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The choice to text and drive in younger drivers: Behavior may shape attitude

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ABSTRACT

Following a previous study that reported a large number of young adult drivers text and drive, the current study investigated this behavior by looking at patterns of use and driver assessment of the risk of the behavior. The data from the current study converge with and extended the previous work showing 70% of the 348 young adult drivers surveyed report initiating texts while driving while higher numbers reply to texts (81%) and read texts (92%) while driving. Additional drivers also report doing these behaviors, but only while stopped in traffic, showing only 2% never text and drive under any circumstances. The drivers indicated that they perceived these behaviors to be very risky and riskier than talking on a cell phone while driving, but perception of risk was a very weak predictor of behavior (for initiating texts) or had no effect on texting (for replying or reading texts while driving). In addition, a factor analysis of the perception of road conditions while texting revealed that making the choice to engage in texting (initiating) led drivers to perceive road conditions as being safer than if they replied to a text or read a text, suggesting that choosing to engage in the behavior itself changes attitudes toward risk.

1. Introduction

Despite the fact that the National Highway Transportation Safety Administration estimates about one-half of a million crashes annually are due to inadequate surveillance or inattention, drivers are more distracted by in-vehicle technologies than ever before (National Highway Traffic Safety Administration, 2008). Driving and talking on a cellular phone has long been recognized as a dangerous activity, and an area of interest to researchers. The distraction posed by cellular phones has only become worse as the devices have become more advanced and now include features such as e-mail and Internet. One of the most popular and potentially distracting of these features is the capability to text message.

Just talking on a cell phone while driving constitutes a dual-task that compromises a driver's ability to maneuver the car safely, presumably due to reduced attention to information on the roadway (Atchley and Dressel, 2004; Brown et al., 1969; Strayer and Drews, 2007; Strayer et al., 2003). Text messaging and driving is even worse as drivers now face a dual task that often requires them to take their eyes off the road for four times as long, leading to problems such as incorrect lane changes (Hosking et al., 2007). It decreases braking speed (Drews et al., 2009) increases speed variability, lateral speed, and lane position variability, all of which suggest a decrease in the ability to control the vehicle (Crisler et al., 2008). The dangers are especially evident for younger drivers who are unlikely to suspend a text messaging task when faced with a difficult driving situation (Lee et al., 2008). It has been estimated that texting while driving contributes to 1.6 million crashes annually (National Highway Traffic Safety Administration, 2008) and is over 20 times as dangerous as driving while not texting (Virginia Tech Transportation Institute, 2009).

Because of these dangers, 18 states and the District of Columbia have outlawed text messaging while driving, with an additional 9 states placing restrictions on the ability of young people to text message and drive. Many other states are currently developing laws to ban texting. Most countries in Europe also have bans in place for hand-help cellular phone use, and some countries, like Great Britain, have taken the aggressive stance of making sentencing more serious if a cellular phone is in use at the time of the crash, including for reading texts (Rosenthal, 2009). Despite this, the experience from cell phone bans and texting bans in the U.S. and other countries suggests the practice may remain frequent even when it is illegal. In New York, the first state in the U.S. to ban cellular phone use while driving, McCartt and Geary (2004) found that the initial decrease in use following the law did not hold over time and that use of cellular phones actually increased. This effect has been replicated in other countries (Rajalin et al., 2005). A more recent study in Australia found that about 27% of drivers text while driving, despite the fact that it is illegal in that country (White et al., 2010). In the U.S., the practice may be far more commonplace, especially among younger drivers. A survey conducted recently revealed that a large portion (about 60%) of younger drivers text and drive, even in states with laws banning the practice (Vlingo Corporation, 2009). The number may be much higher. A recent study of cellular

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use patterns and attitudes among drivers in college (Nelson et al., 2009) also asked respondents about texting and driving rates. In that study, 72% of drivers reported texting and driving. This finding is particularly disturbing for two reasons. First, younger drivers represent the future of road safety. What they practice now will become habit later. Second, younger drivers already represent one of the riskiest demographics on the roadway (Mayhew et al., 2003; McKnight and McKnight, 2003) and adding a secondary task as risky as texting represents a potentially dangerous combination for a group in which automobile crashes are already the leading cause of death (Subramanian, 2005).

There have been a few studies providing clues about why a behavior that outwardly seems so dangerous might be so prevalent among younger drivers. More than ever, younger adults are using texting as a primary means of communication. Over 78% of the youngest age group surveyed (13–19) report they text more than they make calls with their phone, and they have a very high rate of text messaging, with over 500 texts per month (Vlingo Corporation, 2009). The behavior seems to be driven by peer-to-peer interactions (Grinter and Eldridge, 2003), which may be particularly important to the growth of social networks of young adults. The use of cellular telecommunications supports the need of these individuals to belong. Exclusion from social networks supported by text messaging can reduce the feeling of belongingness for younger adults (Smith and Williams, 2004). Walsh et al. (2009) report that feelings of connectedness and belonging are major perceived benefits for mobile phone use among younger users. Thus, this new form of communication is both pervasive and important as a means of maintaining self-esteem and social networks, making the use of these devices the norm among younger drivers.

The question remains as to why so many people would engage in a practice that is known to be dangerous and is often illegal, even if it is the norm. Walsh et al. (2008) explored this question using the theory of planned behavior (TPB) (Ajzen, 1991). TPB posits that intentions, influenced by attitudes, subjective norms, and perceived behavioral control, are the main determents of behavior. In their work, intentions to call or text were assessed across a variety of scenarios, which loosely covered a range of risk (from driving fast and in a hurry to stop and not in a hurry). They found that TPB constructs, including norms, could account for 11–14% of intentions to text message while driving, across all of the scenarios. Also interesting to note is their finding that the perceived risk of apprehension or perceived risk of crashing did not influence the driver's decisions to text message while driving. In a later study, White et al. (2010) determined that for both hands free and hand held cell phone use, perceptions of the disapproval of others (subjective norms), as well as perception of risk of crash or apprehension (attitudes) lowered the likelihood of using a cell phone while driving. In fact, normative beliefs were the most powerful indicator of frequency of using a phone while driving. A similar pattern was observed in Nelson et al. (2009), where perceived importance of a call was a better predictor of the frequency of calling while driving than was perceived risk.

The work of Walsh and others represents an excellent insight into this growing problem, but there remain a number of unanswered questions. For example, one limitation of the White et al. (2010) study was that calling and texting were not differentiated in the analysis. Also, while texting is illegal in Australia, it is not illegal in many parts of the United States, including the region studied here. So the practice may be more common or the lack of appropriate laws may serve as a cue for drivers that the practice is not unsafe. Additionally, while TPB can successfully account for a significant portion of variance with regard to texting behavior, there remains much variability that is unexplained. Understanding the behavior requires that we have a better description of what the behavior actually entails. When a driver indicates "I text and drive", they could actually be referring to a broad range of behaviors, motivated by a range of intentions. For example, a driver who understands the risk of the behavior but who also feels social pressure to respond to texts may mitigate risk and engage in socially desirable behavior by replying to texts with one hand while stopped at a traffic light. This would qualify as texting while driving, but it is certainly a qualitatively different risk than a driver that initiates texts while driving using two hands to text and their forearms to control a vehicle. We know relatively little about the patterns of texting by drivers, which limits our ability to fully explain the choice to engage in this risky behavior or develop effective intervention strategies to prevent the behavior. For example, we do not know the prevalence of drivers that report texting who are simply reading messages, may be replying to messages they receive, or who actively initiating messages while driving. We also do not know when they text. Texting may occur while driving or whole stopped. Finally, we know little about why drivers text. What are common reasons for texting or texting topics that motivate users to engage in the behavior?

The purpose of the current work is to both replicate the findings of Nelson et al. (2009) that texting occurs at an alarmingly high rate in a college sample, and extend the findings to try to understand how the behavior can occur despite what should be perceived as a clear perceived risk. There are three general goals for the current study. The first goal is to better understand patterns of use. While the previous data are consistent with other recent studies, the rate of self-reported texting while driving seemed particularly high and worth re-examination. It is possible, for example, that student reports include instances of reading texts while driving or engaging in the behavior while safely stopped at a traffic light, thus exaggerating the estimate of the frequency of the behavior. It will be important to understand the specific patterns of use if researchers and policy makers seek to change the behavior. For example, in a policy analysis for the Cato Institute (Balko, 2009), it has been argued that a texting ban is unenforceable and thus should not be put into place because police cannot detect drivers reading texts. Knowing the relative prevalence of this behavior versus other texting behaviors would be useful.

The second goal will be to establish when and how drivers choose to text. Drivers may mitigate risk by texting only in calm roadway conditions. If drivers text regardless of road conditions, the behavior may be more resistant to change (calm conditions versus busy roadways, for example). The previous study (Nelson et al., 2009) was not focused on texting, but on talking on a cellular phone while driving, so there was no information in the study about why drivers chose to engage in the behavior. Drivers may also engage in what they feel to be "safe-texting" practices such as texting one-handed and/or only texting while stopped.

A third goal is to investigate the important question about why younger drivers would engage in such a risky behavior (if they even perceive it to be risky). Conversations with previous experimental participants in our laboratory (Atchley and Dressel, 2004) indicated some believed texting to be safer because they felt it was less engaging than a cellular phone conversation. We also would like to know under what circumstances drivers would choose to text, such as when they choose to text and drive and what topics are the most frequent motivators of the behavior. As part of this goal, we would like to investigate if perception of risk weakly mitigates texting behavior as we found with cellular phone use.

The current study seeks to provide data on the patterns of texting among heavy users of the devices (college-aged drivers), and to provide some insights into potential reasons these users continue to use the devices in spite of the known risks. To this end, we conducted a survey in which we examined both the frequency of texting, but also about which topics college students were most likely to send and reply to text messages, and the conditions under which they would choose to do so. We chose to use undergraduates as participants, because as we have shown previously (Nelson et al., 2009) they are among the heaviest users or text messaging and because they represent the future for the technology (see also Glendon and Sutton, 2005). To preview, an alarmingly high number of those sampled actively initiate text messaging, predominately with two-handed devices, typically about socially relevant topics. Additionally, it appears that risk again fails to mitigate the behavior and, more intriguingly, perceived risk of on-road conditions may change as a function of drivers choosing to initiate text messages themselves.

2. Method

An 89 item questionnaire was used consisting of three sections. The questionnaire was delivered via the Internet. The first section covered demographic information (age, gender, phone and car ownership), questions about the student's personal text messaging and driving behavior (frequency, and texting style), and general opinions about text messaging while driving. Initiating a text messaging conversation, replying to a text message, and reading a text message were treated as separate topics. For example, when asked to rate how dangerous it is to text, the question was asked for initiating, replying and reading, separately. The demographic questions and questions about personal behavior were multiple choice or free response. Questions about students' general opinions were assessed via a 7-point Likert scale.

The next section asked four questions about 11 different text messaging topics (see below and Table 2 for the topics). Participants were asked (1) how likely they were to begin a text messaging conversation about this topic while driving, (2) how likely they were to reply to a text message about this topic while driving, (3) how emotional they believed this topic would make them and (4) how dangerous they thought text messaging about this topic while driving would be. The conversation topics were talking about or making plans, text messaging to say hello, school or work-related, text messaging with a significant other, status updates such as letting a friend know that the student is running late, text messaging about current events or sports, giving or receiving directions, wanting or needing to know something instantly, text messaging out of boredom, text messaging to stay awake, and text messaging so it does not have to be done later (multi-tasking). Each of these 44 questions were assessed on a 1 to 7-point Likert scale where 1 was not likely, not risky, or not emotional, and 7 was very likely, very risky, or very emotional (The emotionality variable is not discussed further.). The last section had 21 items asking how likely a student was to respond to, read or initiate a text message conversation while driving in varying driving conditions from intense conditions such as bad weather, to calm or normal driving conditions, or static conditions such as at a stop light.

Undergraduate students recruited from an introductory psychology course participated for course credit. A total of 401 participants (185 females and 216 males) between the ages of 18 and 30 ($M = 18.44$, $SD = 1.54$) completed the questionnaire. The participants were required to own an automobile, and were also required to own a cellular phone in order to be included in the data analysis. Some participants did not meet the above criteria (2 participants did not own a phone and 44 participants did not own an automobile). Another 7 participants were excluded because they did not answer the question regarding their cell phone ownership. In total, 53 participants were excluded from the study and their data were omitted from the following analyses. At the time the survey was administered there were no laws prohibiting the use of a cellular phone in any manner while driving in or around Lawrence, KS where the survey was administered.

2.1. Analytic methods

The data were analyzed with the Mplus program, version 5.0. Given the paucity of literature on texting behavior, our first goal was to explore the use pattern data that were collected. Descriptive statistics for all variables were used to identify patterns consistent with previous empirical work as well as pinpoint any new trends. Additionally, we conducted an exploratory factor analysis on the items pertaining to road conditions to determine if the data could be summarized by fewer variables. Exploratory factor analysis is a data reduction technique in which a small number of latent (i.e. unobserved) variables are proposed to account for the relationships between a larger set of manifest (i.e. observed) variables (Mulaik, 2009). In this framework, the observed correlation between a given pair of questionnaire items is considered to be the result of those items sharing the same underlying causal mechanism. For example, two items that address different aspects of extroversion are said to correlate because responses on both items are caused by the same underlying personality trait. The key goal of exploratory factor analysis is to determine an optimal number of latent factors that explain the relationships between the manifest variables and are readily interpretable.

Parsimony is highly valued in exploratory factor analysis, meaning that we wish to identify the smallest number of latent factors that explain patterns in the data reasonably well and make sense theoretically. To determine this optimal number, a series of models are examined in which each successive model is specified with one more factor than the previous model. These models are then evaluated and compared according to several criteria such as interpretability of the factors, parsimony, statistical fit indices, and adherence to available theory. Of these criteria, only fit indices are evaluated statistically. We evaluated these models according to two well-known model fit indices: The root mean square error of approximation (RMSEA) (Steiger and Lind, 1980) and the Tucker-Lewis index (TLI) (Tucker and Lewis, 1973). Both of these indices provide information on how well a proposed model reproduces the observed data patterns. Conventional cutoff values that indicate acceptable model fit ($RMSEA < 0.05$, $CFI > 0.95$) were used to guide model evaluation and selection (Hu and Bentler, 1999). Normal theory maximum likelihood estimation was used to derive parameter estimates for each model. The estimates were rotated using the Quartimin rotation procedure to improve interpretability.

Our second analytic goal was to partially replicate findings from Nelson et al. (2009) in which the perceived risk of cell phone usage (i.e. calling and answering) while driving was used to predict the probability of engaging in those behaviors. Specifically, we were interested in whether these relationships would hold for the various texting behaviors. Instead of using traditional regression analysis, the authors employed structural equation modeling (SEM) to investigate these relationships. In traditional regression analysis, variables are assumed to be measured without error, an assumption that is rarely met in social and behavioral research. SEM, however, corrects for measurement error by using several manifest variables to define each latent variable of interest (Kline, 2005). This specification forces any shared variance between a set of indicators into a latent variable because it is assumed that this variable causes the indicators' covariation. Consequently, any variance in an indicator that is not shared with the other indicators (measurement error) is removed, and one is left with error-free variables for which predictive models can be specified and tested. Another advantage of SEM over traditional regression methods is the ease in which theory can be translated into a testable statistical model, which may involve a complex causal structure (e.g. mediation) that is difficult or impossible to implement in traditional regression analysis. Once again, the normal theory maximum likelihood procedure was used to estimate our model, which was evaluated according to the pre-

Table 1
Frequency and perceived risk of texting behavior ($n = 348$).

	Texting behavior frequency		
	Yes	Only while stopped	No
Have you ever...			
Read a text while driving?	92%	6%	2%
Replied to a text while driving?	81%	14%	5%
Initiated a text while driving?	70%	19%	11%
Can you text without looking?	70%		30%
	One-handed	Two-handed	
Tend to type with one or two hands?	25%	75%	
	Mean	SD	
How often do (did) you...[a]			
Initiate a text while driving ?	2.95	1.57	
Reply to a text while driving?	3.86	1.65	
Read a text while driving?	4.41	1.60	
Text while driving last week?	14.6	27.5	
	Texting behavior risk perception		
	Less dangerous	Equally dangerous	More dangerous
Compared to talking on a cell phone, is...			
Initiating a text while driving	4%	14%	84%
Replying to a text while driving	4%	13%	83%
Reading a text while driving	10%	27%	67%
	Mean	SD	
In general, how dangerous is it to...[b]			
Initiate a text while driving?	5.28	(1.54)	
Reply to a text while driving?	5.28	(1.50)	
Read a text while driving?	4.63	(1.64)	

[a] Response scale ranges from 1 (never) to 7 (always) for first three questions.
[b] Response scale ranges from 1 (not at all dangerous) to 7 (extremely dangerous).

viously mentioned fit indices, as well as the comparative fit index (CFI) (Bentler, 1990) and standardized root mean square residual (SRMR) (Bentler, 1995). It is important to use several fit indices in a given SEM analysis because each index captures a different aspect of model fit. A CFI greater than 0.95 and an SRMR less than 0.08 are indicative of acceptable model fit according to traditional guidelines (Hu and Bentler, 1999).

3. Results

3.1. Patterns of texting behavior

Descriptive statistics concerning the frequency and use patterns of texting (one or two-handed, texting without looking) can be found in Table 1. Regarding the three behaviors of interest (initiating, replying, and reading), the fewest number of respondents (70%) reported ever initiating a text message conversation while driving. Replying to a text message while driving was the next least frequently reported behavior (81%), which left reading a text message while driving as the most frequently reported behavior ($n = 92\%$). This trend was also observed on the Likert-scaled items, with initiating a text message occurring least often ($M = 2.95$, SD = 1.57) followed by replying ($M = 3.86$, SD = 1.65) and finally reading ($M = 4.41$, SD = 1.60). It appears that passive texting behaviors, such as reading or replying to a text message, occur more often than active texting behaviors, such as initiating a message. In addition, most of the students surveyed report being able to text without looking at the phone (70%) but the majority of those surveyed text using two hands (75%), presumably because they use two-handed keyboards that have become common on many smart phones. Reported frequency of texting was assessed on a scale of 1 (I never text and drive) to 7 (I always text and drive) ranged from a low of 2.95 for initiating texts to 4.41 for reading texts. The average number of texts sent while driving per week was assessed using an open ended response. The range of responses was from 0 to "too many to count". We excluded responses that were too vague to score ("Too many to count" or "A lot") or because the numbers were obvious outliers ("10,000"). Responses like "1–2" or "more than 100" were coded as the average (1.5) or the minimum (100), respectively. We then looked at the average number of texts for drivers that reported texting at least once in the previous week ($n = 261$ responses). The average number of texts sent while driving in the previous week was 14.6 texts (SD = 27.5).

3.2. Texting content

The types of text message conversations drivers engage in was another question of interest. The likelihood of engaging in the eleven texting topics are listed in Table 2 for initiating and replying to texts. For every item, participants reported a greater likelihood of replying to a text message than initiating one. Again, it seems that regardless of the content of the conversation, drivers are more likely to respond to a text message than initiate one. In order to explore the conversation types in greater depth, exploratory factor analyses (EFA) were conducted across the conversation types for initiating and replying. The eleven conversation-type questions were best represented by a two-factor solution for both initiating and replying. Model fit was considered acceptable for both initiating ($\chi 2$ (34) = 91.928, $p < 0.01$; RMSEA = 0.070 (90% C.I. = 0.053 – 0.087; TLI = 0.958) and replying ($\chi 2$ (34) = 127.587, $p < 0.01$; RMSEA = 0.089 (90% C.I. = 0.073 – 0.106; TLI = 0.940) and the rotated solutions were interpretable. Although model fit was slightly below thresholds for conventional standards of close fit, the two-factor solutions were both more parsimonious and inter-

Table 2
Likelihood oftexting by topic and factor loadings by topic for initiating and replying to texts. Items loading on each factor are outlined in grey.

	Initiate			Reply		
		Factor loadings			Factor loadings	
	Likelihood	Task oriented	Boredom	Likelihood	Task oriented	Boredom
Status updates	4.88	0.86	−0.14	4.53	0.61	0.19
Instant gratification	4.41	0.81	0.07	4.73	0.89	0.08
Directions	4.25	0.76	−0.08	4.60	0.81	−0.09
Significant other	4.18	0.62	0.20	4.72	0.75	0.28
Multi-tasking	3.69	0.53	0.36	4.02	0.65	−0.09
Plans	3.51	0.45	0.36	4.23	0.65	0.10
Work/school	3.37	0.46	0.38	3.98	0.75	−0.06
Say hi	2.95	0.00	0.87	3.65	0.34	0.55
Vigilance	2.82	0.12	0.51	3.34	0.28	0.56
Boredom	2.63	−0.06	0.88	3.01	−0.06	0.96
Sports/curr. events	2.59	0.23	0.64	3.02	0.32	0.45

Likelihood ranges from 1 (not at all likely that I will send a text) to 7 (extremely likely I will send a text).

pretable than the three-factor solutions, and the fit indices were still within the range of other traditional model fit guidelines.

Factor loadings can be found in Table 2. A factor loading is the regression coefficient for a given item that is regressed, or 'loads' onto, an underlying latent variable. Equivalently, this number represents the expected unit change in a manifest variable given a unit change in the latent variable. In EFA, every item is regressed onto every latent factor. Ideally, similar items will have strong factor loadings for the latent variable that is causing their observed correlation, and low loadings on other (unrelated) latent variables. The same items constituted each factor for both initiating and replying to text messages, and had the same interpretation across these behaviors. The first factor appeared to measure the likelihood of engaging in the texting behavior for task-oriented purposes (e.g. giving or receiving directions, providing status updates). Thus, we labeled this factor task-oriented. The second factor contained items that related to the likelihood of text messaging to relieve boredom, and was consequently labeled Boredom.

3.3. Texting as a function of road conditions

We were interested in the likelihood of initiating, replying to, and reading texting messages under different road conditions. Table 3 summarizes these data. In general, likelihood for all texting behaviors (reading, replying and initiating) increases as road condition intensity decreases. In other words, students were very to extremely likely to text while stopped, and less likely to do so when road conditions were intense. We next used EFA in an attempt to summarize the data with fewer variables, or in other words, look at the likelihood of reading, replying or sending as a function of general road conditions. There were seven variables for each of the three text messaging behaviors, and thus a total of twenty-one observed outcome variables. For each text messaging behavior, one, two, and three-factor models were evaluated on the seven items. For all three text message behaviors, a three-factor model fit the data best (range of $\chi 2$ (3) = 0.55 − 3.28, *n.s.*; range of RMSEA = 0.000–0.017 (90% C.I. = 0.000 − 0.094; TLI for reading, replying and initiating = 1.0).

Our next task was to examine the factor loading matrices to determine if the three-factor solutions were interpretable. The factor loading matrices are shown in Table 3. As expected, it appears that the likelihood of a driver engaging in texting behavior can be represented by three general road conditions, which we labeled Static, Normal, and Intense. Static refers to any moment in which the vehicle is not moving, Normal refers to average speed and traffic conditions, and Intense refers to high-speed or inclement weather conditions. The likelihood of initiating a text can be broken down into three basic components: (1) The likelihood of initiating a text message conversation while driving in severe road conditions (e.g. heavy rain, low visibility) (2) the likelihood of initiating a text message conversation under normal-traffic, non-highway road conditions, and (3) the likelihood of initiating a text message conversation while stopped at a red light or stop sign. These factors were labeled Intense, Normal, and Static, respectively.

Upon closer examination of the factor loadings, an interesting pattern emerged. For both reading and replying to a text message, the item corresponding to highway driving had its strongest relationship with the Intense factor (0.48 and 0.66, respectively). In other words, a given respondent's likelihood of reading or replying to a text message while driving on a highway was similar to their likelihood of reading or replying to a text message under intense road conditions. However, when a driver chooses to initiate a text message, the item's strongest relationship was with the Normal factor (0.55). That is, when initiating a text, drivers reported they were just as likely to engage in that behavior while driving on the highway as they would be while driving in normal traffic conditions. Overall, it appeared that respondents' likelihood of texting under differing road conditions depended on the type of text messaging behavior under consideration. We will return to this in the discussion.

3.4. Perception of risk of texting

Our final analytic goal was to examine contributions of perceived risk to texting behavior and to replicate the findings of Nelson et al. (2009). The data summarized in Table 1 indicate that the drivers surveyed are aware of the riskiness of texting while driving. The drivers rated texting while driving as very dangerous. On a scale of 1 (not at all dangerous) to 7 (extremely dangerous), driver ratings ranged from 4.63 (reading) to 5.28 (initiating). A large majority of the drivers also rated texting to be more dangerous that talking on a cellular phone while driving. While a small number rated texting as less dangerous than talking on a cellular phone (from 4% to 10% for initiating to reading, respectively), most rated it as more dangerous (from 67% to 84% for reading to initiating, respectively).

We next attempted to replicate the risk findings of Nelson et al. (2009). Before specifying the structural model in which causal pathways were designated, a measurement model was examined. This model, commonly referred to as the confirmatory factor analysis (CFA) model, assesses the extent to which a set of observed variables successfully measures the underlying latent variables of interest. A total of four latent variables were included in the CFA, measured by three indicators each. Residual covariances for corresponding indicators of the three texting behaviors were freely estimated. These items were worded similarly and thus were

Table 3
Factor loadings for three-factor solutions and associated reported likelihoods. Items loading on each factor are outlined in grey.

	Read			Reply			Initiate		
	Intense	Normal	Static	Intense	Normal	Static	Intense	Normal	Static
Intense	0.58	0.15	−0.16	0.75	0.00	−0.01	0.79	0.01	0.01
Highway	0.66	0.12	0.15	0.48	0.33	0.07	0.31	0.55	−0.00
Not highway	0.30	0.54	0.11	0.20	0.66	0.13	0.11	0.74	0.11
Normal	0.07	0.93	−0.05	−0.00	1.01	−0.07	0.05	0.92	−0.01
Calm	−0.04	0.85	0.13	−0.04	0.87	0.11	−0.10	1.02	−0.00
Stop sign	0.24	−0.11	0.68	0.18	−0.06	0.67	0.16	0.22	0.45
Red light	−0.11	0.24	0.76	−0.08	0.07	0.85	−0.02	−0.01	1.07

	Read	Reply	Initiate
Intense	2.96	2.42	2.14
Highway	4.00	3.44	3.02
Not highway	4.78	4.20	3.69
Normal	4.94	4.30	3.89
Calm	5.22	4.61	4.08
Stop sign	4.97	4.35	3.85

Likelihood ranges from 1 (not at all likely that I will send a text) to 7 (extremely likely I will send a text).

expected to share some residual variance not attributable to the latent factor (i.e. method effects, see Brown (2006)). The scale for the four latent variables was identified using the effects-coding method (Little et al., 2006). Scale identification is needed in order to impose the same metric on each of the latent variables. The CFA model showed acceptable model fit as demonstrated by the aforementioned fit indices (χ^2 (39) = 125.187, $p < 0.001$; RMSEA = 0.08 (90% CI = 0.064 – 0.095); CFI = .98; TLI = .97). Therefore, the assumption that the set of outcome variables measured the four latent variables as intended was supported.

Using this model and the chi-square difference test, we tested whether the three latent variable means for texting behaviors were equivalent. Put differently, we wished to see if students were more or less likely to engage in certain texting behaviors. Respondents reported being less likely to initiate a text message than to reply ($\Delta\chi^2$ (1) = 78.34, $p < .001$) or read a text message ($\Delta\chi^2$ (1) = 160.98, $p < .001$), and were also less likely to reply to a text message than read one ($\Delta\chi^2$ (1) = 99.42, $p < .001$). This pattern coincides with the one reported earlier in the descriptive statistics section. A structural model was specified in which Perceived Risk was expected to predict the likelihood of engaging in the three texting behaviors (see Fig. 1). The model demonstrated the same model fit as the CFA model, which was acceptable. The beta estimates (standardized partial regression coefficients) are also shown in Fig. 1. Only the effect of Perceived Risk on Initiating was significantly different from zero ($\beta = -0.12$, $p = 0.03$). However, the effect size for this estimate was quite small ($r^2 = 0.01$). The effects of Perceived Risk on Replying and Reading were not significantly different from zero ($\beta = -0.10$, $p = 0.07$, and $\beta = 0.01$, $p = 0.87$, respectively). As shown in Fig. 1, Perceived Risk accounted for less than 1% of the variance in the three outcome variables. To summarize, respondents' likelihood of initiating, replying to, and reading text messages were not affected by their perception of how dangerous such activities might be. This finding is in contrast to those reported by Nelson et al. (2009) where perceived risk more strongly predicted cell phone call usage, but consistent with previous findings regarding text messaging behaviors.

4. Discussion

Prompted by findings in previous work on cellular phone use (Nelson et al., 2009) that a large number of college students report that they text and drive (about three-quarters), we conducted a study using a similar method to explore this behavior more systematically. Since "texting" while driving can span a range of behaviors from reading texts while stopped at a traffic light to sending texts using a two-handed smart phone while driving on the freeway, one purpose of the current work was to explore texting usage patterns. The data from the current study are consistent with our previous work. The college-age sample reported texting while driving at a very high rate. The rate may actually be much higher than the previous work has suggested, depending on what behaviors are used to define texting. While the number of drivers that reported initiating texts while driving (sending a text without being prompted to text by an incoming message) was very close in the current work (70%) to the previous work (72%), a look at the reported rates of responding to an incoming text (81%) and reading text messages while driving (92%) suggests the overall trend of usage is much higher. Even in the initiate category, when the option to respond "I initiate texts while stopped" was included, an additional 19% of the sample indicate they text while on the roadway. Since it is unlikely in this sample that the drivers are always able to cease texting once traffic begins to flow again, that means the number of these drivers that initiate texts while driving may be as high as 89%. Only 2% of the sample reported not texting (initiating, responding or reading) while driving under any circumstances.

Further, the pattern of behaviors indicates that these users are probably not practicing "safe-texting" practices, if there is such a practice. Specifically, though most of the sample can text one-handed and presumably look at the road while texting (the supposed "safe-texting" method described by one of our previous experimental participants (Atchley and Dressel, 2004), most of the sample reported texting using two hands (75%). The frequency of texting while driving was moderate (initiating texts) to high (reading texts), averaging about fifteen texts while driving per week. Texting while driving was less commonly associated with just catching up ("Saying hi") or alleviating boredom/maintaining vigilance. The type of texts being sent most frequently were task-oriented, such as sending status updates or sending directions, indicating that drivers sending texts are doing so for topics they feel are of immediate importance to them.

Taken together with the data on how many in the sample report texting while driving, the data on how drivers text and what they text about suggest that the idea that texting bans should not be instituted because they are not enforceable is completely wrong (Balko, 2009). Two-handed texting while moving is common enough that enforcement of just that behavior would potentially be a net gain in safety. The data are also consistent with numerous other studies and surveys suggesting the rate of texting is rising, particularly among younger adoptees (see Geser, 2006, 2007 for reviews). While we had not expected to find such a high rate of reported behavior in our sample, given the consistency with our

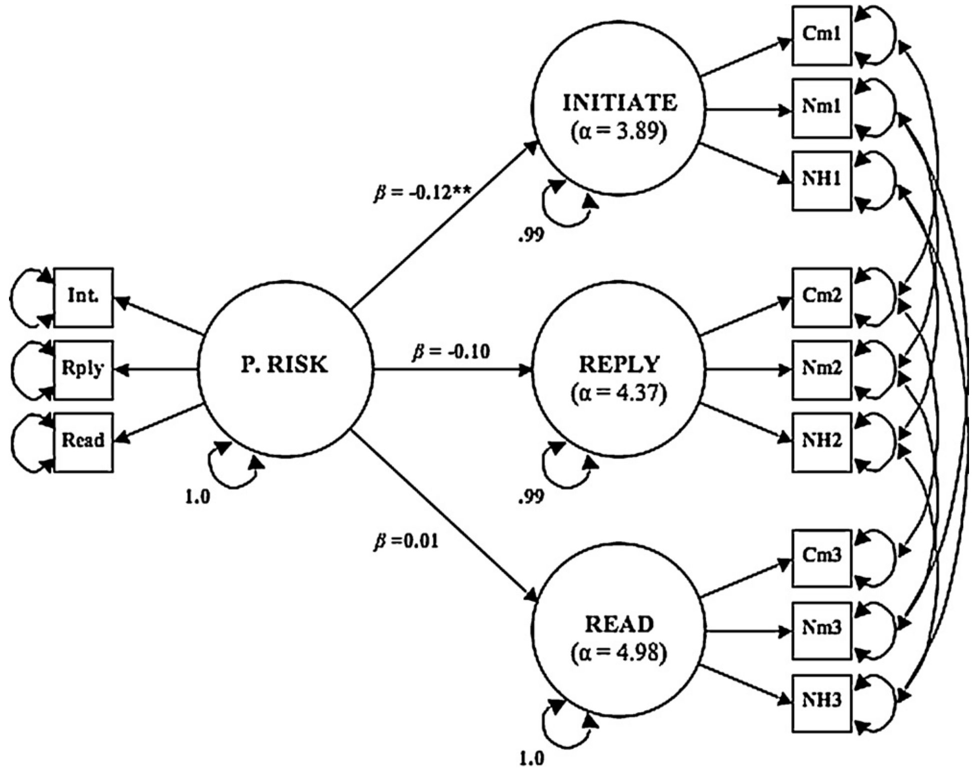

Fig. 1. Structural equation model in which Perceived Risk of text messaging while driving predicts the likelihood of engaging in the three texting behaviors: Initiating, Replying, and Reading. Single headed-arrows represent regressive relationships. Double-headed arrows represent latent factor variances, residual variances, and residual covariances. All estimates are from a completely standardized solution. β is the standardized regression coefficient. α is the estimated latent factor mean. ** is the significantly different from zero ($p < 0.05$).

previous work and what we know about current trends, we have no reason to doubt the current data.

One question that is frequently asked is why drivers would engage in such a behavior if they know it is risky. This is particularly interesting for texting while driving because it is a behavior for which the risks are seemingly obvious, especially if a driver is texting with two-hands while driving, as our data suggests is the most typical situation. While much of the research on behavior change and risk suggests perceptions of risk may not have a strong role in changing health-related behaviors (but see Weinstein, 2007 for an interesting review on these types of studies), our previous work (Nelson et al., 2009) suggested perception of risk may have a small mitigating role on answering and initiating cellular calls while driving. We looked for a similar effect in the current work, as well as looking at how risk perception might be related to driving conditions. The drivers surveyed were clearly aware of the risk of texting while driving. The majority rated the practice of reading a text as more dangerous than talking on a cellular phone while driving (67%) and a large majority rated sending texts for any reason (replying or initiating) as more dangerous (83% and 84%, respectively). The practice of texting while driving was rated as very dangerous (an average rating of 5.06 on a scale from 1 (not at all dangerous) to 7 (extremely dangerous) overall, by the sample group. Yet, when we modeled the contribution of perceived risk as a predictor of reading, replying or initiating a text, risk was only a significant predictor of initiating a text and even then the relationship was small ($\beta = -0.12$). It appears that consideration of risk only plays a role when the driver feels they are making the choice to text. While replying to a text and initiating a text are functionally the same behavior (the driver must type while driving in both cases), in the case of replying to a text, the driver may feel more social pressure to do so, and thus perception of risk may be less critical than responding to an incoming text. In the case of initiating a text, the driver is making the *choice* to text, and thus their own perception of the riskiness of the behavior becomes more important.

This pattern of difference between two functionally similar behaviors (replying and initiating) but for which the perceived choice to engage in them may be different is mirrored in an interesting way in the perception of road conditions as a function type of texting behavior. The exploratory factor analysis of the likelihood of engaging in various texting behaviors as a function of road conditions generally showed that drivers generally perceived normal, calm, and non-highway conditions to be grouped together. Intense road conditions (extreme weather/low visibility) and highway driving also tended to group together. Highway driving, with high speeds and heavy traffic, can be mentally demanding, thus it clusters with intense conditions. When drivers read a text (perceived as the least risky behavior with an average rating of risk of 4.63) this pattern holds. However, when drivers send a text in reply (perceived as a more risky behavior with an average rating of risk of 5.28) but one where choice to do so is present but constrained by social demands, highway conditions cluster with normal conditions as well as intense conditions. When drivers have the greatest choice over whether or not to text (the initiate case which is perceived as being as risky as replying with an average rating of risk of 5.28), highway driving now clusters with normal driving conditions.

One way to understand this shift it to think of not how perceived risk changes behavior, but how behavior might change perceived risk. It has been long known from cognitive dissonance theory (Festinger, 1957, 1964; Festinger and Carlsmith, 1959; Harmon-Jones and Mills, 1999) that when someone engages in a negative behavior and they perceive that they had a choice to do so, their perception of how negative that behavior is actually decreases. In other words, if a driver chooses to engage in a risky behavior, they may then perceive the behavior to be less risky than it actually is. For example, the perceived risk of smoking declines in people that choose to smoke (Arnett, 2000; McCoy et al., 1992) and the riskiness of reckless driving, drinking, and smoking declines in adolescents that engage in those risky behaviors (Gerrard et al., 1996). In the current study, we see the effect of cognitive dissonance in the way in which the clustering of road conditions changes as a function of texting behavior. While replying to a text and initiating a text are perceived as equally risky by the drivers surveyed because they represent the same functional behavior, when drivers make the choice to initiate a text, they reclassify highway driving conditions from intense to normal or calm. This reclassification is classic cognitive dissonance. The driver initiating a text made the choice to engage in a risky behavior, so they unknowingly attempt to reclassify the context of the behavior as being safer than it is, while the driver that responds to a text with a text of their own can make the sender of the original text responsible for their behavior.

It is possible that this finding may explain, in part, why the relationship between risk and behavior is so low. As has been discussed, texting is a very common behavior in younger adults as it supports peer-to-peer interaction and it increases feelings of belongingness. In other words, young adults are strongly motivated to text to keep in touch, even if they are engaging in other tasks. The strength of these expectations will lead to texting in inappropriate and risky situations. When that happens, the normal cognitive defenses against mismatching behavior and attitudes reshape attitudes because behavior has already taken place. Thus, perceived risk may be reduced over time as the behavior persists.

One limitation of the current work is that it did not explicitly examine social norms in the study group. Because perceived norms influence behavior, and because the norms of the sampled group may be different than the population at large, the issue of norms will be important for future studies. One question will be to see if these results generalize to other drivers, or if these results hold for this group as they age. Further, one must wonder if these results are a function of the age of the group or of the normative view of texting in that group, more generally. More specifically, for example, we would not expect in this age group to see such high frequencies if drunk driving was the behavior examined, and we would not expect to see a disconnect between perceived risk and engaging in driving while drunk, even though texting is a much riskier behavior. It may be possible, by comparing perception of texting to other behaviors that it is the perception of norms that must be changed, rather than the perception of risk. Similarly, in Nelson et al. (2009), perceived importance of making a call was the strongest predictor of behavior. The current study did not examine this variable. The relationship between importance and norms, and their influence on risk perception and behavior as well as the reciprocal relationship between behavior and attitudes remains to be examined in more detail.

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