid condition, 41 in the performance visual aid condition, and 40 in the performance no visual aid condition.

Most participants reported having a valid driver's license ($N = 148$, 93.67%), and 3 participants (1.90%) did not indicate their licensed status. Of those who had a license, 4.73% ($N = 7$) reported having been in a distracted driving-related car crash and 1.35% ($N = 2$) reported having been issued a citation for distracted driving.

Descriptive Statistics

Participants' averaged a score of 18.50 ($SD = 13.09$) on the 14-item Distracted Driving Exposure Questionnaire (DDS; Bergmark, Gliklich, Guo, & Gliklich, 2016). Among licensed drivers, the average score was 20.61 ($SD = 10.09$). Cronbach's $\alpha = .86$, slightly lower than $\alpha = 0.92$ found in 11-item version found by Bergmark et al. (2016). However, when the original 11 items were analyzed Cronbach's $\alpha = .84$, so the additional items were included in subsequent analyses. In the last 30 days, 92.17% of licensed participants reported using maps or directions on their phones while driving, 85.22% read a text message while driving, 80.00% had a phone call, 79.13% wrote a text message, 75.65% used a social media app, 26.96% reported reading an email, and 8.70% wrote an email. Greater distracted driving exposure was positive correlated with reports of having been in a car crash because of distracted driving (r = .186, p = .024) and having a citation for distracted driving (r = .214, p = .009).

Descriptive statistics of the measures of perceptions, attitudes, and intentions can be found in Table 1. Repeated measures *t*-tests were run to examine whether these variables changed after exposure to the risk assessment. Contrary to expectations, perceptions were not significantly different between the two measurements, $t(156) = -0.76$, $p = .498$. Although attitudes towards abstaining from distracted driving appeared to increase, the difference was not significant, $t(156) = -1.91$, $p = .058$. Similarly, intentions to refrain from distracted driving appeared to decrease between measurements, but not significantly, $t(156) = -1.79$, $p = .076$.

Participants averaged a score of 0.70 (SD = 0.86) on the 4-item Berlin Numeracy Test. This is significantly lower than the 2.20 average reported for other college-aged samples (Cokely et al., 2012), $t(154) = -21.63$, $p < .001$. The average CRT score was 1.14 (SD = 1.31), which is similar to the average of 1.47 found by Frederick (2005). On the 12-item Raven's Advanced Progressive Matrices, participants averaged 4.97 (SD = 2.32). This is significantly lower than the 8.10 average reported by Arthur and Day (1994), $t(154) = -16.76$, $p < .001$. Participants correctly answered an average of 0.86 (SD = 0.70) inference-based comprehension question, and had an average summed calibration of 1.35 (SD = 1.13). Although working memory capacity was also measured, there was an error in the way in which this data was to be connected to the rest of the study data and the researchers were not able to connect the E-Prime and Qualtrics datasets. Therefore, this data was not included in the analyses.

Table 2 illustrates the correlations among these measures. The cognitive measures shared a significant, positive relationship (*p*s $< .001$). Answer calibration and inference scores were also significantly correlated ($r = -.366$, $p < .001$). While this correlation is negative, this is sensible because lower calibration scores suggests higher accuracy. This suggests that those who were more accurate in their answers of the math-based questions were more likely to provide correct responses to the inference-based questions. Changes in perception had a significant, positive relationship with changes in attitudes ($r = .205$, $p = .010$), but a significant, negative relationship with changes in intentions ($r = -.165$ $p = .039$). This suggests that as perceptions of the risks associated with texting while driving increased, attitudes towards refraining from this activity also rose. Surprisingly, as these perceptions increased, intentions to refrain from texting while driving tended to decrease.

The relationships among cognitive abilities and the self-report measures were examined separately by Risk Content. Table 3 shows the correlation in the prevalence conditions, and Table 4 shows this information for the performance conditions. Attitudes ($r = -.273$, $p = .017$) and intentions ($r = -.365$, $p = .001$) were both negatively correlated with distracted driving exposure in the prevalence condition, but only attitudes ($r = -.227$, $p = .042$) was negatively correlated with DDE in the performance condition. This indicates that prior exposure to distracted driving was not related to intentions in the performance condition. In contrast to the full sample, answer calibration and inference scores were no longer significantly correlated in either Risk Content condition. Additionally, all three cognitive abilities in the prevalence condition were significantly, negatively correlated with answer calibration (all *p*s $< .05$), but only CRT scores shared a significant, negative relationship with answer calibration in the performance condition ($p = .024$). This suggests that performance on the comprehension question was more closely tied to cognitive abilities in the prevalence, rather than the performance conditions. Finally, attitudes, perceptions, and intentions were all significantly correlated to one another in both conditions.

Impact of Message Format and Content on Comprehension

The impact of the Risk Content and Risk Format factors on comprehension was assessed to test the effectiveness of the experimental manipulations (Table 5). A two-way MANOVA was run, comparing answer calibration and inference scores among the experimental conditions. Using Pillai's trace, there was a significant multivariate effect of Risk Content on comprehension, $V = .968$, $F(2,151) = 2283.48$, $p < .001$, $\eta^2_p = .97$. There was no significant multivariate effect of Risk Format on comprehension, $V = .027$, $F(2,151) = 2.12$, $p = .123$, $\eta^2_p = .03$, nor an interaction between Risk Content and Risk Format, $V = .020$, $F(2,151) = 1.53$, $p = .221$, $\eta^2_p = .02$. While the content of risk material impacted participants' comprehension, the format of that material did not.

Separate univariate ANOVAs on the outcomes variables were run. Risk Content had a significant effect on inference scores, $F(1, 152) = 27.50$, $p < .001$, $\eta^2_p = .15$, and on calibration, $F(1, 152) = 4593.13$, $p < .001$, $\eta^2_p = .97$. Those in the prevalence-based Risk Content condition answered significantly more inference-based question ($M = 1.14$, $SD = 0.62$) than those in the performance-based condition ($M = 0.60$, $SD = 0.66$). Additionally, those in the prevalence-based condition were significantly more accurate ($M = 0.97$, $SD = 0.44$) than those in the performance-based condition ($M = 7.36$, $SD = 1.42$). These results indicate that participants were better able to comprehend and answer the prevalence-based content, as opposed to the performance-based content.

Impact of Cognitive Abilities on Comprehension

In order to assess the contributions of cognitive abilities on comprehension, moderation analyses were conducted using the PROCESS SPSS macro (Hayes, 2013). This analysis employs ordinary least squares (OLS) regressions to determine the estimate of the outcome variable (Y) given a predictor variable (X), a moderator variable (M), and the interaction of the two (X x M). Coefficients, standard errors, *t* and *p*-values, and 95% confidence intervals are given. The whole model's R^2 is also given, along with an *F*-test.

PROCESS also compiles additional analysis of the interaction of the predicting and moderating variables. The change in the model's R^2 with the addition of the interaction variable (X x M) is computed and tested with a *t*-test and 95% confidence interval. This interaction may be probed with the pick-a-point approach, in which computed values for the outcome (Y) and predictor variable (X) based on values of the moderating variable (M) are calculated and may be graphed.

Given the influence that Risk Content had on comprehension, separate analyses were run for the prevalence and performance conditions. Answer calibration was used as a proxy for the outcome variable (Y) of comprehension because of its stronger relationship with other variables. Additionally, each analysis was repeated using a different moderator (M). BNT and CRT scores were alternatively used as proxies for cognitive abilities (the RAPM was also attempted, but none of these models were significant). In each model, a dummy-coded Risk Format variable (i.e., visual aid =1, no visual = -1) was used as the predictor (X).

Results of these moderation analyses are reported in Tables 6-9. The first model (Table 6), which examined how scores on the BNT moderate the relationship between prevalence-related formats and answer calibration, was found to be significant. Risk Format (X_1) was found to be significant predictor variable (β = .13, p = .026). Because greater accuracy is expressed by answer calibration scores closer to zero, those in the visual aid condition performed slightly worse than those in the no visual aid condition. Additionally, BNT performance (M_1) was found to be a significant moderator (β = -.14, p = .028). Higher BNT scores were associated with better answer calibration. However, the interaction of the moderator and predictor (X_1 x M_1) was found to be non-significant. Contrary to expectations, those with lower BNT scores did not have better answer calibrations when in the visual aid condition. Figure 4 illustrates the results of this moderation model.

The model evaluating how scores on the CRT moderate the relationship between prevalence-based formats and answer calibration was also significant (Table 7). Risk Format (X_2) was found to be a significant predictor (β = .16, p = .014), and CRT performance (M_2) was a significant moderator (β = -.09, p = .022). Once again, those in the visual aid condition had worse answer calibration, while those with higher CRT scores had better answer calibration. Like the first model, there was a non-significant interaction (X_2 x M_2) between format and CRT scores: those with lower CRT scores did not have improved calibration in the visual aid condition. These results are displayed in Figure 5.

The model examining the moderating influence of BNT scores between performance-based formats and answer calibration was not significant (see Table 8). Although the model was not significant (p = .074), there was a significant interaction between Risk Format and BNT scores (X_3 x M_3: β = -.35, p = .043). This relationship is illustrated by Figure 6, and seems to suggest that those with lower BNT scores performed the same regardless of risk format. In contrast, those with elevated numeracy had improved answer calibration in the visual aid condition. However, the interpretability of this interaction is limited because the overall model was not significant.

Fortunately, the model examining the relationship among CRT Scores, answer calibration, and performance-based formats was significant (see Table 9). Although Risk Format was not a significant predictor (β = .02, p = .092), elevated CRT scores were significantly related to better answer calibration (β = -.33, p = .004). Furthermore, there was a significant interaction between Risk Format and CRT scores, (β = -.29, p = .013). As illustrated in Figure 7, those with higher CRT scores showed improved performance when in the visual aid condition. These results run contrary to the initial hypothesis that those with lower levels of cognitive abilities would experience the greatest boost in performance when in the visual aid condition. Explanations for this finding will be explored further in the discussion section.

Changing Perceptions, Attitudes, and Intentions

Another key prediction was that exposure to the risk-based materials would result in changes in perceptions, attitudes, and intentions regarding texting while driving. Unfortunately, there was not a significant effect of experimental condition on changes in perceptions, attitudes, or intentions (Tables 10-12). A two-way MANOVA was run, comparing perceptions, attitudes, and intentions towards distracted driving among the two experimental condition variables (Risk Content and Risk Format). Using Pillai's trace, there was not a significant multivariate effect of Risk Content on changes in perceptions, attitudes, or intentions, V = .024, F(3,151) = 1.26, p = .290, η^2_p = .02. Nor was there a significant multivariate effect of Risk Format on changes in perceptions, attitudes, or intentions, V = .009, F(3,151) = 0.48, p = .700, η^2_p = .01. Furthermore, there was not a significant interaction between Risk Content and Risk Format, V = .011, F(3,151)

$= 0.54$, $p = .658$, $\eta^2_p = .01$. Perceptions, attitudes, and intentions were not altered by exposure to materials detailing the risks of distracted driving, regardless of the content or format.

Predicting Intentions

Analyses were conducted to examine the relationship between intentions and the other variables. Because the experimental conditions were not found to have significantly impacted changes in perceptions, attitudes, or intentions, the post-assessment variables were used.

In the full sample, attitudes had the strongest relationship with intentions ($r = .600$, $p < .001$), followed by perceptions of risk ($r = .282$, $p < .001$). This indicates that those with more positive attitudes towards refraining from distracted driving, and those who perceived the risks to be greater, had greater intentions to refrain from texting while driving. Furthermore, there was a negative relationship between intentions and distracted driving exposure (DDE; $r = -.281$, $p < .001$), suggesting those who engaged in less distracted driving in the past were less likely to intend to do so in the future.

A multiple regression analysis was conducted to further explore the relationship between intentions and comprehension scores. The hypothesis was that increased comprehension should decrease intentions to text and drive by impacting perceptions of risk and attitudes towards texting while driving. Intentions were regressed on attitudes, perceptions, and DDE on step one, with answer calibration and inference scores entered on step two (see Table 13). Attitudes, perceptions, and prior distracted driving exposure accounted for nearly 38% of the variance in intentions to refrain from texting while driving in the first step ($R^2 = .376$, $F(3, 151) = 30.29$, $p < .001$). Attitudes were a significant predictor ($\beta = .55$, $p < .001$), as was DDE ($\beta = -.14$, $p = .033$). Those with positive attitudes towards not texting and driving were less likely to intend to do it, as were those with less prior exposure. The addition of the comprehension measures on step 2 did not significantly increase the amount of variance explained (F-change (2, 149) = 0.36, p = .698), but the model was significant (R^2 = .379, F(5, 149) = 18.16, p < .001). Comprehension of statistical representations of the risks related to texting while driving did not significantly alter intentions to engage in that behavior.

These multiple regression analyses were repeated for the separate content-based conditions to assess the impact of format on intentions. In both models intentions were regressed on attitudes, perceptions, and DDE on step one, with answer calibration, inference scores, and a Risk Format dummy variable entered on step two (see Table 14 and 15). Attitudes, perceptions, and distracted driving exposure accounted for nearly 39% of the variance in intentions to abstain from texting while driving among those in the prevalence-based conditions (R^2 = .387, F(3, 72) = 15.12, p < .001). Attitudes (β = .46, p < .001) and DDE (β = -.24, p = .015) were both significant predictors. However, the addition of the comprehension variables and format condition did not significantly improve the model (F-change (3, 69) = 1.75, p = .164). In the prevalence-based conditions, neither Risk Format nor comprehension significantly impacted intents to engage in texting while driving.

In the performance-based conditions, only attitudes significantly predicted intentions in step one (β = .62, p < .001). Still, the model was significant and predicted about 39% of the variance in intentions (R^2 = .387, F(3, 75) = 15.78, p < .001). The additional of comprehension variables and risk format did not significantly improve the amount of variance explained (F-change (3, 72) = 1.37, p = .258). However, the revised model was significant, R^2 = .648, F(6, 72) = 8.69, p < .001. Once again, only attitudes significantly predicted intentions (β = .62, p < .001), but Risk Format approached significance (β = .18, p = .070). While these results may suggest that those exposed to visual aids had greater intentions to refrain from texting while driving, additional testing is required. A follow-up analysis was conducted, with intentions regressed on attitudes and visual aid condition. As demonstrated in Table 16, Risk Format was not a significant predictor of intentions in this model ($\beta = .13$, $p = .129$). Therefore, it is unlikely that exposure to visual aids impacted intentions in the performance-based conditions.

To further probe the relationship among intentions, attitudes, and distracted driving exposure, a mediation analysis was conducted. This analysis employs bias-corrected bootstrapping and confidence intervals to calculate the indirect effect of how the predictor variable influences the outcome variable through a mediating variable. Using this method, the total indirect effect is examined and determined to be significant if its 95% confidence interval does not overlap with zero. OLS regressions for total effect and direct effect are also given and significance is similarly determined if 95% confidence intervals do not overlap with zero, although *F*-tests are also calculated.

Results of this mediation analysis are reported in Table 17, and illustrated in Figure 8. The first step of the model evaluates the extent to which increasing attitude scores affect DDE. The total effects model examines direct effect of attitudes on intentions, whereas the mediation model adds the variable DDE to the regression equation. Participants with more positive attitudes towards refraining from texting while driving were found to have less distracted driving exposure (path a = -0.73), and participants with elevated distracted driving exposure reported less intentions to refrain from texting while driving (path b = -0.11). Furthermore, the confidence interval of the indirect effect (ab = 0.076) was determined to be above zero (95% CI: .03 to .17).

Additionally, a direct effect was found whereby those with increased attitudes also had greater intentions (path *c*’ = 0.35, 95% CI: 0.20 to 0.50). This demonstrates that past distracted driving behavior does impact the relationship between attitudes towards distracted driving and intentions to refrain from this behavior.

Chapter 4:

Discussion

This study investigated the impact of visual aids in altering distracted driving behavior by facilitating young adults' comprehension of the statistical risks associated with texting while driving. Those with low levels of cognitive ability in particular were predicted to experience the greatest gains in comprehension. Furthermore, performance-related content was expected to be related to more positive attitudes and intentions towards abstaining from distracted driving behaviors. It was also hypothesized that increased comprehension of the risks would translate into more positive attitudes and intentions towards refraining from texting while driving.

The results of this study did not support many of the initial hypotheses. Regardless of the content or format of the materials used in the risk assessment, participants' perceptions, attitudes, and intentions towards texting while driving did not change after viewing the risk-related materials. Being exposed to the likelihood of getting into a distracted driving car crash did not alter beliefs about how dangerous the associated behavior was and whether refraining from texting while driving was effective. Intentions to refrain from texting while driver also did not change. Additionally, statistical comprehension did not generally improve by displaying the statistical information in the form of visual aids. In the prevalence-based condition, comprehension scores were in fact lower when the information was displayed graphically compared when it was presented in a table. In the prevalence-based condition, conversely, comprehension scores were higher for those in the visual aid condition, but only among those with high levels of cognitive ability. These finding runs contrary to the initial hypotheses that were proposed; although they do provide direction for future studies.

The first goal of this study was to assess the impact of visual aids on perceptions, attitudes, and intentions related to texting while driving. Although not explicitly stated, it was anticipated that attitudes towards texting while driving would be related to intentions to engage in that behavior. The results did show that individuals with more positive attitudes towards refraining from texting while driving also reported intentions to abstain from that behavior. This is consistent with previous evidence on the role of attitudes in intentions to engage in distracted driving (Benson et al., 2015; Nemme & White, 2010; Walsh et al., 2008). The theory of planned behavior (TPB; Azjen, 1991) is a useful paradigm with which to understand the complex relationship among attitudes, intentions, and behavior. According to TPB, reasoned behaviors occur when there are intentions to engage in that behavior and adequate ability to do so. Azjen also posits that intentions themselves are influenced by attitudes, perceived control, and subjective norms (see Figure 9). Theoretically, targeting beliefs about one of these factors, such as attitudes, should decrease intentions to engage in the behavior, making that behavior less likely to occur. Attitudes have been reliably found to predict intentions to drive while using a mobile phone (Benson et al., 2015; Walsh et al., 2008), and self-reported distracted driving behavior after a one-week delay (Nemme & White, 2010). The present study found that individuals with positive attitudes towards refraining from texting while driving may indeed intend to abstain from this behavior, but only if they have not engaged in texting while driving in the past. These results confirm previous research in which past behaviors predicted intentions to send and read text messages while driving (Benson et al., 2015; Nemme & White, 2010). Individuals with strong attitudes might intend to refrain from texting while driving as compared to those with weaker attitudes possibly because that is how they have behaved in the past. Thus, past behavior might drive, at least in part, the pathway between the attitudes and intention relationship. The present study's results extend this literature suggesting that there is a link between attitudes, past behavior, and intentions to engage in that behavior. Future research should explore interventions that can simultaneously promote positive attitudes towards abstaining from distracted driving while also disrupting the influence of past behavior.

The second goal of the present study was to investigate how the content of risk-related information impacts perceptions, attitudes, and intentions related to distracted driving. It was initially hypothesized that the performance condition would be related to changes in attitudes and intentions related to distracted driving. While this was not the case, there was a surprisingly large difference in comprehension between the performance and prevalence conditions, independent of format. Although it should be noted that comprehension was primarily assessed using their answer calibration (i.e., how close their responses were to the correct answers), since no participants correctly answered the statistics-based comprehension questions. It was determined that those in the prevalence conditions provided much closer estimates using this metric than their counterparts in the performance conditions.

In explaining the discrepancies in answer calibration between the two content conditions, it is worth noting that the conditions varied in the type of information provided and the way this content was displayed in the visual aid conditions. In the performance condition, the information compared the increased likelihood of a car crash for every second an individual spent using their cell phone compared to other distractors. The non-visual aid format displayed tables with statistical information, as opposed to line graphs in the visual aid condition. The prevalence condition contained statistics about the extent to which young drivers comprised cell phone-related traffic fatalities. In the visual aid condition, participants viewed a graph of overlapping categories; in contrast, the non-visual aid condition used a simple table to display this information. Additionally, the questions used to assess comprehension varied between these conditions, further complicating comparisons.

There are two possibilities for why participants may have yielded different comprehension scores across material content groups. On the one hand, the questions may have been easier to answer in the prevalence condition. It could be that the mathematical calculations required by these questions were simpler to calculate. If this was the case, it would be expected that cognitive abilities would be more strongly associated with comprehension scores in the performance condition than in the prevalence condition. Per dual-process theories of cognition (e.g., Evans & Stanovich, 2013), a stronger relationship between relative accuracy and cognitive abilities in a more difficult condition indicates that better calibrated individuals needed to rely more on effortful, analytic thinking. As such, it would be expected that those with higher levels of cognitive abilities would be required to answer more difficult questions. However, cognitive abilities were more strongly associated with relative accuracy in the supposedly easier prevalence condition than in the potentially more difficult performance condition. It is then unlikely that the questions in the prevalence condition were easier, because cognitive ability were less strongly associated with comprehension scores in this condition. An alternative explanation is that the information contained within the prevalence condition may have been easier to comprehend. This is supported by the finding that more correct answers to the inferential questions were generated in the prevalence rather than in the performance conditions. These inferential questions did not require mathematical calculations, and correct responses to these questions did not depend on answering the mathematical questions correctly. The fact that participants were better able to answer inference-based questions in the prevalence condition, and cognitive abilities were more strong correlated with comprehension scores, indicates that the improved performed on the math-based assessment was because the material was better understood and not because the questions were easier.

Although visual aids did not improve statistical comprehension across experimental conditions, displaying the information graphically did have an impact on statistical comprehension when analyzing the content conditions separately. For the prevalence condition, those in the visual aid condition had worse relative accuracy than those were exposed to the information with a table alone (see Figures 4 and 5). This negative impact of visual aids was present regardless of participants' cognitive abilities. In contrast, there was an interaction between cognitive ability and format in the performance condition. Participants with evaluated cognitive ability had improved comprehension when exposed to visual aids. This finding that only cognitively gifted individuals would benefit from the visual aids from was unexpected, given that previous research suggests that individuals exposed to messaging containing visual aids tend to perform better on measures of statistical comprehension (Garcia-Retamero & Cokely, 2011, 2013, 2014; Garcia-Retamero et al., 2015). This is especially surprising because participants in the prevalence condition were required to make Bayesian inferences based on nested sets. According to Barbey and Sloman's (2007) NST, nested sets often obscure the relationship between a whole unit and its parts. In this case, the number of car crashes caused by young drivers using cell phones is nested within both the number of all distracted driving-related crashes and the number all young driver-involved crashes. Theoretically, a visual aid should make these relationships more explicit by providing concrete features, which tends to improve individuals' comprehension (Ancker et al., 2006). Additionally, the visual aid in this condition was grid-based, a format that Garcia-Retamera and Cokely (2014) found to be best suited to increasing comprehension among individuals with low numeracy.

A key difference between the materials used by similar studies and the present study is that the present materials in the non-visual aid condition did not employ probabilities to express information. Evidence suggests that individuals struggle with statistical inferences in conditions where the content is expressed as a probability (e.g., 10%) because such calculations require high levels of cognitive ability (Johnson & Tubau, 2015; Lesage et al., 2013; McNair & Feeney, 2015; Sirota & Juanchich, 2011; Sirota, Juanchich, & Hagmayer, 2014). When natural frequencies (e.g., 10 out of 100) are substituted, performance improves (i.e., Lesage et al., 2013, Garcia-Retamera & Cokely, 2011). In both the prevalence and performance conditions, the non-visual aid materials were presented in a table using the actual data. Displaying the content as actual numbers bypasses the deficits associated with content expressed in probabilities. It is therefore reasonable that comprehension was not worse in the non-visual aid condition. The fact that participants in the non-visual aid condition did better than those in the visual aid condition may indicate that the visual aids obscured the relationships among the nested sets in the prevalence condition. It could be that the participants found the graphic depiction to be more confusing than when the information was simply presented in table format. Unfortunately, participants only viewed the information either in a table or as a graphic. Without within-subject comparisons, no definitive explanation on this point can be provided.

The third goal of this study was to examine the link between risk comprehension and individual differences in cognitive ability. As predicted, those with superior cognitive abilities, as measured by the CRT and BNT, performed better on the risk comprehension task. The moderation analyses showed that cognitive ability was significantly related comprehension of the material. Relative answer accuracy was predicted by higher scores of both numeracy (as measured by BNT; Cokely et al., 2012) and cognitive reflectivity (as measured by the CNT;

Frederick, 2005). This finding is consistent with previous research that has connected performance on reasoning tasks with individual differences in cognitive ability (Frederick, 2005; Garcia-Retamera & Cokely, 2014; Johnson & Tubau, 2015; Lesage et al., 2013; Toplak et al., 2011). Fluid intelligence (as measured by the RAPM; Author & Day, 1994), however, was not related to greater accuracy in this sample, contrary to Sirota et al. (2014). Although, Sirota et al. compared probabilities to natural frequencies, whereas the current study did not employ either.

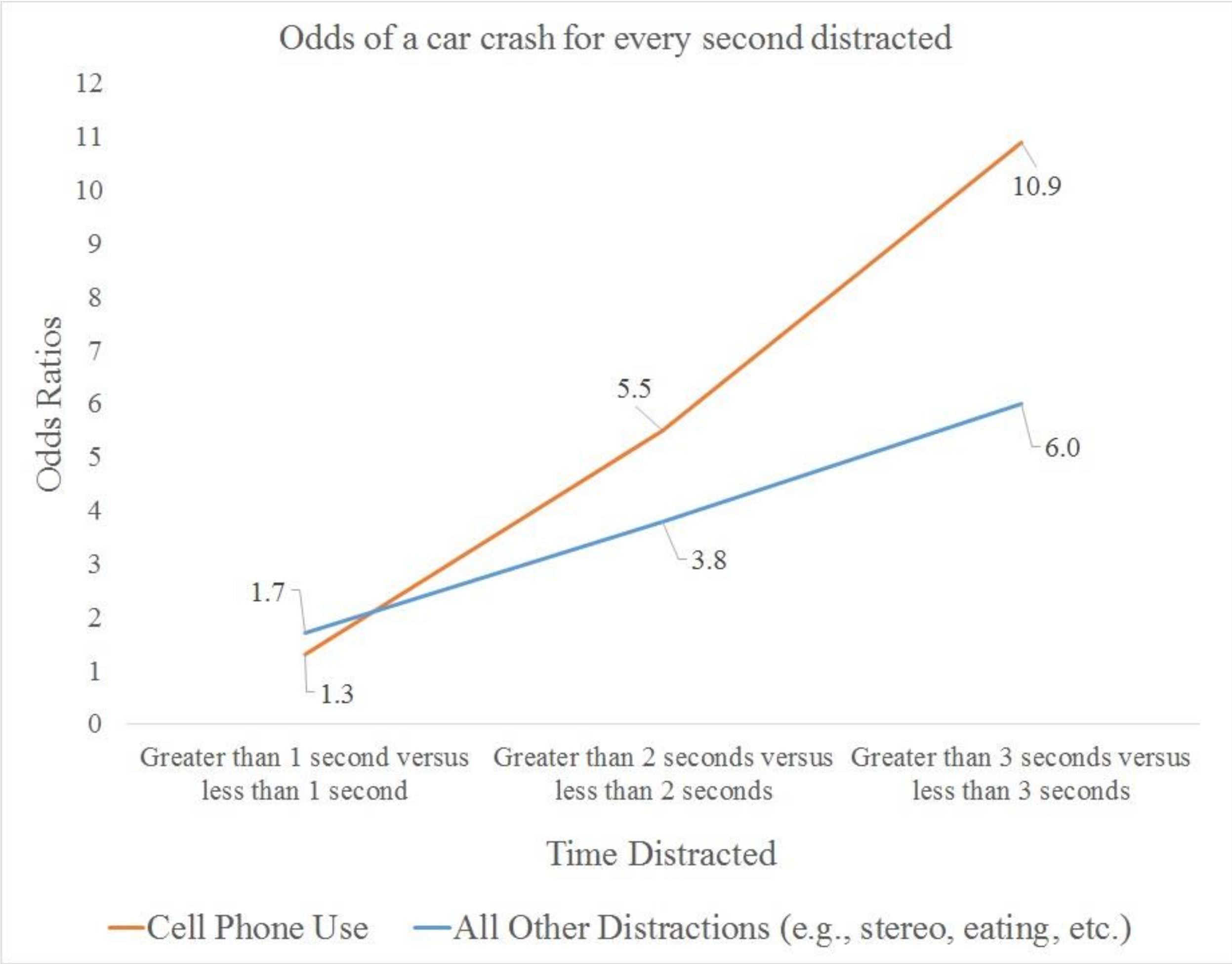
Unexpectedly, there was an interaction between format and cognitive abilities found in the performance condition. Those with higher levels of cognitive reflectivity, but not those with lower levels, had better relative accuracy in the visual aid condition. At first glance, this finding may seem counter-intuitive. The goal of the current study was to explore how visual aids may be utilized to assist those with low levels of cognitive abilities comprehend statistical information. However, other studies have also found that some formats only benefit those with higher levels of cognitive ability. For instance, Lesage et al. (2013) found that only those with higher levels of cognitive ability performed better on a reasoning task when nested sets were made more explicit. Similarly, Garcia-Retamera and Cokely (2014) found that some visual aids did not improve comprehension among those with low numeracy and low graph literacy. Numeracy is thought to be critical to not only comprehending statistical information related to risk, but also making inferences based on that information (Johnson & Tubau, 2015). Visual aids need to be properly designed and tailored to those with low levels of cognitive abilities; otherwise, they offer no benefits. Notably, the participants in this study’s sample performed poorly on the numeracy and fluid intelligence measures as compared to other college-age samples. The comparatively low levels of cognitive ability in this sample may offer some insights into this study’s many unexpected findings, such as the fact that perceptions, attitudes, and intentions did not change after participants completed the risk assessment. It could be that the participants in this sample did not understand the risk assessment because of their relatively low levels of numeracy and fluid intelligence. This interpretation is bolstered by the fact that not a single participant offered a correct response on the comprehension task. One future would be to reexamine the variables related to distracted driving after eliminating those participants who performed below a certain threshold on the numeracy and fluid intelligence measures. At the same time, the poor performance on these tasks suggests that extra attention ought to have been spent on tailoring the materials to ensure those with low numeracy could comprehend the material.

One major limitation of this study was the fact that the materials may not have been properly piloted before data collection began. This study attempted to use newly designed materials to alter perceptions, attitudes, and intentions regarding a risky behavior. However, the materials were not fully vetted to ensure that they were comprehendible to an undergraduate student population. The results of this study suggest that the materials in the performance condition were better understood when presented graphically, but only among those with higher levels of cognitive ability. In contrast, the materials in the prevalence condition are better understood not as a graph, but as a table of data. While this could indicate that that the risk-related information was not persuasive enough to discourage testing while driving, this is far from certain. It could be that the table format was an effective means of conveying the information. In order to evaluate the influence of risk-related materials on intentions to engage in a risky behavior, future research ought to alter these materials so that individuals with low levels of cognitive ability can better understand the information. Additionally, these materials should be compared to non-quantitative means of displaying risk already in use, such as those created by the National Highway Traffic Safety Administration (2017). This would allow researchers, traffic safety advocates, and government personnel to be more informed about the most effective means of changing young adults' behavior related to texting and driving.

Another limiting factor in this study was the loss of data related to working memory capacity. Although working memory capacity has not been directly linked to statistical inferences, it has been connected to fluid intelligence (Kane, Hambrick, & Conway, 2005), cognitive reflectivity (Cokely & Kelley, 2009), and the use of causal inferences to understand cause-and-effect relationships (Linderholm, 2002), among other abilities. Due to these connections, it would have been interesting to evaluate the extent to which working memory capacity is engaged in statistical comprehension. Having this data may have also clarified the relationship between the sample's low numeracy and poor performance on the risk comprehension task by providing another means of assessing cognitive ability. It is not certain that working memory capacity would similarly moderate the relationship between format and comprehension. Working measuring capacity measures assess a different aspect of cognitive ability than the BNT, CRT, and RAPM. Working memory capacity represents an earlier stage in processing (Conway et al., 2005), and a valid assessment could show whether visual aids improve comprehension at this earlier stage. Future efforts to analyze the impact of visual aids on risk comprehension should include working memory capacity measures, and ensure that the data is properly collected.

Overall, this study examined how improving comprehension of statistical information related to risky behavior would increase intentions to avoid that behavior. The results of the study showed that risk format and risk content did not have the expected effects on comprehension, perceptions, attitudes, or intentions. Visual aids influenced comprehension, but only supported those with higher levels of cognitive ability who viewed line charts that graphically displayed performance data. Furthermore, exposure to information about the risks associated with texting while driving did not change reported perceptions, attitudes, or intentions, regardless of content or format. Although cognitive abilities were related to superior comprehension, this improved understand did not influence perceptions, attitudes, or intentions. Nonetheless, this study did provide notable insights on the relationship of past behavior, attitudes, and intentions. Positive beliefs about refraining from distracted driving directly influenced intentions to avoid texting while driving. However, past experiences with distracted driving can disrupt this relationship. Therefore, work is needed to develop materials that promote positive attitudes to turn people's intentions away from distracted driving while also negating the influence of their past behavior.

Figure 1. Visual aid for performance related message content (adapted from Simons-Morton et al., 2014)



Likelihood for five durations of single longest single glance off forward roadway (LGOR) involving (A) All Secondary Tasks; (B) Wireless Secondary Tasks. s = seconds

Figure 2. Visual aid to illustrate fatalities associated with young drivers' cell phone use

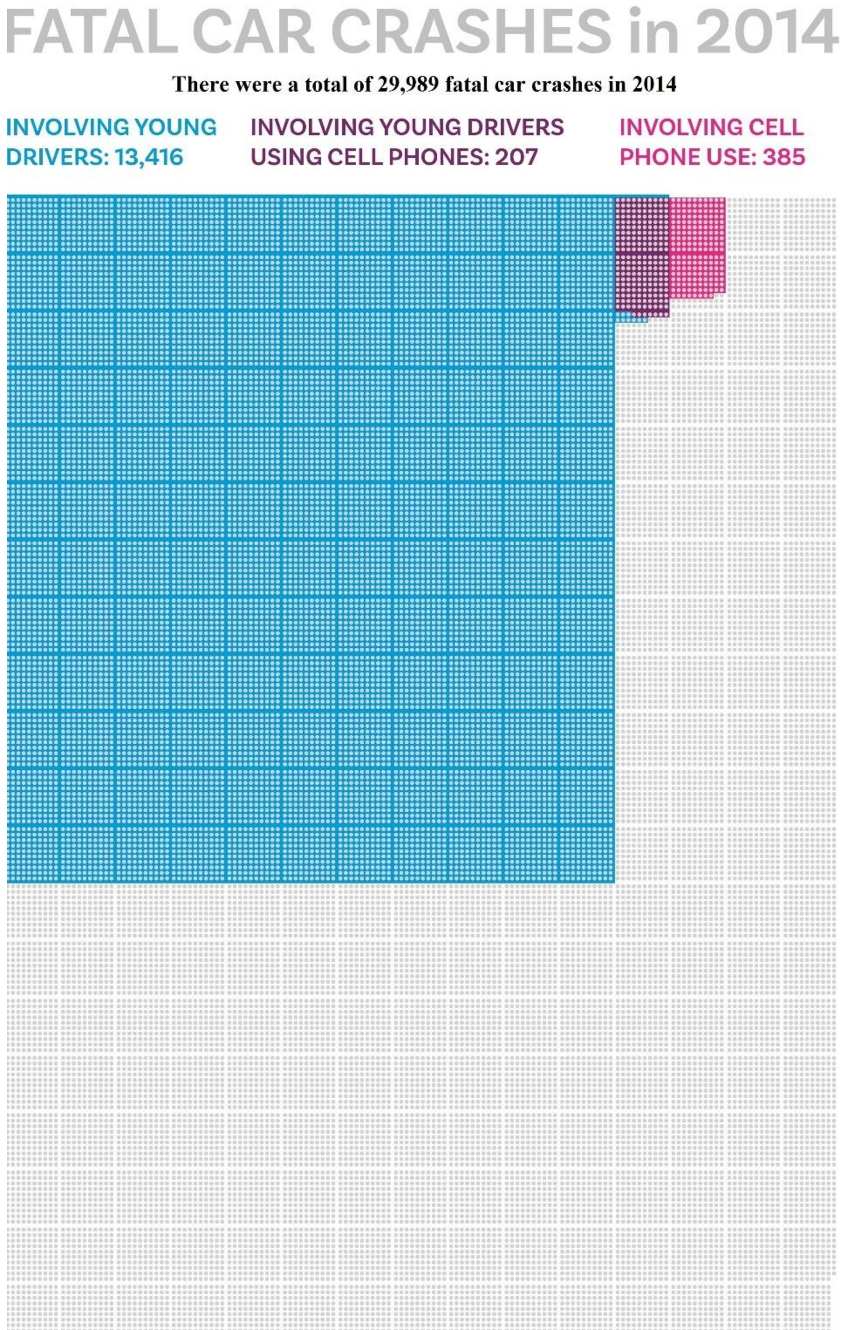


Figure 3. OSPAN and RSPAN (from Foster et al., 2014)

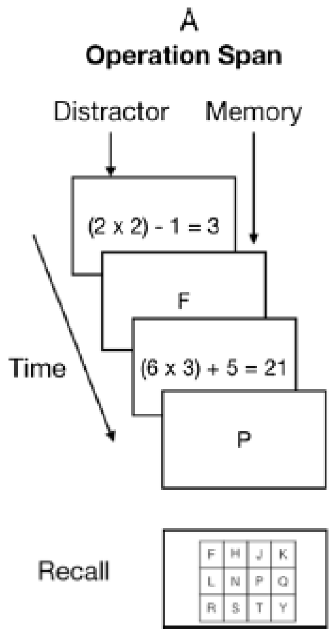


Figure 3. Example of OSPAN protocol

Operations Span test (OSPAN; Foster et al., 2015)

Participants will see a set of mathematical equations and will be asked to judge whether the equation is valid (selecting either “True” or “False”). Approximately half of the equations will be valid. After each equation, participants will see an element (a letter) for 500 milliseconds for recall at the end of the set. Set sizes range from 4–6, with two trials administered for each set size. Scores will be calculated by summing the number of letters correctly recalled in the correct order. See Figure 3, below.

Before starting the actual OSPAN test, participants will be given three pre-trial tasks to introduce them to the procedure. First, participants will be presented with examples of the letter identification task without the equation masks, in which they must identification sets of 2 and then 3 letters. The second task will present participants with 3 examples of the mathematical equations, which they must judge to be “True” or “False.” Next, participants will be presented with the full task with a set size of 3. This pre-trial will not be scored.

Reading Span test (RSPAN; Foster et al., 2015)

Participants will see a set of sentences of approximately 10–15 words in length and will be asked to judge whether or not the sentence is sensible (selecting either “True” or “False”). Approximately half of the sentences will be sensible. After each sentence, participants will see an element (a letter) for 500 milliseconds for recall at the end of the set. Set sizes range from 4–6, with two trials administered for each set size. Scores will be calculated by summing the number of letters correctly recalled in the correct order.

Before starting the actual RSPAN test, participants will be given three pre-trial tasks to introduce them to the procedure. First, participants will be presented with examples of the letter identification task without the sentence masks, in which they must identification sets of 2 and then 3 letters. The second task will present participants with 3 examples of the 10-15 word sentences, which they must judge to be “True” or “False.” Next, participants will be presented with the full task with a set size of 3. This pre-trial will not be scored.

Table 1: *Perceptions, Attitudes, and Intentions regarding Texting while Driving before and after the Risk Assessment*

Measure	Pre-Assessment		Post-Assessment	
	Scores *M* (*SD*)	Reliability Cronbach's α (Number of items)	Scores *M* (*SD*)	Reliability Cronbach's α (Number of items)
Perceptions	12.22 (3.77)	.512 (2)	12.41 (4.05)	.608 (2)
Attitudes	26.69 (5.76)	.821 (4)	30.41 (5.98)	.870 (4)
Intentions	12.25 (4.39)	.854 (2)	12.93 (4.37)	.849 (2)

Table 2: *Correlation Matrix of Study Measures*

	DDE	BNT	CRT	RAPM	Calib.	Infer	Perc. Δ	Att. Δ	Intent Δ
DDE	1	.065	.025	.099	-.041	-.095	.121	.102	-.075
BNT		1	.414**	.253**	.158	-.045	.060	-.069	.006
CRT			1	.378**	-.060	.035	-.064	-.151	.147
RAPM				1	-.034	.125	.083	-.139	-.090
Calib.					1	-.366	.099	.118	.012
Infer						1	-.082	-.129	-.062
Perc. Δ							1	.205**	-.165*
Att. Δ								1	-.124
Int. Δ									1

Note: DDE = Distracted Driving Exposure; BNT = Berlin Numeracy Scale; CRT = Cognitive Reflection Test; RAPM = Raven's Advanced Progressive Matrices; Calib. = Calibration Comprehension (lower scores are better); Infer = Inferences Comprehension Score; Perc Δ = Change in Perceptions; Att. Δ = Change in Attitudes; Int. Δ = Change in Intentions. $*p < .05$ $** p < .01$

Table 3: *Correlation Matrix of Study Measures (prevalence conditions only)*

	DDE	BNT	CRT	RAPM	Calib.	Infer	Percept.	Attitudes	Intentions
DDE	1	.132	.061	.185	-.020	-.138	.010	-.273	-.365
BNT		1	.227	.457**	-.262*	-.091	.095	-.147	.013
CRT			1	.335**	-.295*	.045	-.154	-.338**	.000
RAPM				1	-.252*	.128	-.039	-.140	-.029
Calib.					1	-.194	-.009	.118	-.108
Infer						1	-.006	-.151	-.078
Percept							1	.409**	.305**
Attitudes								1	.573**
Intentions									1

Note: DDE = Distracted Driving Exposure; BNT = Berlin Numeracy Scale; CRT = Cognitive Reflection Test; RAPM = Raven's Advanced Progressive Matrices; Calib. = Calibration Comprehension (lower scores are better); Infer = Inferences Comprehension Score; Percept. = Post-Assessment Perceptions; Attitudes = Post-Assessment Attitudes; Intentions = Post-Assessment Attitudes. *$p < .05$ ** $p < .01$

Table 4: *Correlation Matrix of Study Measures (performance conditions only)*

	DDE	BNT	CRT	RAPM	Calib.	Infer	Percept.	Attitudes	Intentions
DDE	1	.013	-.007	.022	-.182	-.074	-.114	-.227	-.196
BNT		1	.547**	.133	-.021	-.015	-.083	-.048	-.143
CRT			1	.411**	-.253*	.044	-.286**	-.066	-.164
RAPM				1	-.053	.138	-.084	-.009	-.083
Calib.					1	.071	.204	.045	.068
Infer						1	-.109	-.187	-.169
Percept.							1	.461**	.260*
Attitudes								1	.625**
Intentions									1

Note: DDE = Distracted Driving Exposure; BNT = Berlin Numeracy Scale; CRT = Cognitive Reflection Test; RAPM = Raven's Advanced Progressive Matrices; Calib. = Calibration Comprehension (lower scores are better); Infer = Inferences Comprehension Score; Percept. = Post-Assessment Perceptions; Attitudes = Post-Assessment Attitudes; Intentions = Post-Assessment Attitudes. *p < .05 ** p < .01

Table 5: *Statistical Comprehension by Risk Content and Risk Format*

	Prevalence Condition		Performance Condition	
	Inference Scores *M* (*SD*)	Calibration Scores *M* (*SD*)	Inference Scores *M* (*SD*)	Calibration Scores *M* (*SD*)
Visual Aid Condition	1.05 (0.66)	0.97 (0.44)	0.59 (0.68)	7.41 (0.72)
No Visual Aid Condition	0.81 (0.37)	0.81 (0.37)	0.61 (0.67)	7.39 (0.73)

Note: lower calibration scores indicate higher accuracy.

Table 6: *Results of the OLS Moderation Model of the Effect of Format on Answer Calibration by BNT scores in Prevalence-Based Content Conditions*

		Coeff.	*SE*	*t*	*p*
R^2 = 0.20*, *MSE* = 0.16 *F* (3, 70) = 5.97, *p* = .001					
	i_1	1.04	0.06	18.08	>.001
Format (*X*)*	b_1	0.13	0.06	2.28	.026
BNT Score (*M*)*	b_2	-0.14	0.06	-2.24	.028
Format x BNT (*X*x*M*)	b_3	0.04	0.06	0.70	.486

Note: *N* = 74. *Indicates significance where the 95% CI did not overlap with 0.

Figure 4: The Conditional Effect of Berlin Numeracy Test (BNT) Scores on Answer Calibration by Risk Format (prevalence condition). Values calculated by PROCESS (Hayes, 2013).

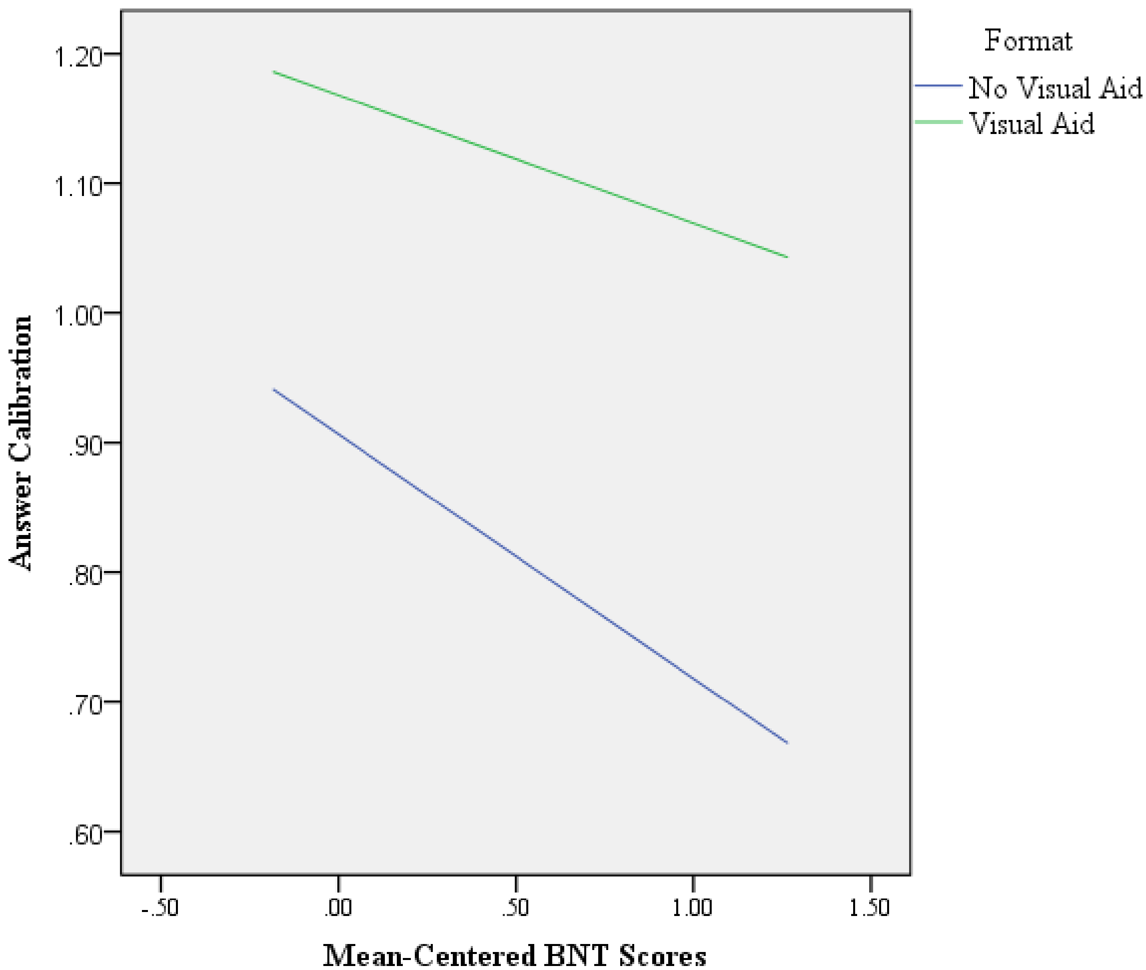


Table 7: *Results of the OLS Moderation Model of the Effect of Format on Answer Calibration by CRT scores in Prevalence-Based Content Conditions*

		Coeff.	*SE*	*t*	*p*
R^2 = 0.21*, *MSE* = 0.16 *F* (3, 69) = 5.97, *p* = .001					
	i_1	1.06	0.06	16.98	>.001
Format (*X*)*	b_1	0.16	0.06	2.23	.014
CRT Score (*M*)*	b_2	-0.09	0.04	-2.24	.022
Format x CRT (*X*x*M*)	b_3	-0.01	0.04	-0.15	.883

Note: *N* = 73. *Indicates significance where the 95% CI did not overlap with 0.

Figure 5: The Conditional Effect of Cognitive Reflection Test (CRTT) Scores on Answer Calibration by Risk Format (prevalence condition). Values calculated by PROCESS (Hayes, 2013).

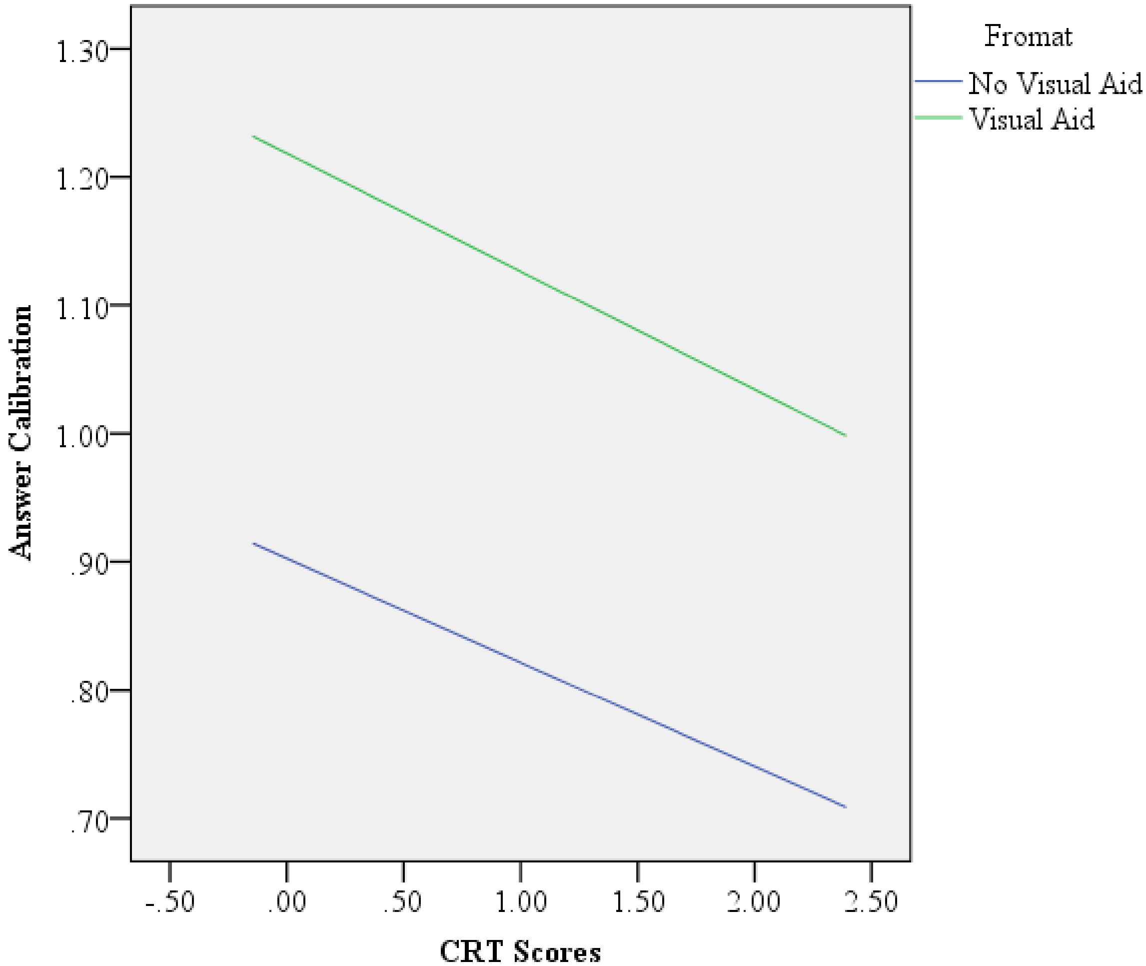


Table 8: *Results of the OLS Moderation Model of the Effect of Format on Answer Calibration by BNT scores in Performance-Based Content Conditions*

		Coeff.	*SE*	*t*	*p*
R^2 = 0.30, *MSE* = 1.94 *F* (3, 75) = 2.43, *p* = .072	i_1	7.42	0.21	34.91	>.001
Format (*X*)	b_1	0.01	0.21	0.07	.946
BNT Score (*M*)	b_2	-0.15	0.17	-0.86	.392
Format x BNT (*X*x*M*)*	b_3	-0.35	0.17	-2.06	.043

Note: *N* = 79. *Indicates significance where the 95% CI did not overlap with 0.

Figure 6: The Conditional Effect of Berlin Numeracy Test (BNT) Scores on Answer Calibration by Risk Format (performance condition). Values calculated by PROCESS (Hayes, 2013).

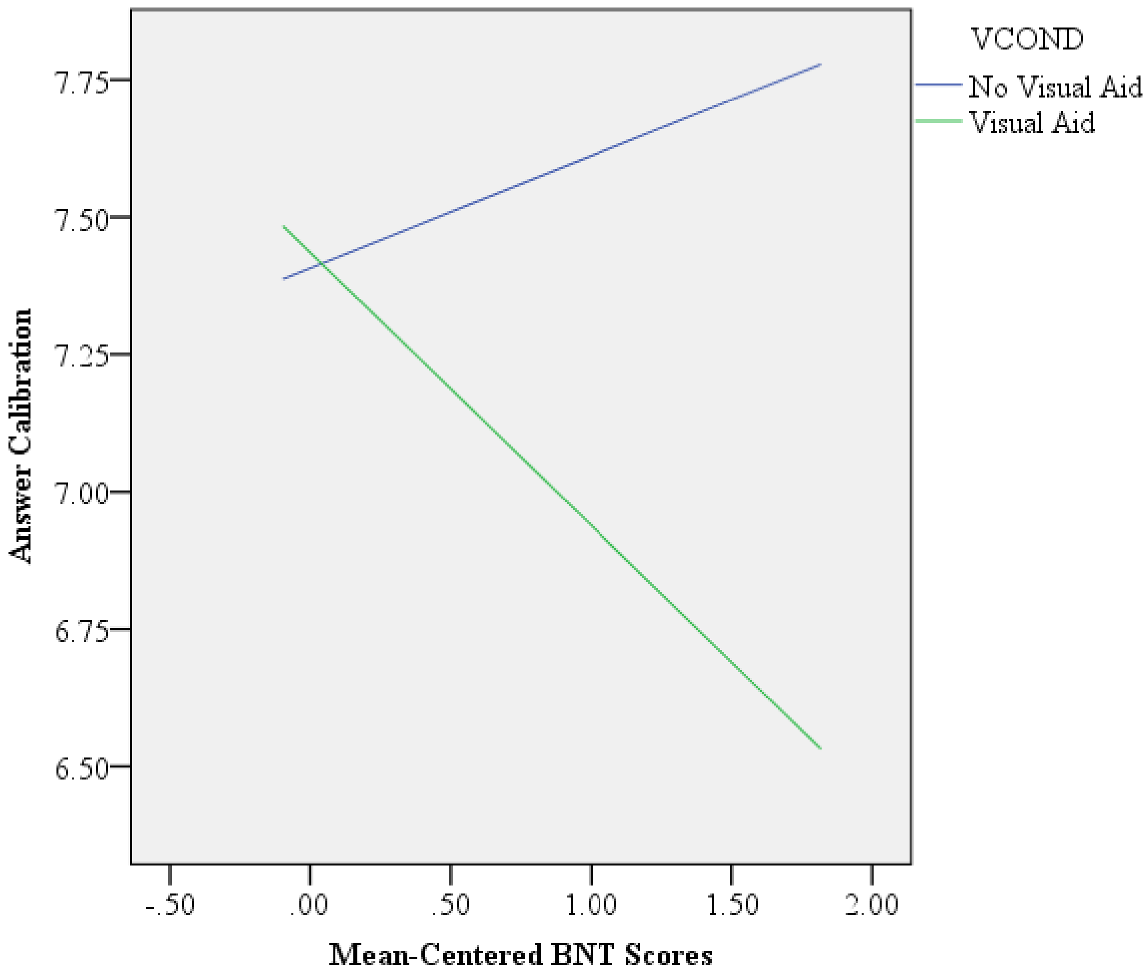


Table 9: *Results of the OLS Moderation Model of the Effect of Format on Answer Calibration by CRT scores in Performance-Based Content Conditions*

		Coeff.	*SE*	*t*	*p*
R^2 = 0.43*, *MSE* = 1.75 *F* (3, 75) = 5.47, *p* = .002					
	i_1	7.70	0.20	39.07	>.001
Format (*X*)	b_1	0.02	0.20	0.12	.902
CRT Score (*M*)*	b_2	-0.33	0.11	-2.94	.004
Format x CRT (*X*x*M*)*	b_3	-0.29	0.11	-2.55	.013

Note: *N* = 79. *Indicates significance where the 95% CI did not overlap with 0.

Figure 7: The Conditional Effect of Cognitive Reflection Test (CRTT) Scores on Answer Calibration by Risk Format (performance condition). Values calculated by PROCESS (Hayes, 2013).

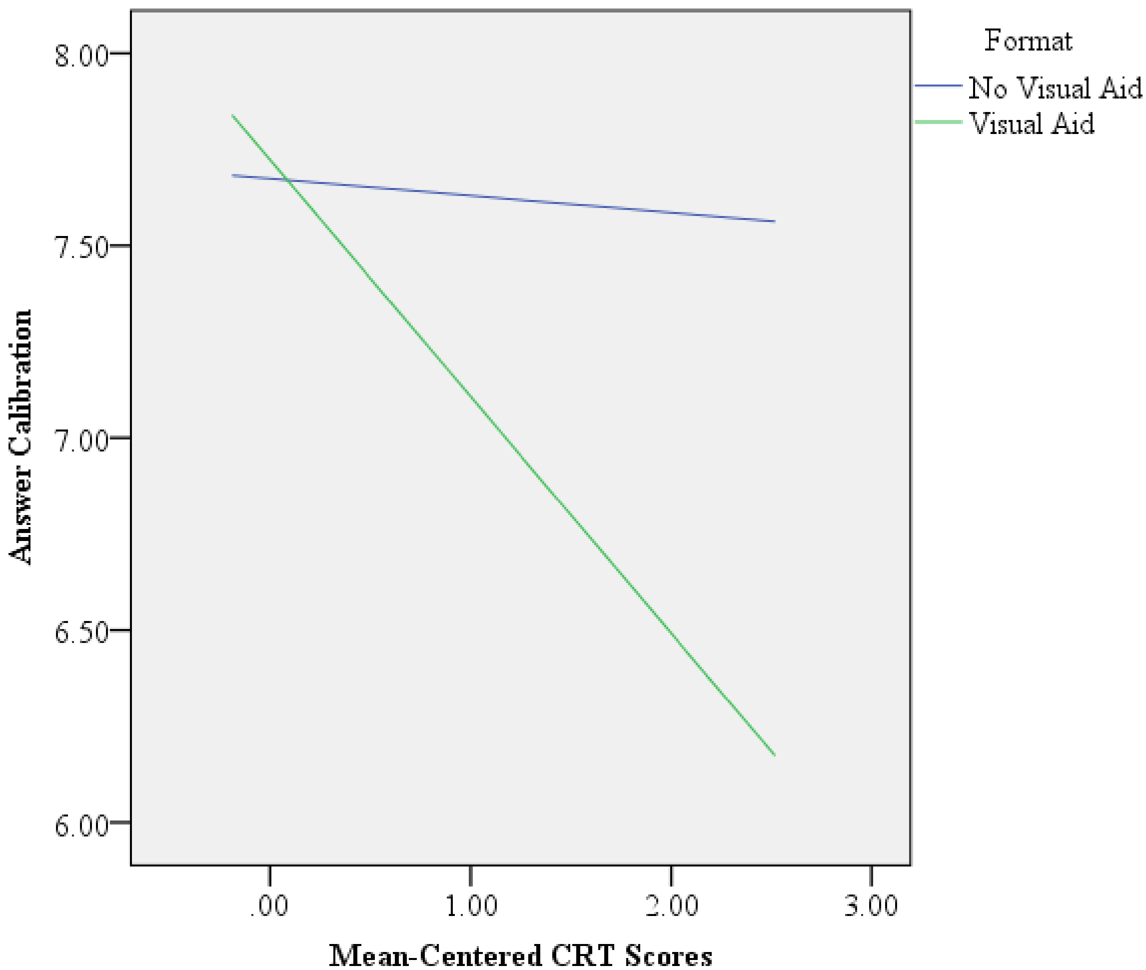


Table 10: *Attitudes towards Texting while Driving before and after the Risk Assessment by Risk Content and Risk Format*

	Prevalence Condition		Performance Condition	
	Pre-Assessment Attitudes *M* (*SD*)	Post-Assessment Attitudes *M* (*SD*)	Pre-Assessment Attitudes *M* (*SD*)	Post-Assessment Attitudes *M* (*SD*)
Visual Aid Condition	23.21 (3.81)	22.79 (4.83)	22.22 (4.57)	23.12 (5.16)
No Visual Aid Condition	23.36 (4.03)	23.76 (4.17)	22.43 (4.91)	23.28 (3.97)

Note: higher scores indicate more positive attitudes towards refraining from distracted driving as a means of avoiding car crashes.

Table 11: *Intentions regarding Texting while Driving before and after the Risk Assessment by Risk Content and Risk Format*

	Prevalence Condition		Performance Condition	
	Pre-Assessment Intentions *M* (*SD*)	Post-Assessment Intentions *M* (*SD*)	Pre-Assessment Intentions *M* (*SD*)	Post-Assessment Intentions *M* (*SD*)
Visual Aid Condition	11.47 (5.11)	11.63 (5.34)	11.61 (4.88)	13.07 (4.71)
No Visual Aid Condition	12.79 (3.99)	13.47 (4.43)	11.65 (5.02)	11.85 (5.27)

Note: higher scores indicate increased intentions to avoid distracted driving.

Table 12: *Perceptions regarding Texting while Driving before and after the Risk Assessment by Risk Content and Risk Format*

	Prevalence Condition		Performance Condition	
	Pre-Assessment Perceptions *M* (*SD*)	Post-Assessment Perceptions *M* (*SD*)	Pre-Assessment Perceptions *M* (*SD*)	Post-Assessment Perceptions *M* (*SD*)
Visual Aid Condition	12.00 (3.50)	12.21 (4.17)	12.34 (4.19)	12.78 (4.16)
No Visual Aid Condition	12.97 (3.61)	12.71 (3.98)	11.63 (3.79)	11.93 (4.00)

Note: higher scores indicate elevated perceptions of distracted driving risk.

Table 13: *Regression of Intentions on Attitudes, Perceptions, Distracted Diving Exposure, and Risk Comprehension*

Variables	β	*SE*	*t*	*p*
Step 1: R^2 = .38*				
Attitudes*	.55	.08	7.38	>.001
DDE*	-.14	.03	-2.15	.033
Perceptions	.04	.09	0.51	.610
Step 2: R^2 = .38*				
Attitudes*	.53	.08	7.02	>.001
DDE*	-.15	.03	-2.26	.025
Answer Calibration	-.06	.51	-0.80	.423
Inference Score	-.04	.10	-0.56	.579
Perceptions	.04	.09	0.56	.577

Note: *N* = 155. DDE = Distracted Driving Exposure. *Indicates significance where the 95% CI did not overlap with 0.

Table 14: *Regression of Intentions on Attitudes, Perceptions, Distracted Driving Exposure, Risk Comprehension, and Risk Format (Prevalence Condition)*

Variables	*β*	*SE*	*t*	*p*
Step 1: R^2 = .39*				
Attitudes*	.46	.12	4.31	>.001
DDE*	-.24	.04	-2.49	.015
Perceptions	.12	.04	1.18	.242
Step 2: R^2 = .43*				
Attitudes*	.44	.12	4.01	>.001
DDE*	-.27	.04	-2.73	.008
Answer Calibration	-.14	1.14	-1.39	.168
Perceptions	.12	.12	1.17	.245
Risk Format	-.11	.50	-1.10	.275
Inference Score	-.09	.76	-0.94	.349

Note: *N* = 76. DDE = Distracted Driving Exposure. *Indicates significance where the 95% CI did not overlap with 0.

Table 15: *Regression of Intentions on Attitudes, Perceptions, Distracted Driving Exposure, Risk Comprehension, and Risk Format (Performance Condition)*

Variables	*β*	*SE*	*t*	*p*
Step 1: R^2 = .62*				
Attitudes*	.62	.11	5.98	>.001
DDE	-.06	.04	-0.64	.527
Perceptions	-.03	.13	-0.34	.737
Step 2: R^2 = .68*				
Attitudes*	.62	.12	5.87	>.001
Risk Format	.18	.48	1.84	.070
DDE	-.11	.04	-1.12	.265
Perceptions	-.08	.13	-0.75	.456
Answer Calibration	.07	.33	0.78	.437
Inference Score	-.07	.69	-0.78	.438

Note: N = 79. DDE = Distracted Driving Exposure. *Indicates significance where the 95% CI did not overlap with 0.

Table 16: *Regression of Intentions on Attitudes and Risk Format (Performance Condition)*

Variables	*β*	*SE*	*t*	*p*
Step 1: R^2 = .64*				
Attitudes*	.63	.01	7.20	>.001
Risk Format	.13	.43	1.53	.129

Note: *N* = 81. *Indicates significance where the 95% CI did not overlap with 0.

Table 17: *Unstandardized Coefficients (Standard Errors) of the Mediating Effect of Distracted Driving Exposure on Attitudes and Intentions Using OLS Regression*

Variables	β	*SE*	*t*	*p*
DDE as DV Model: R^2 = .25, F(1, 155) = 10.29*				
Attitudes* (X)	-0.73	.23	-3.21	.002
Total Effects Model: R^2 = .17, F(1, 155) = 31.14*				
Attitudes* (X)	0.43	.08	5.58	>.001
Mediation Model: R^2 = .50, F(2, 154) = 25.25*				
Attitudes* (X)	0.35	.08	4.66	>.001
DDE* (M)	-0.11	.03	-4.04	>.001

Note: N = 79. DDE = Distracted Driving Exposure. Predictor variable is Attitudes, mediating variable is DDE, and outcome variable is Intentions. *Indicates significance where the 95% CI did not overlap with 0.

Figure 8. Mediation analysis results of distracted driving exposure's mediating effect on the relation of attitudes on intentions.

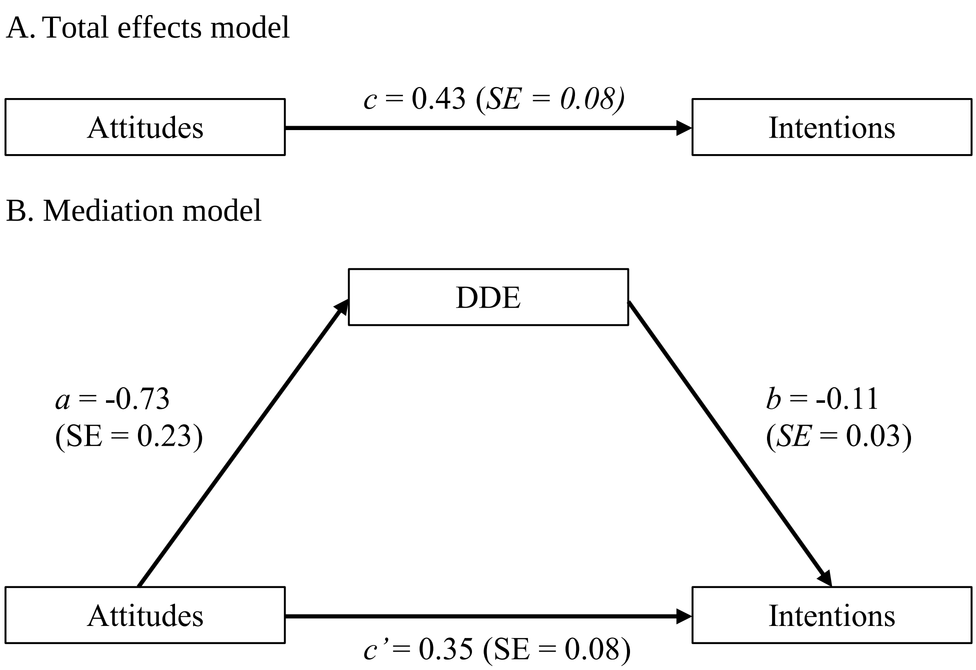
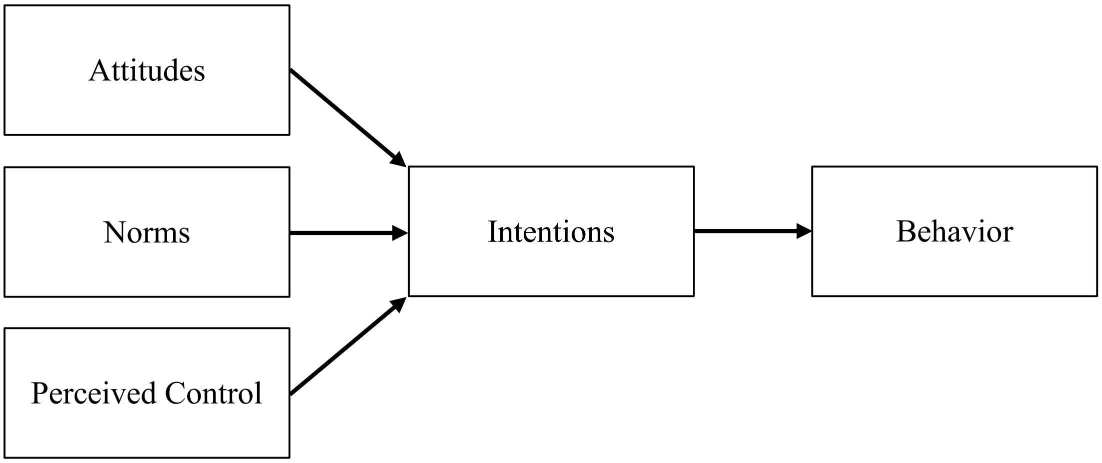


Figure 9. Variables related to the Theory of Planned Behavior (TPB; Azjen, 1991).



Appendix A. Demographic Questionnaire

1A. Please indicate your sex:

Options: Female; Male; Other; Prefer not to answer

2A. What is your age?

3A. With what race do you identify?

Options: American Indian or Alaska Native; Asian; Black or African American; Caucasian or White; Native Hawaiian or Other Pacific Islander; Multiple; Other; Prefer not to answer

4A. Do you identify as Hispanic or Latino?

Options: Yes; No; Prefer not to answer

5A. Do you have a valid driver's license?

Options: Yes; No

6A. Do you own a personal motor vehicle?

Options: Yes; No

7A. Have you ever been in a car crash in which you were using your cell phone while driving?

Option: Yes; No

8A. If you answered yes to the previous question, how many times have you been in a car crash in which you were using your cell phone while driving?

9A. Have you ever received a citation for using your cell phone while driving?

Option: Yes; No

10A. If you answered yes to the previous question, how many times have you received a citation for using your cell phone while driving?

Appendix B. Items used to assess distracted driving exposure related to cell phone use (adapted from Barmark et al., 2016)

B1. Do you think that you can safely text and drive?

Never	Rarely	Some of the time	Most of the time	Always
1	2	3	4	5

B2. In the last 30 days, have you READ text messages while driving?

Never	Rarely	Some of the times I drove	Most of the times I drove	Every time I drove
1	2	3	4	5

B3. In the last 30 days, WHEN have you READ text messages (select all that apply)?

None of the above	While stopped at a red light	While in stop-and-go traffic	While driving at a low speed (under 25 mph)	While driving at any speed
1	2	3	4	5

B4. In the last 30 days, have you READ an email while driving?

Never	Rarely	Some of the times I drove	Most of the times I drove	Every time I drove
1	2	3	4	5

B5. In the last 30 days, WHEN have you READ an email (select all that apply)?

None of the above	While stopped at a red light	While in stop-and-go traffic	While driving at a low speed (under 25 mph)	While driving at any speed
1	2	3	4	5

B6. In the last 30 days, have you viewed maps or directions on your phone while driving?

Never	Rarely	Some of the times I drove	Most of the times I drove	Every time I drove
1	2	3	4	5

B7. In the last 30 days, have you WRITTEN a text message while driving?

Never	Rarely	Some of the times I drove	Most of the times I drove	Every time I drove
1	2	3	4	5

B8. In the last 30 days, when have you WRITTEN a text message while driving (select all that apply)?

None of the above	While stopped at a red light	While in stop-and-go traffic	While driving at a low speed (under 25 mph)	While driving at any speed
1	2	3	4	5

B9. In the last 30 days, have you WRITTEN an email while driving?

Never	Rarely	Some of the times I drove	Most of the times I drove	Every time I drove
1	2	3	4	5

B10. In the last 30 days, when have you WRITTEN an email while driving (select all that apply)?

None of the above	While stopped at a red light	While in stop-and-go traffic	While driving at a low speed (under 25 mph)	While driving at any speed
1	2	3	4	5

B11. In the last 30 days, have you read messages or viewed information on social media apps or sites while driving (e.g., Facebook, Twitter, Snapchap, etc.?)

Never	Rarely	Some of the times I drove	Most of the times I drove	Every time I drove
1	2	3	4	5

B12. In the last 30 days, when have you read messages or viewed information on social media apps or sites while driving (select all that apply)?

None of the above	While stopped at a red light	While in stop-and-go traffic	While driving at a low speed (under 25 mph)	While driving at any speed
1	2	3	4	5

B13. In the last 30 days, have you TALKED on your cell phone while driving?

Never	Rarely	Some of the times I drove	Most of the times I drove	Every time I drove
1	2	3	4	5

B14. In the last 30 days, when have you TALKED on your cell phone while driving (select all that apply)?

None of the above	While stopped at a red light	While in stop-and-go traffic	While driving at a low speed (under 25 mph)	While driving at any speed
1	2	3	4	5

Appendix C. Items used to assess risk comprehension

Risks based on prevalence

C1a. Young drivers (those ages 15 to 29) comprise what percentage of total fatal car crashes?

____ out of ____

Answer: 44.74%

C2a. Young drivers (those ages 15 to 29) were involved in what proportion of fatal car crashes involving cell phone use? ____ out of ____

Answer: 53.77%

C3a. Drivers over the age of 29 comprise what percentage of total fatal car crashes?

____ out of ____

Answer: 55.25%

C4a. Drivers over the age of 29 were involved in what proportion of cell phone-related fatal crashes?

____ out of ____

Answer: 46.23%

C5a. Do young drivers make up a larger, a smaller, or the same proportion of cell phone-involved fatal car crashes compared to drivers over the age of 29?

Answer: Larger

C6a. Do young drivers make up a larger, a smaller, or the same proportion of all fatal car crashes compared to drivers over the age of 29?

Answer: Smaller

Risks based on performance deficits

C1b. Look at the odds ratios of cell phone use while driving. By what percentage does your risk of a car crash increase between one second of use and three seconds of use?

Answer: 252.94%

C2b. Look at the odds ratios of distracted driving in general. By what percentage does your risk of a car crash increase between one second of distraction and three seconds of distraction?

Answer: 738.46%

C3b. Compare the odds ratios of distracted driving in general to distracted driving for cell phones. What percentage greater is your risk of a car crash at two seconds of cell phone use?

Answer: 44.74%

C4b. Compare the odds ratios of distracted driving in general to distracted driving for cell phones. What percentage greater is your risk of a car crash at three seconds of cell phone use?

Answer: 81.67%

C5b. Comparing distracted driving in general to cell phone use while driving, is the odds of a car crash at one second of distraction more likely, less likely, or similarly likely?

Answer: Similarly likely

C6b. Comparing distracted driving in general to cell phone use while driving, is the odds of a car crash at three seconds of distraction more likely, less likely, or similarly likely?

Answer: More likely

Appendix D. Items used to assess distracted driving risk perception, attitudes, and intentions (adapted from Garcia-Retamero & Cokely, 2011)

Perception

D1. How likely are you to get into a car crash as a consequence of cell phone use while driving?

Very unlikely Very likely

1	2	3	4	5	6	7	8	9

D2. How worried are you about getting into a car crash as a consequence of cell phone use while driving?

Not at all Very much

1	2	3	4	5	6	7	8	9

Attitudes

D3. How effective is refraining from using your cell phone while driving in reducing your risk of a car crash?

Not at all Very much

1	2	3	4	5	6	7	8	9

D4. How important is it to you to refrain from using your cell phone while driving?

Not at all Very much

1	2	3	4	5	6	7	8	9

D5. How beneficial to you is it to refrain from using your cell phone while driving?

Not at all Very much

1	2	3	4	5	6	7	8	9

D6. How favorable do you feel about the prospect of refraining from using your cell phone while driving?

Not at all Very much

1	2	3	4	5	6	7	8	9

Intentions

D7. I likely is it that you will refrain from using my cell phone in the next 30 days

I have no intention of doing this I am certain that I will do this

1	2	3	4	5	6	7	8	9

Appendix E: Measures of cognitive ability

Cognitive Reflection Test (CRT; Frederick, 2005)

E1. A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? ______ cents [Correct answer = 10 cents; heuristic answer = 5 cents]

E2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? ______ minutes [Correct answer = 100; heuristic answer = 5]

E3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? ______ days [Correct answer = 24; heuristic answer = 47]

CRT-L Items (Primi, Morsanyi, Chiesi, Donati, & Hamilton, 2015)

E4. If three elves can wrap three toys in hour, how many elves are needed to wrap six toys in 2 hours? _____ elves [Correct answer = 3; heuristic answer = 6]

E5. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are there in the class? ______ students [Correct answer = 29 students, heuristic answer =30 students]

E6. In an athletics team, tall members are three times more likely to win a medal than short members. This year the team has won 60 medals so far. How many of these have been won by short athletes? ______ medals [Correct answer =15; heuristic answer = 20]

Berlin Numeracy Test (BNT; Cokely, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012)

E7. Out of 1,000 people in a small town 500 are members of a choir. Out of these 500 members in the choir 100 are men. Out of the 500 inhabitants that are not in the choir 300 are men. What is the probability that a randomly drawn man is a member of the choir? Please indicate the probability in percent. 25%

E8. Imagine we are throwing a five-sided die 50 times. On average, out of these 50 throws how many times would this five-sided die show an odd number (1, 3 or 5)? 30 out of 50 throws.

E9. Imagine we are throwing a loaded die (6 sides). The probability that the die shows a 6 is twice as high as the probability of each of the other numbers. On average, out of these 70 throws how many times would the die show the number 6? 20 out of 70 throws.

E10. In a forest 20% of mushrooms are red, 50% brown and 30% white. A red mushroom is poisonous with a probability of 20%. A mushroom that is not red is poisonous with a probability of 5%. What is the probability that a poisonous mushroom in the forest is red? 50 %

Raven’s Advanced Progressive Matrices (RAPM; Raven, 1958)

The RAPM task consists of 12 items from the larger, 36-item RAPM (Author & Day, 1994). In the RAPM, subjects see a 3×3 grid of shapes with the bottom right shape missing. The shapes themselves follow a logical pattern from left to right, and from top to bottom. The subject’s task is to choose, from a list of eight possible choices, the shape that logically fits in the missing corner.

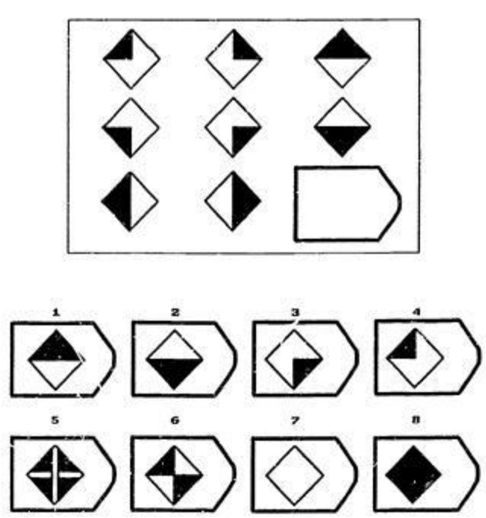


Figure 8: Example from the RAPM (Author & Day, 1994). The correct answer is 8.

Appendix F. Informed Consent Form

PRINCIPAL INVESTIGATOR: Blair Shevlin

PHONE: 267-266-2997

EMAIL: Bshevl2@students.towson.edu

Purpose of the Study:

This study is designed to evaluate the extent to which cognitive abilities contribute to the capability to understand the risks associated with distracted driving.

Procedures:

Participants will take an online survey using a school computer. The survey should take no longer than one (1) hour. You will be asked to tell us about your experience with distracted driving. You will be asked questions about your perceptions of distracted driving. You will be asked to make statistical inferences about the risks associated with distracted driving. You will also be asked about your attitudes and intentions towards distracted driving. Additionally, this survey will include several math-based questions, as well as tasks designed to evaluate your ability to recognize patterns and to remember several items of information in short period of time.

Risks/Discomfort:

There are no known risks associated with participation in the study. Should the survey become distressing to you, you may stop or quit the study immediately.

Benefits:

For participating today, you will be awarded course credits through the participant pool.

Alternatives to Participation:

Participation in this study is voluntary. You are free to withdraw or discontinue participation at any time. Refusal to participate in this study will in no way affect your grade or standing at Towson University.

Confidentiality:

All information collected during the study period will be kept strictly confidential. Your data associated with your performance today will only be identified through an identification number. No publications or reports from this project will include identifying information on any participant. If you agree to join this study, please indicate so below.

Voluntary Consent

1. I have read the information above and have freely volunteered to participate in this experiment.
2. I understand that all aspects of this project will be carried out in the strictest of confidence and in a manner in which my rights as a human subject are protected.
3. I have been informed in advance as to what my task(s) will be and what procedures will be followed.
4. I have been given the opportunity to ask questions, and have had my questions answered to my satisfaction.
5. I am aware that I have the right to withdraw consent and discontinue participation at any time, without prejudice.
6. If I decide not to participate in this research project my performance and/or grade in any course associated with this research project will not be affected.

7. My selection of the “I consent to participate” checkbox below may be taken as affirmation of all the above, prior to participation.

If you have any questions regarding this study please contact Dr. Kerri Goodwin at (410) 704-3202 or the Institutional Review Board Chairperson, Dr. Elizabeth Katz, Office of University Research Services, 8000 York Road, Towson University, Towson, Maryland 21252; phone (410) 704-2236.

I, ____, affirm that I have read and understood the above statement and have had all of my questions answered.

Signature: ____ Date: _____________

Appendix G: IRB Approval

IRB Approval # 1610007586 Inbox x

Taylor, Amy L. <altaylor@towson.edu> 11/29/16

to Blair, Kerri, IRB

The IRB has approved your protocol "Cognitive Abilities Associated with Risk Literacy of Distracted Driving " effective 11/29/2016.

Your IRB protocol can now be viewed by your faculty advisor in MyOSPR. For more information, please visit: http://www.towson.edu/academics/research/sponsored/myospr.html

If you should encounter any new risks, reactions, or injuries to subjects while conducting your research, please notify IRB@towson.edu. Should your research extend beyond one year in duration, or should there be substantive changes in your research protocol, you will need to submit another application.

We do offer training and orientation sessions for faculty/staff, please sign up for one of the sessions: http://fusion.towson.edu/www/signupGeneric/index.cfm?type=OSPR

Check back to that registration site frequently – we'll post additional sessions for January and spring semester soon.

Regards,
Towson IRB

Amy L. Taylor, MBA, CRA · Assistant Vice President for Research
Office of Sponsored Programs & Research
Towson University · 8000 York Road · Towson, Maryland, 21252-0001
t. 410-704-4931 · f. 410-704-4494

TOWSON UNIVERSITY

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50,* 179-211.

Ancker, J. S., Weber, E. U., Kukafka, R., & Starren, J. B. (2006). Design features of graphs in health risk communication: A systematic review. *Journal of American Medical Informatics Association*, *13*, 608–618. doi:10.1197/jamia.M2115

Arthur, W., & Day, D. V. (1994). Development of a short form for the Raven Advanced Progressive Matrices Test. *Educational and Psychological measurement*, *54,* 394-403.

Atchley, P., Atwood, S., & Boulton, A. (2010). The choice to text and drive in younger drivers: Behaviors may shape attitude. *Accident Analysis and Prevention*, *43,* 134-142. doi: 10.1017/j.aap.2010.08.003

Atchley, P., & Warden, A. C. (2012). The need of young adults to text now: Using delay discounting to assess informational choice. *Journal of Applied Research in Memory and Cognition*, *1*, 229-234. doi: 10.1016/j.jarmac.2012.09.001

Barbey, A. L., & Sloman, S. A. (2007). Base-rate respect: From ecological rationality to dual process. *Behavioral and Brain Sciences*, *30*, 241-297. doi: 10.1017/S0140525X07001653

Benson, T., McLaughlin, M., & Giles, M. (2015). The factors underling the decision to text while driving. *Transportation Research Part F*, *35,* 85-100. doi: 10.106/j.trf.2015.10.013

Bergmark, R. W., Gliklich, E., Guo, R., & Gliklich, R. E. (2016). Texting while driving: The development and validation of the distracted driving survey and risk score among young adults. *Injury Epidemiology*, *3,* 1-10. doi: 10.1186/s40621-016-0073-8

Cismaru, M., & Lavack, M. A. (2007). Tobacco warning labels and the protection motivation model: Implications for Canadian tobacco control policy. *Canadian Public Policy/Analyse de Politiques, 33*, 477–486.

Cismaru, M., & Nimegeers, K. (2016). "Keep your eyes up, don't text and drive": A review of anti-texting while driving campaigns' recommendations. *International Review on Public and Nonprofit Marketing*, *13*, 1-23. doi:10.1007/s12208-016-0166-7

Cokely, E. T., Galesic, M., Schulz, E., Ghazal, S., & Garcia-Retamero, R. (2012). Measuring risk literacy: The Berlin numeracy test. *Judgment and Decision Making*, *7*, 25-47.

Conway, A. R. A., Kane, M. J., Bunting, M. F., Hambrick, D. Z., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin & Review*, *12*, 769-786.

Domigan, J., Glassman, T. J., Miller, J., Hug, H., & Diehr, A. J. (2015). Message testing to create effective health communication campaigns. *Health Education*, *115*, 480-494. doi: 10.1108/HE-02-2014-0012

Drews, F. A., Yazdani, H., Godfrey, C. N., Cooper, J. M., & Strayer, D. L. (2009). Text messaging during stimulated driving. *Human Factors*, *51*(5), 762-770. doi: 10.1177/0018720809353319

Evans, J. St. B. T., & Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science*, *8*, 223-241. doi: 10.1177/1745691612460685

Foster, J. L., Shipstead, Z., Harrison, T. L., Hicks, K. L., Redick, T. S., & Engle, R. W. (2014). Shortened complex span tasks can reliably measure working memory capacity. *Memory & Cognition*, *43*, 226-236. doi: 10.3758/s13421-014-0461-7

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives*, *19*, 25-42. doi: 10.1257/089533005775196732

Garcia-Retamero, R., & Cokely, E. T. (2011). Effective communication of risks to young adults: Using message framing and visual aids to increase condom use and STD screening. *Journal of Experimental Psychology*: *Applied*, *17*, 270–287. doi: 10.1037/a0023677

Garcia-Retamero, R., & Cokely, E. T. (2013). Communicating health risks with visual aids. *Current Directions in Psychological Science*, *22*, 392-399. doi: 10.1177/0963721413491570

Garcia-Retamero, R., & Cokely, E. T. (2014). The influence of skills, message frame, and visual aids on prevention of sexually transmitted diseases. *Journal of Behavioral Decision Making*, *27*, 179-189. doi: 10.1002/bdm.1797

Garcia-Retamero, R., Cokely, E. T., & Hoffrage, U. (2015). Visual aids improve diagnostic inferences and metacognitive judgment calibration. *Frontiers in Psychology*, *6*, 932-944. doi: 10.3389/fpsyg.2015.00932

Harrison, M. A. (2011). College students' prevalence and perceptions of text messaging while driving. *Accident Awareness & Prevention*, *43*, 1516-1520. doi: 10.1016/j.aap.2011.03.003

Hayashi, Y., Russo, C. T., & Wirth, O. (2015). Texting while driving as impulsive choice: A behavioral economic analysis. *Accident Analysis & Prevention*, *83*, 182-189. doi: 10.1016/j.aap.2015.07.025

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Press.

He, J., Chaparro, A., Nguyen, B., Burge, R. J., Crandall, J., Chaparro, B., Ni, R., & Cao, S. (2014). Texting while driving: Is speech-based text entry less risky than handheld entry? *Accident Analysis and Prevention*, *72*, 287-295. doi: 10.1016/j.aap.2014.07.014

Hill, L., Rybar, J., Styer, T., Fram, E., Merchant, G., & Eastman, A. (2015). Prevalence of and attitudes about distracted driving in college students. *Traffic Injury Prevention*, *16*(4), 362-367. doi: 10.1080/15389588.2014.949340

Johnson, E. D., & Tubau, E. (2015). Comprehension and computation in Bayesian problem solving. *Frontiers in Psychology*, *6*, 938-957. doi: 10.3389/fpsyg.2015.00938

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: individual differences in working memory. *Psychological Review*, *99*, 122.

Kahneman, D. & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. Griffin, and D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgments* (pp. 49-81). New York, NY: Cambridge University Press.

Kane, M. J., & Engle, R. W. (2003). Working-memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to Stroop interference. *Journal of Experimental Psychology: General*, *132*, 47-70.

Kane, M. J., Hambrick, D. Z., & Conway, A. R. (2005). Working memory capacity and fluid intelligence are strongly related constructs: comment on Ackerman, Beier, and Boyle (2005).

Lesage, E., Navarrete, G., & De Neys, W. (2013). Evolutionary modules and Bayesian facilitation: The role of general cognitive resources. *Thinking & Reasoning*, *19*, 27-53. doi: 10.1080/13546783.2012.713177

Linderholm, T. (2002). Predictive inference generation as a function of working memory capacity and causal text constraints. *Discourse Processes*, *34*, 259-280.

McNair, S. J., & Feeney, A. (2015). Whose statistical reasoning is facilitated by a causal structure intervention? *Psychonomic Bulletin and Review*, *22*(1), 258-264. doi: 10.3758/s13423-014-0645-y

National Highway Traffic Safety Administration. (2016). Distracted driving 2014. T*raffic Safety Facts: Research Notes*. (Report No. DOT HS 812 260). Washington, DC: National Highway Traffic Safety Administration. Retrieved from http://www.nhtsa.gov/Research/Crash+Avoidance/Distraction

National Highway Traffic Safety Administration. (2017). U drive. U text. U pay. Retrieved April 14, 2017, from https://www.nhtsa.gov/risky-driving/distracted-driving#16986

Nemme, H. E., & White, K. M. (2010). Texting while driving: Psychosocial influences on young people's texting intentions and behaviors. *Accident Analysis & Prevention*, *42*(4), 1257-1265.

Nelson, E., Atchley, P., & Little, T. D. (2009). The effects of perception of risk and importance of answering and initiating a cellular phone call while driving. *Accident Analysis and Prevention*, *41*, 438-444. doi: 10.1016/j.aap.2009.01.006

Oswald, S. L., McAbee, S. T., Redick, T. S., & Hambrick, D. Z. (2014). The development of a short domain-general measure of working memory capacity. *Behavioral Research*, *47*(4), 1343-1355. doi: 10.3758/s13428-014-0543-2

Overton, T. L., River, T. E., Hecht, C., Shafi, S., & Gandhi, R. R. (2014). Distracted driving: Prevalence, problems, and prevention. *International Journal of Injury Control and Safety Promotion*, *22*(3), 187-192. doi: 10.1080/17457300.2013.879482

Petrova, D., Garcia-Retamero, R., & Cokely, E. T. (2015). Understanding the harms and benefits of cancer screening: A model of factors that shape informed decision making. *Medical Decision Making*, *35*(7), 847-858. doi: 10.1177/0272989X15587676

Primi, C., Morsanyi, K., Chiesi, F., Donati, M. A., & Hamilton, J. (2015). The development and testing of a new version of the Cognitive Reflection Test applying Item Response Theory (IRT). *Journal of Behavioral Decision Making*. doi: 10.1002/bdm.1883

Ranney T. A. (2008) Driver distraction: A review of the current state-of-knowledge. (Report No. DOT HS 810 787). Washington, DC: National Highway Traffic Safety Administration.

Simons-Morton, B., Guo, F., Klauer, S. G., Ehsani, J. P., & Pradhan, A. J. (2014). Keep your eyes on the road: Young driver crash risk increase according to duration of distraction. *Journal of Adolescent Health*, *54*(5), S62-S70. doi: 10.1016/j.jadohealth.2013.11.021

Sirota, M., & Juanchich, M. (2011). Role of numeracy and cognitive reflection in Bayesian reasoning with natural frequencies. *Studia Psychologica*, *53*(2), 151-161.

Sirota, M., Juanchich, M., & Hagmayer, Y. (2014). Ecological rationality or nested sets? Individual differences in cognitive processing predict Bayesian reasoning. *Psychonomic Bulletin*, *21*, 198-204. doi: 10.3758/s13423-013-0464-6

Stanovich, K. E. & Toplak, M. E. (2012). Defining features versus incidental correlates of Type 1 and Type 2 processing. *Mind & Society*, *11*, 3-13. doi: 10.1007/s11299-011-0093-6

Stothart, C., Mitchum, A., & Yehnert, C. (2015, June 29). The attentional cost of receiving a cell phone notification. *Journal of Experimental Psychology: Human Perception and Performance*, *41*(4), 898-903. doi: 10.1037/xhp0000100

Strayer, D. L. (2015). Is the technology in your car driving you to distraction? *Policy Insights from the Behavioral and Brain Sciences*, *2*(1), 1-9. doi: 10.1177/2372732215600885

Strayer, D. L., & Johnston, W. A. (2001). Driven to distraction: Dual-task studies of simulated driving and conversing on a cellular phone. *Psychological Science*, *12*, 462–466.

Struckman-Johnson, C., Gaster, S., Struckman-Johnson, D., Johnson, M., & May-Shinagle, G. (2015). Gender differences in psychosocial predictors of texting while driving. *Accident Analysis and Prevention*, *74*, 218-228

Toplak, M. E., West, R. F., & Stanovich, K. E. (2011). The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks. *Memory & Cognition*, *39*, 1275-1289. doi: 10.3758/s13421-011-0104-1

Walsh, S. P., White, K. M., Hyde, M. K., & Watson, B. (2008). Dialing and driving: Factors influencing intentions to use a cell phone while driving. *Accident Analysis and Prevention*, *40*, 1893–1900.

World Health Organization. (2011). Mobile phone use: A growing problem of driver distraction. WHO. Geneva: Switzerland. Retrieved from http://www.who.int/violence_injury_prevention/publications/road_traffic/distracted_driving/en/

Curriculum Vita

BLAIR R. K. SHEVLIN

Summary

- Disciplined investigator with a strong background in technical writing
- Passion for data collection, analysis, and presentation
- Research interests: Decision making, psychometrics, risky behavior

Education

Towson University, Towson, MD. Expected Graduation May 2017
- M.A. in Experimental Psychology | GPA: 4.0
- Awarded Distinguished Graduate Student Prize

Goucher College, Baltimore, MD. May 2013
- B.A. in Psychology, Magna Cum Laude | GPA: 3.8
- Minors in Cognitive Studies and Philosophy

Professional Experience

Cognitive Psychology Lab. Towson, MD. Aug. 2016 – Present
Researcher (Supervisor: Kerri Goodwin, PhD)
Principal investigator for project evaluating young adults' understanding of the risks related to distracted driving. Supervises and trains research assistants. Runs experimental sessions that utilize E-Prime software to measure working memory capacity.

Towson University. Towson, MD. Aug. 2015 – Present
Graduate Assistant (Supervisor: Justin Buckingham, PhD)
Assists in administrative tasks related the graduate program, including course scheduling, website updates, recruitment, student evaluations, and the representation of the department at special events. Organizes application materials as member of the Experimental Psychology program's admissions committee. Leads experimental sessions investigating the moderating effects of perfectionism in relation to negative feedback on challenging tasks.

Acclaro Research Solutions, Inc. Baltimore, MD. May 2015 – Present
Research Associate (Supervisor: Katherine Fiedler, PhD)
Responsible for technical writing tasks related to contract proposals, project white papers, and program evaluations for NHTSA. Developed electronic document accessibility training, delivered via webinars to FEMA project managers and training developers. Completed course assessments for the Department of Homeland Security. Managed FDA childcare subsidy program.

TransAnalytics. Quakertown, PA. Nov. 2014 – Nov. 2015
Research Assistant (Supervisor: Loren Staplin, PhD)

Compiled reports based on quantitative analysis of traffic trends for the National Highway Traffic Safety Administration. Managed system assessment, parts acquisition, and technical integration for a project evaluating driving exposure in older adults. Edited and wrote manual for technical installation of systems to track drivers with GPS data recorders.

Habitat for Humanity of the Chesapeake, Baltimore, MD. Aug. 2013 – Aug. 2014

AmeriCorps VISTA (Supervisor: Leila Kohler-Frueh)

Coordinated with staff, community partners, and residents to implement evaluation of organizational activities in three neighborhoods. Advised company executives and board in planning activities. Served as community liaison with focus on youth engagement. Supervised volunteer teams in surveying and analyzed subsequent findings with Excel, SPSS, and Tableau.

Behavioral Pharmacology Research Unit, Johns Hopkins University, Baltimore, MD. Sept. 2012 – May 2013

Research Assistant (Supervisor: Miriam Mintzer, PhD)

Supervised study sessions of computerized cognitive training tasks. Recruited and screened study participants. Organized study materials and maintained participant database.

Memory Research Lab, Goucher College, Towson, MD. Sept. 2011 – May 2013

Research Assistant (Supervisor: Jennifer McCabe, PhD)

Performed data collection, scoring, computation, and analysis of experimental mnemonics study. Presented research at 2012 and 2013 Eastern Psychological Association conferences.

Honors & Activities:

- American Psychological Association
- Association for Psychological Science
- Psychonomic Society
- Society for Judgement and Decision Making
- Maryland Psychological Association
- Psi Chi Psychology Honors Society
- Goucher Prison Education Partnership | Tutor | Goucher College
- Ultimate Frisbee Team President | President | Goucher College
- Lewent Fund for Summer Research in the Sciences ($2500) | Goucher College
- Dean’s Scholarship (Full tuition) | Goucher College

Professional Research Articles & Presentations

Shevlin, B. (2016, November). Cognitive abilities associated with rational decision making. Poster presented at Psychonomic Society’s 57th Annual Meeting, Boston, MA.

Shevlin, B. R. K. (2016, April). Cognitive abilities associated with rational decision making. Poster presented at Towson University Student Research Expo, Towson, MD.

Shevlin, B. R. K. & McCabe, J. A. (2016, March). Relationship between responses and reaction times on the Cognitive Reflection Test. Poster presented at Eastern Psychological Association, New York City, NY.

Shevlin, B. R. K. (2013, May). *Cognitive Reflection in Undergraduates: Relationships with Educational Experiences and Metacognition*. Presentation at Goucher College Student Symposium, Towson, MD.

Shevlin, B. R. K. & McCabe, J. A. (2013, March). *Cognitive reflection in undergraduates: Relationships with educational experiences and metacognition.* Poster presented at Eastern Psychological Association, New York City, NY.

Shevlin, B. R. K. & McCabe, J. A. (2012, July). *Exploring the relationship of cognitive reflection, decision making, and metacognition with undergraduate educational experiences*. Poster presented at Landmark Summer Science Symposium, Bethlehem, PA.

McCabe, J. A., Chefitz, L. S., Shevlin, B. R. K., & Turpin, S. (2012, March). *Hand gestures and mnemonics: Effects of viewing and enacting*. Poster presented at Eastern Psychological Association, Pittsburgh, PA.

Computer Skills

Expert: Excel, MS Office, PowerPoint, Qualtrics, SPSS
Intermediate: HTML, Inquisit, Photoshop, QGIS, R, Tableau
Beginner: E-Prime, Linux/UNIX, Python, QuickBooks