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Driving under the influence of distraction: Examining dissociations between risk perception and engagement in distracted driving

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ABSTRACT

Driving while distracted is a critical and unwavering problem in the United States leading to numerous injuries and fatalities each year. While increasing legislation and developing technological interventions strive to ensure we only focus on driving, individuals still drive distracted. We surveyed college-aged adults to examine the factors that influence both their risk perception of driving while distracted and how often they engage in distracting activities and situations while driving. We found a disassociation between individuals' perception of driving distraction risk and their engagement with the distraction. Exposure, perceived knowledge of risks, fairness beliefs, and ratings of perceived visual and cognitive demands was associated with risk perception. Conversely, risk-seeking traits, how voluntary the task was perceived, and previous exposure to a distraction influenced engagement. Overall, we recommend additional research focusing on factors that predict engagement in driver distraction rather than perceived risk alone.

1. Introduction

Driving while under the influence of distraction is a crucial and prominent issue in our society. Distraction induced driving errors are associated with the high cost of increased motor-vehicle crashes, injuries, and fatalities. The National Highway and Safety Administration (NHTSA) estimated that 3331 (10%) people were killed and another 387,000 were injured in vehicle crashes involving distraction in 2011 (NHTSA, 2012, 2013a). While the frequency of drivers who converse on the phone concurrently with driving has stabilized, drivers are now more likely to participate in distractions that require more engagement and glances away from the road: i.e. texting, internet use (e.g. social media, downloads, music), games, and video (NHTSA, 2013b). This trend is increasing more quickly among teenage and younger adult drivers (ages 16–24) than for any other age group (NHTSA, 2013c). Over time, society, and consequentially driving, is becoming progressively more technologized, ultimately creating new forms of distraction such as engagement in voice texting (Mayhew et al., 2013) and using personalized phone-based digital assistance (e.g. Siri on iPhone; Yager, 2013).This trend underscores the need to understand the factors that contribute to drivers' choices to drive while distracted, which have been studied insufficiently (Patel et al., 2008).

Driver distraction or the behavior of driving while distracted is defined as the driver redirecting attention from driving to perform supplementary behaviors, tasks, or situations that reduce the drivers' ability to maintain situation awareness, accurately engage in decision-making processes, and be in full control of the vehicle (Hedlund, 2005; Mayhew et al., 2013). Many empirical research studies have shown the potential dangers of driving while distracted (Regan et al., 2011; Young et al., 2012). Because driving is already a multifaceted and complex task, mistakes and performance decrements such as reduced lateral control, failures to recognize and obey signage, reduced hazard response times, and inattentional blindness are easily introduced when attention is diverted away to complete secondary activities (Recarte and Nunes, 2003; Regan et al., 2011; Robertson, 2012; Strayer and Drews, 2004). This ultimately increases the probability that the distracted driver will be involved in a vehicle crash. (Robertson, 2012; Young et al., 2012).

Distracted driving research has categorized distractions into two major classifications (Wallace, 2003), Internal: distractions within the vehicle (e.g. cell phones, in-car-entertainment) and external: distractions from outside the vehicle (e.g. billboards, pedestrians). Internal distractions have received the most attention, while external distraction research has been more limited (Rupp, 2012). This is partly because technology-enabled vehicles

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and using portable electronics in automobiles is becoming more prevalent which, in turn, is increasing the frequency and severity of in-car distraction (NHTSA, 2013b). Longitudinal research of internal distractions has revealed that distractions like conversation, cell phone use and reading were all common with food-related distractions being associated with the greatest number of adverse events (Feaganes et al., 2003). On the other hand, external distractions are actually more frequently encountered (Stutts et al., 2005) and account for a greater number of vehicle crashes (Stutts et al., 2000). One explanation for the power of external distractions posits that the number and variety of stimuli outside the vehicle contributes to a complex visual presentation that can clutter a driver's attention, preventing him or her from recognizing important information (Horberry et al., 2006). These distractions include: weather, work zones, billboards, and pedestrians (Bungum et al., 2005), bicycles (Schramm et al., 2010), motorcycles (Clarke et al., 2007), roadside crashes (Colon et al., 2013), and searching for street signs (Horberry and Edquist, 2009).

Additionally, few studies in the literature have investigated both risk perception and willingness to engage in a distraction (Titchener and Wong, 2010). Lerner and Boyd (2005) found willingness to engage and risk perception were a 1:1 relationship, but this study included only a small number of internal distractions. Risk perception studies have stated drivers perceive internal distractions as more risky to engage in than distractions that occur outside the vehicle (Patel et al., 2008; Titchener and Wong, 2010). On the other hand, perceptions of risk do not always match reality. Objective studies of adverse vehicle states (i.e. near misses and motor vehicle crashes) indicate external sources are equally risky (e.g. Feaganes et al., 2003). Thus, drivers may rate distractions that have been demonstrated to be risky as relatively low risk. Examples of this are drivers' perception of hands-free phone use, food distractions (White et al., 2004) and passenger conversations (McEvoy et al., 2007; Titchener et al., 2009). These distractions were rated as relatively low risk, but still distract the driver away from driving. Risk perception of external distracters has also not received as much focus as internal distracters (Patel et al., 2008), indicating a clear gap in the literature.

1.1. Importance of risk perception

Solving the problem of distracted driving especially among younger drivers may not be resolved by legislation (Sperber et al., 2010) or technological interventions (e.g. Parasuraman et al., 1997) because drivers often satisfice their driving performance (Hancock et al., 2009), opting instead to engage in a plethora of other activities (Regan et al., 2011). Individuals may engage in distracting behaviors for many reasons, principle among them are social norms (Atchley et al., 2012) and an over-inflated sense of self-efficacy (Kruger and Dunning, 1999). Often drivers may view that engaging in certain distractions are low risk behaviors because being involved in a vehicle crash generally is a relatively low probability occurrence (Hancock et al., 2009). Reason (2000) stated that complex human-machine system failures occur because multiple errors must occur simultaneously (like aligning the holes of several pieces of Swiss cheese). This means while drivers may have many "near misses", they may not form a strong connection between the risk of driving while distracted and being involved in a vehicle crash. However, while the crash risk is low for a single driver, taken across the number of drivers on the road, even a low probability occurrence leads to thousands of injuries and fatalities due to distraction each year (NHTSA, 2013a). Therefore, it is imperative to understand the factors involved with individuals' risk perception of various driving distractions (Patel et al., 2008; Slovic, 1987) and consequently their likelihood of engaging in distracting behaviors (Hatakka et al., 1997), which gives an indication of how seriously they take the perceived risk.

1.2. Predictors of perceived driving risk

Risk perception and engagement in distracting activities may be due to qualitative characteristics (QCs) of the distraction itself. Previous studies have shown QCs such as a driver's perception of control, risk knowledge, and perceived cognitive demand predicted driver's perception of crash risk (Patel et al., 2008). Other studies have stated that the legality of the activity, likelihood of crash risk, extent that the behavior is perceived to be voluntary or coerced (voluntariness), familiarity, and perceived fairness beliefs (the belief that engagement is justified or reasonable) were important predictors of risk (Patel et al., 2008; Titchener et al., 2009; Titchener and Wong, 2010). An increased familiarity with a particular distraction on average led to lower perceived risk (Lansdown, 2012). Further, greater perceived control over the distraction, fairness, and legality of a distraction were also associated with lower perceived risk. On the other hand, distractions that were perceived as more cognitively demanding or distractions to which people had less exposure were perceived as having a greater risk of causing a vehicle crash (Patel et al., 2008; Titchener et al., 2009).

Several other QCs have been shown in the literature to be relevant to engagement and risk perception, but have not yet been integrated with previous driving distraction risk perception studies indicating another research gap. The sensory, or processing modality of the distraction may further play a role in both risk perception and engagement of the distraction because tasks that demand resources from the same modality will degrade performance more than completing tasks that require different resources (Wickens, 2002). However, since driving is such a complex task, drivers must expend effort spanning multiple sensory or processing domains: visual, auditory, biomechanical, and cognitive (working memory, executive functioning; Williams-Bergen et al., 2011). Some types of distractions may only demand input of a single modality or combinations of modalities. For example, hand-held phone use requires biomechanical, visual, and cognitive input. On the contrary, hands-free phone use removes the need for biomechanical and possibly visual input, but still requires cognitive effort. Hands-free systems may even increase cognitive demands because the cues are not visually available. Instead, users must access and hold this information in memory, thus trading a visual demand for a more cognitive one. In other words, people not only have to think about the task, but the procedure required to complete the task as well as dealing with potential errors that may occur while using the system (e.g. speech-to-text recognition issues; Mayhew et al., 2013).

Finally, many risk perception studies have chosen to leave the term "risk" undefined (e.g. Patel et al., 2008) to not bias participants. However, we also note that data from Titchener et al. (2009) showed that individuals rated both the probability of having a vehicle crash and the perceived risk of the distraction very similarly, with accident probability accounting for 88% of the variance in risk perception. We argue that this multicollinearity stems from participants defining their subjective risk ratings as the likelihood of having a vehicle crash and thus may make this inappropriate as a predictor of risk perception.

1.3. Sensation seeking, risk taking and perceived risk

The extant literature fails to examine personality variables as they relate to risk perception and willingness to engage in distracted driving. Sensation seeking and risk taking behavior are both potentially relevant traits. Sensation seeking behavior is associated with the tendency to engage in riskier behavior while driving, especially among younger adults (Arnett, 2002). Specifically, high sensation-seekers may proactively seek out riskier driving situations than lower sensation-seekers (Arnett, 2002). Sensation seeking (Arnett, 1994) is a personality trait characteristic of an individual's proclivity for seeking out arousing, intense and novel stimuli. Sensation seeking is associated with greater risk taking overall (Arnett, 1994, 2005) and taking driving related risks in particular (Iversen, 2004). One longitudinal study followed adolescent drivers for three-months and found that greater sensation seekers rated higher engagement in risky activities such as speeding and violating safe driving laws (Hartos et al., 2002). Since engagement in distraction is a form of risk-taking during driving, risk-taking should also apply to engagement in distractions. Overall personality may be critical to understand engagement in distracted driving and risk perception. This relationship may also be age contingent as younger adults are more likely to be risk takers (Arnett, 2002) and risk perceptions of distraction may also vary with age (Gentzler et al., 2013). Therefore, in the current study we sought to determine how risk taking and sensation seeking behavior may impact not only engagement with a distracter, but individuals perception of risk and ratings of the qualitative characteristics that are associated with risk perception.

1.4. The disconnect between risk perception and engagement

Previous research has indicated that while drivers were aware that completing secondary tasks during driving or engaging in distracting scenes while driving was dangerous, drivers still reported engaging in such tasks as calling (McEvoy et al., 2007; Nelson et al., 2009) and texting while behind the wheel (Atchley et al., 2011; Feaganes et al., 2003; Stutts et al., 2005). Another study, Nelson et al. (2009) failed to find a link between the perceived risk of engaging in a secondary task to the actual frequency of engagement of the task; the data further indicate that engaging in distracting tasks are only risky for others, not themselves (Bean, 2013). Moreover, there is also a disassociation between the initiation of a distraction – proactively engaging in the distracter task – and answering, or replying to an incoming call or text message – reactively engaging in the distracter task. Consistently across studies, drivers rate proactive engagement as more risky than reactive engagement (Atchley et al., 2011; Nelson et al., 2009).

It has been shown many times (e.g. Jones and Harris, 1967) that individuals often use situational explanations for themselves while using dispositional attributions for others for the same behavior, leading to overestimations of self-efficacy. One study found drivers rated their driving performance while distracted much higher than objective measurements of their actual performance (Horrey et al., 2009). This disassociation between perceived and objective ability may lead drivers to engage in distracted driving even though they intellectually understand that the behavior is risky – it is just not risky for them. Other studies have shown invulnerability biases in younger adults especially among males, which may further exacerbate the effect among this demographic (e.g. Arnett, 2002). However, one study indicated that male drivers may actually be more accurate at predicting their performance while distracted (Lesch and Hancock, 2004). This may indicate that the overconfidence effect shown by Arnett is moderated by factors other than gender. Sensation seeking is one factor that is associated with being male, as well as with greater willingness to engage in secondary tasks while driving (Horrey and Lesch, 2008). Lesch and Hancock (2004) also found gender and age effects regarding ratings of confidence in driving ability while distracted. Overall, older male drivers were more accurate at rating their driving performance while conversely, older female drivers were overconfident in their performance. Further, additional cognitive biases such as our tendency to be overconfident of our own abilities (Zell and Krizan, 2014) and our tendency to display unrealistic optimism for future events (Shepperd et al., 2015) may also lead to incorrect judgements of our own abilities.

Another explanation for drivers voluntarily engaging in certain distractions is that they inappropriately underestimate the risk. For instance, drivers may feel that the risk is relatively high, but not high enough to avoid engaging in the distraction. One recent study (Horrey et al., 2015) treated this as an error to properly calibrate the effects the distraction had on their performance. Because engagement in secondary tasks requires drivers to split their focus, they may not fully process the dynamically changing current state of the world. This failure in turn decreases the salience of environmental and performance information that could potentially inform the driver of their decreased ability. Further, in the presence of incomplete information the driver may use cognitive heuristics instead of objective data as a judge of their performance. Given the mix of results, more research on the relationship between risk perception and engagement is needed. For example, one of the research questions we sought to answer in the current study is: do QC's that predict the perception of risk also predict engagement with a distracter?

1.5. Current study

This study expanded on the previous work of Gentzler et al. (2013) – a pilot study that examined a broad spectrum of both internal and external distractions. Our goal in the current study was to expand the previous research on perceived risk judgments of various driver distractions by centering on how risk perception compares among the various distractions and on how perceived risk compares to objective research in driver distraction. We have included a non-distraction condition to fully gauge the magnitude of the perceived distraction effect over the perceived normal demands of driving, which has not always been included in previous questionnaire studies of perceived distraction risk. Secondly, we sought to determine what explains risk perception using personality, qualitative characteristics, and willingness to engage in distractions as possible factors. Specifically, we wanted to determine what was the strongest predictor of perceived risk as well as the strongest predictor of engagement. The ultimate goal of this line of research was to make drivers fully realize the risk of driving distraction and to find ways to encourage drivers to engage less in voluntary distractions.

1.5.1. Hypotheses

H_1: Our data will replicate previous findings connecting self-reported qualitative characteristics, especially cognitive demand, exposure, control, and risk knowledge factors to perceived driving risk. Specifically, we expect that increased cognitive demand and risk knowledge will lead to greater perceived risk while increased control and exposure will lead to lower perceptions of risk.

H_2: The perceived visual demands of a distracting task will predict perceived driving risk. Specifically, increased demand will lead to greater perceived risk.

H_3: Higher sensation seeking and risk taking scores will predict lower perceived driving risk and greater engagement in distractions while driving.

H_4: Internal distractions will be rated as more voluntary and more controlled; whereas external distractions will be rated less voluntary and less controlled. This will lead to internal distractions to be rated as riskier than external distractions.

H_5: Greater perceived risk will predict lower engagement in distractions.

2. Methods

2.1. Participants

We recruited 365 participants (251 women) from a large university in the southern United States using an online experiment participation tool used by the university. Participants were compensated with partial course credit for their time. We analyzed the data for unusual response patterns, (outliers: those ± 3 *SDs* of the mean), overall response times, and incorrect answers on eight quality control questions placed throughout the survey (i.e. "this question is for quality control, please choose 4 as the answer to this question"). We found 57 unusual cases that would indicate that a participant was not following directions or answering honestly. After exclusion, there were 308 individuals (211 women) between the ages of 18–50 years ($M = 19.58$; $SD = 3.55$). All self-reported that they were currently enrolled in college at the time of participation. Further, 66.20% had previously completed a high school diploma or GED, 30.50% a 2-year college degree (A.A. or A.S.), 2.90% a 4-year college degree (B.A. or B.S.), and 0.30% had previously completed a Master's degree. Students also self-reported the following ethnicities: White (79.50%), African American/Black (7.80%), Asian (7.80%), American Indian (0.60%), Hawaiian or Pacific Islander (0.60%) or other (4.10%). Additionally 16.60% self-reported they were of Hispanic descent. Finally, all participants reported holding a valid driver's license for an average of 3.39 years ($SD = 3.42$ years) and owned a vehicle at the time of participation.

2.2. Procedure

We posted the study online and students self-selected to participate after reading a brief study description similar to the informed consent. After clicking on a link from the participation site, participants were transferred to an online survey management system (Qualtrics) housing the survey. All participants completed the study at their own pace and their progress in the system was tracked so they could continue from where they stopped at a later time. However, most participants completed the survey in a single sitting with a mean response time of 26.87 min ($SD = 26.17$). The survey was active for a six month period between the months of February to August 2014. Participants completed the study in three separate questionnaire blocks. In the first block participants completed the informed consent followed by the driver distraction questionnaire. The second block consisted of the sensation seeking and risk taking inventories, followed by the final block of the demographics and driving habits questionnaire. We used a randomized order for the driver distraction and personality questionnaires to reduce order bias.

2.3. Materials

2.3.1. Driver distraction questionnaire

Based on previous research (e.g. Patel et al., 2008; Titchener and Wong, 2010), we asked participants to rate the distractions across several qualitative characteristics (QCs): Mental concentration (Cognitive), Ambiguous risk (AmbRisk), the risk or probability of an automobile crash (CrashProb), Exposure, Control, Engagement, Perceived knowledge of risks, Fairness, Voluntariness, and Visual demand. Our definitions match closely with the previously used terms in the literature (shown in Table 1). Additionally, we decided to include visual demand separately from cognitive demand as another important qualitative aspect of distraction risk. All of the individual QCs were rated on a 10-point Likert type scale scored with anchor points ranging from 1 (very little) to 10 (a lot) for all characteristics.

2.3.2. Sensation seeking

We incorporated one of the most widely used scales of sensation seeking developed by Arnett (1994) to measure individuals' level of sensation seeking (Arnett Inventory of Sensation Seeking; AISS). The sensation seeking scale includes 20 items on two separate subscales, novelty and intensity, rated on a four point Likert type scale (anchors included "describes me well" and "does not describe me well"). The novelty subscale measures the propensity to engage in new experiences such as being spontaneous, eating spicy foods and space travel, while the intensity of experience subscale measures the propensity of intense sensory experiences over more mild ones such as riding roller coasters and gambling.

2.3.3. Risk taking

We obtained two measures of risk taking from the International Personality Item Pool (IPIP; Goldberg et al., 2006), which is a free open source database of various validated measures of personality and individual differences. Specifically, we used the CAT-PD-SFv1.1 and the JPI risk taking inventories on the IPIP website including both positively and negatively coded items. Both were scored on a Likert scale from "very inaccurate" to "very accurate" as anchors.

2.3.4. Demographics and driving habits

Our demographics and driving habits questionnaire asked participants basic demographic information (e.g. sex, age, education) as well as driving habits (e.g. driving experience).

3. Results

Prior to analysis, we evaluated assumptions of multivariate normality and linearity through SPSS for the entire dataset. Normality of the observed variables was assessed using SPSS FREQUENCIES using histograms and by calculating z-scores of skewness and kurtosis values. We discovered that several of the individual distraction ratings across qualitative characteristics were significantly skewed; however, when taken as an overall total score, each of the qualitative characteristics were no longer significantly skewed, therefore the decision was made to analyze them as observed variables in both the measurement and structural models. Otherwise, the CAT-PD-SFv1.1 risk taking measure exhibited a slight positive skew.

We first report the results on the individual distraction ratings across the qualitative characteristics, risk perception, and engagement, followed by the structural equation model to determine the predictors of driving distraction engagement and perception of distraction risk. Within the discussion of the structural equation modeling technique, we describe the method, the full model estimation, the latent correlations including risk seeking and the relationships between the qualitative characteristics. We conclude with the path loadings including the variables of risk perception, engagement, and exposure.

3.1. Risk perception and engagement across individual distractions

One of the main research questions of the current study was how participants would rate the individual distractions on risk and engagement (see Table 2 for complete listing of *M*'s and *SD*'s for all study variables). Among the internal distractions for engagement, in vehicle passenger conversation ($M = 7.08$) was rated only 0.46 below the no distraction condition, suggesting that drivers engaged in passenger conversation quite frequently. The rest of the internal distractions were rated on the scale below the average of 5.30. Reading SMS or email was the second highest rated engagement compared to passenger conversation at an average of 5.26. This was followed by writing and sending SMS or email ($M = 4.68$) and then handheld phone conversations ($M = 4.31$). The

Table 1
Definitions of all qualitative characteristics used in the study as seen by study participants.

Qualitative Characteristic		Definition
1	Engagement	How much or often do you physically perform the following tasks or experience the following situations while driving?
2	Ambiguous Risk (AmbRisk)	How risky are completing the following tasks or situations while driving?
3	Crash Probability (CrashProb)	How likely is it that completing the following tasks or situations while driving will cause a driver to crash his or her vehicle?
4	Voluntariness	Are the following tasks or situations voluntary or imposed?
5	Control	How much control do you have over completing the following tasks or being in the following situations while driving?
6	Exposure	How much are you exposed to or do you encounter each of the following tasks or situations in your everyday life?
7	Visual Demand	How much visual input (looking, glancing, watching etc. . .) do the following tasks or situations require to complete?
8	Cognitive Demand	How much mental effort, concentration, or thought is required to complete the following tasks or situations?
9	Fairness	How reasonable is it that drivers engage in the following tasks or situations while they drive?
10	Perceived Knowledge of Risks	How much knowledge do you have about the risks of the following tasks or situations in regards to how they affect driving?

Table 2
Means, standard deviations, and 95% confidence intervals of all driver distractions by Qualitative Characteristic (QC). Each QC was rated on a 1–10 scale with 1 being "very little" to 10 being "a lot". Ratings closer to 10 indicate greater ratings on that characteristic.

		Ambiguous Risk		Crash Probability		Engagement		Voluntariness		Control	
#	Driving Distractions	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI
1	Write & send SMS/email	8.88 (1.66)	[8.70; 9.07]	8.84 (1.71)	[8.65; 9.04]	4.68 (3.03)	[4.34; 5.02]	9.43 (1.87)	[9.22; 9.64]	7.90 (3.01)	[7.56; 8.24]
2	Read SMS/email	8.18 (2.00)	[7.95; 8.40]	8.36 (2.07)	[8.13; 8.60]	5.26 (3.00)	[4.93; 5.59]	9.36 (1.90)	[9.15; 9.57]	8.10 (2.83)	[7.78; 8.41]
3	Adverse weather	7.60 (2.14)	[7.36; 7.84]	7.90 (1.84)	[7.70; 8.11]	6.57 (1.99)	[6.35; 6.80]	1.85 (2.08)	[1.62; 2.08]	2.75 (2.54)	[2.46; 3.03]
4	Eating	6.53 (2.15)	[6.29; 6.77]	6.43 (2.28)	[6.18; 6.69]	3.98 (2.37)	[3.71; 4.24]	9.20 (1.89)	[8.99; 9.41]	7.96 (2.64)	[7.67; 8.26]
5	Roadside crashes, traffic, work zones	6.50 (2.23)	[6.25; 6.76]	6.41 (2.13)	[6.17; 6.64]	5.59 (2.16)	[5.35; 5.83]	1.86 (1.95)	[1.64; 2.08]	3.10 (2.77)	[2.79; 3.41]
6	HH phone conversation	6.05 (5.80)	[5.80; 6.29]	6.23 (2.27)	[5.98; 6.49]	4.31 (2.82)	[3.99; 4.62]	9.13 (1.82)	[8.91; 9.34]	8.06 (2.66)	[7.76; 8.35]
7	Pedestrians near road	5.89 (2.30)	[5.63; 6.15]	5.43 (2.28)	[5.18; 5.69]	5.89 (2.43)	[5.62; 6.17]	2.20 (2.33)	[1.94; 2.46]	3.55 (2.98)	[3.22; 3.89]
8	Bicyclist on/near road	5.77 (2.25)	[5.52; 6.02]	5.30 (2.18)	[5.05; 5.54]	5.70 (2.32)	[5.44; 5.69]	2.21 (2.30)	[1.95; 2.47]	3.55 (2.95)	[3.22; 3.88]
9	Motorcyclist on/near road	5.59 (2.31)	[5.33; 5.85]	5.35 (2.31)	[5.10; 5.61]	5.82 (2.38)	[5.55; 6.09]	2.19 (2.30)	[1.93; 2.44]	3.57 (2.98)	[3.24; 3.91]
10	Looking for addresses/sign	5.34 (2.10)	[5.11; 5.58]	5.29 (2.19)	[5.04; 5.53]	6.17 (2.34)	[5.90; 6.43]	5.66 (3.17)	[5.31; 6.02]	7.20 (2.33)	[6.94; 7.46]
11	HF write & send SMS or email	4.71 (2.10)	[4.47; 4.94]	4.54 (2.27)	[4.29; 4.80]	2.24 (2.27)	[1.99; 2.50]	9.17 (1.93)	[8.95; 9.38]	8.09 (2.64)	[7.80; 8.39]
12	HF phone conversation	4.58 (2.10)	[4.35; 4.82]	4.62 (2.29)	[4.36; 4.88]	3.37 (3.02)	[3.03; 3.71]	8.99 (2.01)	[8.77; 9.22]	8.41 (2.35)	[8.15; 8.67]
13	HF read SMS/email	4.55 (2.13)	[4.31; 4.78]	4.44 (2.25)	[4.19; 4.69]	1.97 (2.02)	[1.74; 2.20]	9.16 (1.94)	[8.94; 9.38]	8.05 (2.62)	[7.76; 8.35]
14	Billboards/advertisements	4.06 (2.34)	[3.79; 4.33]	4.06 (2.22)	[3.81; 4.31]	6.03 (2.69)	[5.73; 6.33]	2.68 (2.70)	[2.38; 2.98]	3.94 (3.35)	[3.56; 4.31]
15	In-vehicle passenger conversation	3.84 (2.01)	[3.62; 4.07]	4.21 (2.15)	[3.97; 4.45]	7.08 (2.23)	[6.79; 7.36]	7.60 (2.75)	[7.29; 7.91]	8.11 (2.25)	[7.85; 8.36]
16	No distraction	2.99 (2.29)	[2.73; 3.25]	2.76 (2.23)	[2.51; 3.01]	7.54 (2.59)	[7.25; 7.74]	5.86 (3.75)	[5.44; 6.28]	7.81 (2.91)	[7.49; 8.14]

		Exposure		Visual Demand		Cognitive Demand		Fairness		Perceived Risk Knowledge	
#	Driving Distractions	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI	*M* (*SD*)	95% CI
1	Write & send SMS/email	5.29 (2.99)	[4.95; 5.62]	8.98 (1.96)	[8.76; 9.20]	7.21 (2.41)	[6.94; 7.48]	2.79 (2.59)	[2.50; 3.08]	9.18 (1.44)	[9.01; 9.34]
2	Read SMS/email	5.84 (2.88)	[5.52; 6.16]	8.80 (1.93)	[8.59; 9.02]	6.31 (2.34)	[6.05; 6.58]	3.16 (2.70)	[2.86; 3.46]	9.10 (1.52)	[8.93; 9.27]
3	Adverse weather	6.62 (1.95)	[6.40; 6.84]	8.61 (1.90)	[8.40; 8.82]	7.21 (2.40)	[6.94; 7.47]	7.47 (2.48)	[7.20; 7.75]	8.47 (1.98)	[8.25; 8.70]
4	Eating	4.19 (2.50)	[3.92; 4.47]	6.63 (2.50)	[6.35; 6.91]	5.86 (2.38)	[5.59; 6.13]	4.20 (2.46)	[3.93; 4.48]	7.56 (2.69)	[7.26; 7.86]
5	Roadside crashes, traffic, work zones	6.08 (2.00)	[5.86; 6.31]	7.51 (2.20)	[7.27; 7.76]	6.40 (2.17)	[6.16; 6.64]	7.20 (2.53)	[6.91; 7.48]	7.75 (2.42)	[7.48; 8.02]
6	HH phone conversation	4.62 (2.75)	[4.31; 4.93]	4.41 (2.75)	[4.10; 4.71]	5.50 (2.33)	[5.24; 5.76]	4.68 (2.66)	[4.38; 4.98]	7.86 (2.55)	[7.57; 8.14]
7	Pedestrians near road	6.44 (2.24)	[6.19; 6.69]	8.14 (1.98)	[7.92; 8.37]	5.93 (2.46)	[5.65; 6.20]	7.37 (2.44)	[7.09; 7.64]	7.76 (2.39)	[7.49; 8.03]
8	Bicyclist on/near road	6.10 (2.22)	[5.86; 6.35]	8.08 (2.00)	[7.86; 8.31]	5.89 (2.40)	[5.62; 6.16]	7.38 (2.47)	[7.10; 7.66]	7.56 (2.47)	[7.28; 7.84]
9	Motorcyclist on/near road	6.22 (2.24)	[5.97; 6.48]	8.06 (2.04)	[7.83; 8.29]	5.64 (2.49)	[5.36; 5.92]	7.59 (2.35)	[7.32; 7.85]	7.82 (2.34)	[7.56; 8.08]
10	Looking for addresses/sign	6.31 (2.24)	[6.05; 6.38]	8.68 (1.60)	[8.50; 8.86]	6.04 (2.18)	[5.79; 6.28]	7.99 (2.07)	[7.76; 8.23]	6.85 (2.98)	[6.51; 7.18]
11	HF write & send SMS or email	2.56 (2.44)	[2.29; 2.84]	3.96 (2.64)	[3.67; 4.26]	4.41 (2.13)	[4.14; 4.65]	5.64 (2.86)	[5.32; 5.96]	6.49 (3.20)	[6.13; 6.85]
12	HF phone conversation	3.58 (2.93)	[3.25; 3.91]	3.74 (2.75)	[3.43; 4.05]	4.16 (2.25)	[3.91; 4.41]	6.06 (2.70)	[5.76; 6.36]	7.24 (2.91)	[6.92; 7.57]
13	HF read SMS/email	2.31 (2.22)	[2.06; 2.55]	3.91 (2.68)	[3.61; 4.21]	3.98 (2.07)	[3.75; 4.21]	5.68 (2.87)	[5.36; 6.00]	6.41 (3.25)	[6.04; 6.77]
14	Billboards/advertisements	6.33 (2.70)	[6.03; 6.63]	6.40 (2.65)	[6.10; 6.70]	3.72 (2.12)	[3.48; 3.96]	6.88 (2.62)	[6.58; 7.17]	6.28 (3.12)	[5.93; 6.63]
15	In-vehicle passenger conversation	6.99 (2.45)	[6.72; 7.27]	4.41 (2.62)	[4.11; 4.70]	3.94 (2.24)	[3.69; 4.19]	7.85 (2.25)	[7.59; 8.10]	6.93 (2.99)	[6.59; 7.26]
16	No distraction	7.20 (2.70)	[6.90; 7.51]	7.04 (3.44)	[6.65; 7.42]	4.23 (2.87)	[3.91; 4.55]	9.02 (2.15)	[8.78; 9.26]	8.26 (2.56)	[7.97; 8.54]

rest of the internal distractions were rated below 4.00 on engagement. For ambiguous risk, passenger conversation was rated at an average of 3.84 ($SD = 2.01$), compared to the no distraction condition rated at 2.99 ($SD = 2.29$). Hands-free phone conversation was rated at 4.58 ($SD = 2.10$), whereas handheld conversation was rated at 6.05 ($SD = 5.80$), showing that participants felt that hands-free phone conversation is less risky than handheld phone. Although engagement was higher with reading and writing/sending SMS or email than many of the other distractions, they were by far rated the most risky, 8.18 ($SD = 2.00$) and 8.88 ($SD = 1.66$) respectively. Participants reported that writing and sending were more risky than reading text messages only. They also reported being more likey to read a message than compose one. For the external distractions, the range in engagement was between a low of 5.70 to a high of 6.57, thus all were rated in the moderately engaging range. This was logical given that these distractions were much less voluntarily engaged in and were quite common to encounter in driving. Of more interest were the ambiguous risk ratings for the external distractions. Billboards and advertisements were rated lowest at 4.06. This finding is concerning because billboards can cause drivers to shift their gaze substantially away from the road depending on the location of the billboard (Edquist et al., 2011). This could also be the case when looking for an addresses/sign, which was rated at only 5.34 for risk. Moreover, there are a range of different types of billboards today with advanced graphics and animations which could add to the distraction. Bicyclists, motorcyclists, and pedestrians near or on the road were only rated at close to the middle of the risk scale (Table 2). This is worrisome given the potential threat these obstacles pose, particularly due to their reduced size and conspicuity. The highest rated external distraction on risk was adverse weather (7.60), which could be considered risky for more reasons other than being distracting, such as the risk posed by icy or slippery roads.

3.2. Structural equation modeling

Structural Equation Modeling (often abbreviated SEM) is a multivariate statistical technique that combines both factor analysis and regression or path analysis to assess both correlational and causal associations between variables. This technique has the ability to model complex relationships between multiple independent variables and dependent variables simultaneously, reducing the risk of type I error that comes with multiple comparisons. Additionally, SEM can model latent constructs as a composite of measured variables that are all theoretically related while also modeling measurement error (Kline, 2015). In SEM, hypothesized relationships are specified a priori based on theorized associations between variables either as a non-directional (correlational) relationship identified as a double-sided arrow, or as a directional (causal) relationship identified as a single-headed arrow indicating the hypothesized direction of effect (MacCallum and Austin, 2000).

We based our model fit on the standardized criteria in the literature (see Hu and Bentler, 1999 for more information). These criteria suggest using multiple fit indices to determine a convergence of model fitness. We used the following indices to judge model fit: Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Squared Residual (SRMR), both with lower values indicating better fit; ratings below 0.06 indicate excellent fit. Additionally, we used the Comparative Fit Index (CFI) and the Non-Normed Fit Index (called TLI or the Tucker Lewis Index) both which range from 0 to 1 with values closer to 1.0 indicating better fit; a rating of a 1 indicates an absence of error fitting the model. We also reported the results of χ^2; however, this measure is very sensitive at sample sizes such as ours, and significant results are possible with even trivial model issues; thus our judgment of model fit was based on using the other indices of fit (Bentler, 1990; Hu et al., 1992; Table 3).

3.2.1. Measurement model

A confirmatory factor analysis (CFA) was conducted in AMOS v.22 to determine the suitability of the measurement model prior to full data analysis. The full measurement and structural model is presented in Fig. 1, where circles represent latent variables, double sided arrows indicate proposed covariances and single arrows indicate hypothesized direct effects between variables. Overall the CFA including risk taking, sensation seeking and the seven qualitative characteristics fit extremely well, RMSEA = 0.005 (95% CI: 0.00; 0.054); CFI = 1.00; TLI = 0.99; SRMR = 0.017; $\chi^2 = 15.13$, $df = 15$; $p = 0.44$ (Table 3; CFA 1). We also noticed that the latent correlation between sensation seeking and risk taking was high ($\varphi = 0.86$). Correlation values of this magnitude indicate that, in our dataset, sensation seeking and risk taking may be measuring the same construct. Therefore, we decided to merge these two variables into a single risk-seeking variable. After this modification to the model we ran the CFA again and we found excellent model fit, RMSEA = 0.036 (95% CI: 0.00; 0.063); CFI = 0.98; TLI = 0.97; SRMR = 0.026; $\chi^2 = 32.19$, $df = 23$; $p = 0.096$ (Table 3; CFA 2).

3.2.2. Full structural model estimation

As previously stated, we were interested in the predictors of both risk perception and engagement in driver distractions. Prior to analysis, we observed a high zero-order correlation between ambiguous risk and crash probability ($r = 0.76$, $p < 0.001$; Table 4) as previously found in the literature (e.g. Titchener and Wong, 2010). Because of this finding, we allowed both ambiguous risk and crash probability to load on the same latent variable of Distraction Risk (Risk). We then specified a model of risk-seeking and the seven qualitative characteristics predicting both engagement and risk in each distracting task. Finally, we allowed risk to predict engagement to determine the impact of risk on engagement in a distraction task while we allowed all Ksi's (predictor variables) to covary in the model. We utilized the maximum likelihood estimation procedure to estimate all parameters in the model. Raw data (covariance matrix) was used without any missing data. The hypothesized model fit the data well, RMSEA = 0.059 (95% CI: 0.040; 0.077); CFI = 0.97; TLI = 0.93; SRMR = 0.030; $\chi^2 = 82.26$, $df = 40$; $p < 0.001$; Table 3). A review of the modification indices did not reveal any theoretically valid changes to the model; therefore, we maintained the theorized model and did not perform any post hoc changes to the model based on the modification indices. The final model with standardized coefficients is illustrated in Fig. 1.

For the ease of understanding, we present the results of the latent correlations between the predictor variables first, followed by the results of the significant path loadings between the predictor and dependent variables in our hypothesized statistical model.

3.2.2.1. Latent correlations. We found several of the latent correlations significant within the model. Significant standardized path loadings should be interpreted similar to beta weights in a multiple regression analysis.

3.2.2.1.1. Risk-Seeking. Our results indicated that individual differences in risk-seeking affected how participants rated fairness, control, and visual demand of the driving distractions. While holding all else constant, increases in risk-seeking was associated with individuals rating each distraction as more fair ($\beta = 0.127$, $p = 0.041$), having lower visual ($\beta = -0.171$, $p = 0.006$) and cognitive ($\beta = -0.179$, $p = 0.004$) demand, and having more control ($\beta = -0.162$, $p = 0.010$) over the distracting task than individuals with lower risk-seeking scores.

3.2.2.1.2. Relationships between qualitative characteristics. We found several significant relationships between each of the qualitative characteristics: (1) Perceived knowledge of risks, (2) Exposure, (3) Voluntariness, and (4) Visual demand. The results revealed that individuals who subjectively felt they had more knowledge of the risks of the distractions used in this study were likely to rate each distraction on average requiring more visual ($\beta = 0.214$, $p < 0.001$) and cognitive demand ($\beta = 0.144$, $p = 0.013$) to perform or engage in. Individuals also rated drivers as having more control ($\beta = 0.164$, $p = 0.005$) over these tasks and situations were more voluntary ($\beta = 0.181$, $p < 0.001$) and less imposed on drivers than individuals with lower perceived knowledge of risks. The results showed that individuals who have been exposed more to a distracter rated it as requiring higher amounts of visual ($\beta = 0.266$, $p < 0.001$) and cognitive demand ($\beta = 0.245$, $p < 0.001$). The results also showed that individuals rated each distraction on average as more fair ($\beta = 0.225$, $p < 0.001$) and having higher perceived knowledge of risk ($\beta = 0.271$, $p < 0.001$) than those with less exposure to the distractions. Distractions rated as more voluntary were associated with being more controlled ($\beta = 0.236$, $p < 0.001$) as well as requiring more visual attention ($\beta = 0.211$, $p < 0.001$). Finally, distractions rated higher in visual demand were also rated as higher in cognitive demand ($\beta = 0.449$, $p < 0.001$).

3.2.2.2. Path loadings. We now describe the effects across the significant path loadings for risk-seeking and the qualitative characteristics on both risk perception and distraction engagement.

3.2.2.2.1. Risk perception. We found that several of the qualitative characteristics significantly predicted individuals' perception of risk. Increases in cognitive ($\beta = 0.527$, $p < 0.001$) and visual demand ($\beta = 0.189$, $p < 0.001$), exposure to the distraction ($\beta = 0.198$, $p < 0.001$), and perceived knowledge of the risks ($\beta = 0.148$, $p < 0.001$) were associated with an increase in the perception of risk, while higher ratings of perceived fairness

Table 3
Model fit indices for each model run.

Model	NNFI (TLI)	CFI	SRMR	RMSEA	95% CI	χ^2	*df*
CFA Model 1 (separate risk taking and sensation seeking)	0.99	1.00	0.017	0.005	[.00; 0.054]	15.13	15
CFA Model 2 (combined risk taking and sensation seeking)	0.97	0.98	0.026	0.036	[.00; 0.063]	32.19	23
Full Structural Model	0.93	0.97	0.030	0.059	[.040; 0.077]	82.26[a]	40

[a] Chi square significant at $p < 0.001$, NNFI = Non-Normed Fit Index, TLI = Tucker Lewis Index, CFI = Comparative Fit Index, SRMR = Standardized Root Mean Squared Residual, RMSEA = Root Mean Squared Error of Approximation.

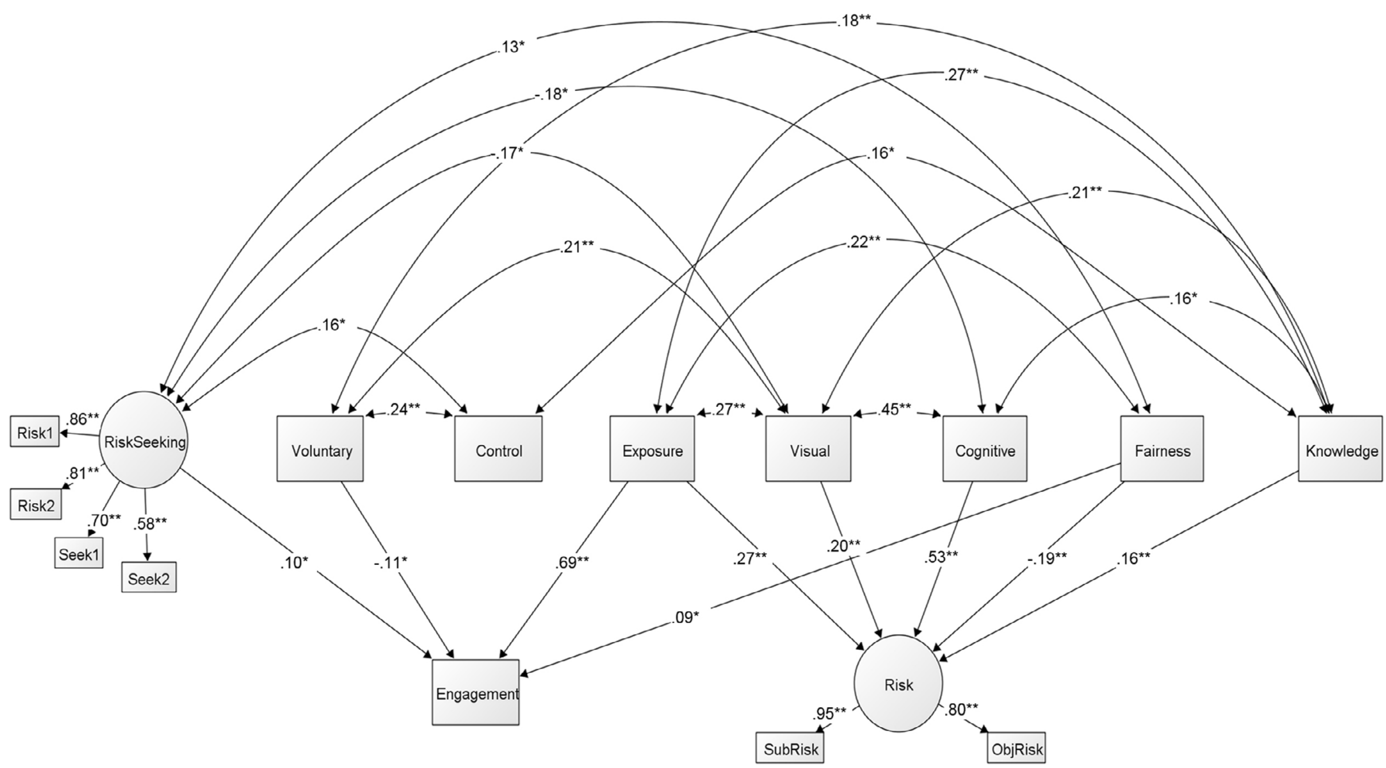

Fig. 1. Hypothesized full structural model. Numbers are β's. Dashed lines indicate non-significant loadings. Solid lines are significant ($^{*}p < 0.05$; $^{**}p < 0.001$). Double-sided arrows represent latent correlations between variables and single-sided arrows represent directional predictions between variables.

Table 4
Variances, covariance's, and correlations among study variables.

	Variable	1	2	3	4	5	6	7	8	9	10	11	12
1	Sensation Seeking	**48.97**	44.61	27.27	−18.05	−16.88	0.68	20.32	16.98	−21.13	−19.08	24.16	20.50
2	Risk Taking	0.640**	**99.23**	31.03	−33.74	−27.26	−2.62	25.93	18.78	−31.74	−37.76	20.69	7.19
3	Engagement	0.186**	0.149**	**438.62**	83.70	120.40	−18.83	43.42	327.41	93.83	98.64	141.22	155.70
4	Ambiguous Risk	−0.113*	−0.148**	0.175**	**521.06**	406.40	40.91	1.83	157.63	233.38	347.47	−72.17	195.93
5	Crash Probability	−0.103	−0.116*	0.244**	0.756**	**553.90**	52.39	−19.70	185.14	260.28	247.92	−62.40	229.66
6	Voluntariness	0.007	−0.020	−0.068	0.136*	0.169**	**174.13**	60.02	13.02	60.38	2.97	−25.87	73.71
7	Control	0.151**	0.135*	0.108	0.004	−0.043	0.236**	**371.58**	38.06	42.09	2.87	46.15	97.54
8	Exposure	0.114*	0.089	0.735**	0.325**	0.370**	0.046	0.093	**452.31**	122.73	119.55	111.44	177.57
9	Visual Demand	−0.139*	−0.147**	0.206**	0.471**	0.509**	0.211**	0.101	0.266**	**471.48**	224.34	5.91	143.29
10	Cognitive Demand	−0.119*	−0.165**	0.205**	0.662**	0.458**	0.010	0.006	0.245**	0.449**	**528.57**	27.01	101.70
11	Fairness	0.148**	0.089	0.289**	−0.136*	−0.114*	−0.084	0.103	0.225**	0.012	0.050	**542.56**	21.16
12	Perceived Risk Knowledge	0.095	0.023	0.241**	0.279**	0.317**	0.181**	0.164**	0.271**	0.214**	0.144*	0.029	**948.78**

Note: $^{*}p < 0.05$; $^{**}p < 0.001$; Correlations are on the lower left of the matrix and covariance's are on the upper right of the matrix. Variances are on the diagonal in bold.

(β = −0.204, $p < 0.001$) were associated with a decrease in perceived distraction risk.

3.2.2.2.2. Engagement. The results signified that individuals with higher risk-seeking were more likely to engage in distracting tasks and situations (β = 0.096, $p = 0.025$). Additionally, higher fairness ratings (β = 0.086, $p = 0.035$) increased engagement while individuals were more likely to engage in distractions that were less voluntary (β = −0.106, $p = 0.007$). Next, our results indicated that the greatest predictor of engagement in distracting activities was individuals prior exposure to the distraction or situation (β = 0.692, $p < 0.001$). Finally, perceived knowledge of risk (β = 0.072, $p = 0.078$) and perceptions of risk (β = −0.117, $p = 0.085$) were not significant predictors of engagement in distractions.

4. Discussion

Driving while distracted is a major cause of injury and fatality in the United States. Due to the inherent dangers of distracted driving, it is important to research exactly which factors lead to this risky behavior on the roadway. As such, this study examined drivers' perceived level of risk for common distractions both inside and out of the vehicle, their level of engagement with the distracter, as well as the relationship between college-aged drivers' perception of risk and reported engagement in driving distraction. Although the statistical method by which we analyzed the data is not commonly seen in this domain, it is frequently used in other domains. Further, it is the most appropriate statistical technique for this study as it allows for analysis and a better understanding of any differences among the different factors presented. To examine the impact of the qualitative characteristics (QC's) on perceived risk and distraction engagement, we presented the interrelationships among the QC's, risk-seeking behavior, and their relationship between risk and engagement.

First addressing hypothesis 1 (H_1), we found that the QC's accounted for a significant proportion of variance among perceived risk and the engagement of a distraction. Additionally, while we noticed there was some overlap between the factors that led to risk and engagement, there was a clear separation between the two. Overall we hypothesized that factors leading to increased perceptions of risk would also lead to less engagement; however, our results revealed that this was not always the case. The amount of perceived cognitive demand was the most important factor to risk perception, although it accounted for little variance in engagement. This finding ($\beta = 0.53$) was very similar to previous studies, particularly research conducted by Titchener and Wong (2010) ($\beta = 0.55$). The same pattern was also found for perceived risk, knowledge, and perceived visual demand (see hypothesis 2 (H_2)). For example, distractions such as passenger conversation and billboards which were rated as less risky were also rated as less cognitively and visually distracting. On the other hand, higher rated distractions on risk such as writing and reading text messages or emails were rated as highly cognitively and visually demanding. This relationship was also prevalent in Patel et al. (2008). In the Patel study, a distracter's lack of control, lack of cognitive demand, exposure, lack of fairness, and lack of legality led to greater perceived risk.

In terms of hypothesis 3 (H_3), risk-seeking behavior was predictive of engagement but not the perception of risk. Risk-seekers (combination of sensation seeking and risk taking) are more likely to engage in distraction than non-risk-seekers regardless of their perception of the risk (Arnett, 2002; Iversen, 2004). Supporting this, we found a significant correlation between the number of self-reported near misses participants had in the previous year and risk-seeking ($r = 0.11$ for sensation seeking and r's $= 0.13$ for risk taking). However, the frequency of near misses was not related to perceived risk or engagement in distractions, thus was not included in the overall model.

Next, we showed partial support for hypothesis 4 (H_4). While internal distractions were rated as more voluntary and controlled than distractions outside the vehicle (Table 2), they were not rated as less risky for either ambiguous risk or the probability of causing a vehicle crash (Table 3). This finding was contrary to White et al. (2012) and Titchener and Wong (2010), who found a significant connection between voluntariness and perceived risk. The differences in findings may be due to including more external distractions in the current study. While this hypothesis was not fully supported, we did find a significant association between voluntariness of the distraction and engagement. Drivers do not always have complete control over if or when they engage in a distraction. This is more likely for external distractions, which may have led them to be rated as less voluntary and controlled. Another explanation is that once the variance between voluntariness and engagement was accounted for, the association between voluntariness and risk was no longer significant. This explanation is supported by a small but significant zero order correlation between ambiguous risk and voluntariness ($r = 0.136$; $p < 0.05$).

Finally, our hypothesis 5 (H_5) that perceived risk will predict lower distraction engagement was not supported. We found that risk perception did not directly predict engagement. This finding challenges a prior research finding from Lerner and Boyd (2005). These researchers found that both in situ driving and questionnaire data showed drivers' willingness to engage was directly related to their perception of risk. One reason for this divergence is that we included a large variety of distractions both inside and outside the vehicle. Distractions outside the vehicle were more likely to be rated as both risky and engaged in frequently. However, even within the internal distractions (e.g. phone, passenger, eating) we find a much lower correlation between risk and willingness to engage.

Another potential reason for the discrepancy may be due to our younger sample, as risk and willingness to engage data varied somewhat across the lifespan in the Lerner and Boyd study. More recent evidence, also using a younger sample, supports the dissociation between risk and engagement that we found in the current data (Atchley et al., 2011; NHTSA, 2012, 2013a). Overall, our study supports the idea that although drivers were aware that distraction is quite a risky endeavor, participants rated that they engage in it regardless of this risk. Our research found that two factors were predictive of both risk perception and distraction engagement: perceived fairness and exposure. While increased fairness of a distraction corresponded with decreased risk, it only slightly increased engagement.

This may be accounted for by the influence of injunctive social norms. A fear of punishment or incarceration may influence participants to identify the risk associated with a particular distraction (Atchley et al., 2011). However, previous research has indicated that this perception does not change driver's behavior. Among a drivers' peer group, it may be seen as more fair to engage in secondary tasks (Atchley et al., 2012). The role of fairness on risk perception and engagement may also be gender dependent. Tay (2005) found that law enforcement campaigns targeted at illegal driving activities were only effective at reducing engagement for young male drivers. If this is indeed the case, it may explain our relatively low path loading for fairness and engagement since our sample contained more female participants than males.

Next, our study found that previous exposure was the most predictive factor of engagement and accounted for more variance than visual demand, fairness, and perceived knowledge of risk. One potential explanation is that exposure may serve as a way to calibrate the driver in terms of these metrics. Although greater exposure was associated with greater ratings of visual demand and risk knowledge, these effects may have been discounted by the increased perception in fairness which led to a decreased perception in risk. However, even when people perceive distractions to be visually and cognitively demanding or violate social norms they may still engage in that behavior. The negative consequences of drivers' behavior (e.g. vehicle crash) due to distraction is perceived to be a rare occurrence (Slovic, 1987). Due to this theorized low prevalence, while exposure leads to greater risk perception, it also leads to greater engagement. It may also be the case that individuals are often overconfident of their own skill, which could be because their skill deficiency prevents them from being able to distinguish good versus poor performance (Kruger and Dunning, 1999). Therefore, this exposure-risk calibration may provide evidence that the driver can use to justify their engagement in the distraction.

The connection between perceived risk and engagement in the literature has been unclear. While one study (Nelson et al., 2009) showed similar findings to the current study, Lansdown (2012) found that high-risk distractions, such as texting and using a GPS system, had lower engagement. However, Lansdown used an exclusive sample from the UK which included older drivers while Nelson and colleagues as well as the current study used an American sample of college-aged drivers. This may indicate either a cultural difference between drivers from the US and UK or that our findings are more specific to younger drivers. Although the path between risk and engagement was not significant, it was negative similar to the Lansdown study ($\beta = -0.12$; $p > 0.05$). An analysis of the mean differences between engagement and risk perception for specific distractions revealed that texting, eating, and billboard distractions had this inverse relationship similar to Lansdown (2012). Our small beta weight for risk predicting engagement may be a consequence of including a large set of distractions rather than focusing on a smaller, higher risk set.

4.1. Does perceived risk differ from studies of objective risk?

There were several instances where the perceived risk of a distraction found in our study differed from more objective distraction studies examining driving performance. One study noted that driving performance decrements while reading and writing texts are similar (Cooper et al., 2011). However, our participants rated writing text messages (texts) as less distracting than reading texts. Upon diving deeper into these results, we realized participants felt that a crash was more likely with writing and sending texts rather than reading these messages due to their increased visual demand. There was a much larger difference in cognitive demand, with participants rating writing and sending more cognitively demanding than reading text messages. Participants also felt that reading was more fair or acceptable than writing and sending texts. This gives credit to the argument that engaging in some distractions may not be determined by perceived risk, but rather by social pressures, perception of others, and what other people are doing behind the wheel.

Our sample felt that talking with a hands-free (HF) phone is safer than talking on a handheld (HH) phone specifically in terms of crash probability. Research has shown that talking on a hands-free and handheld phone have similar detrimental effects on driving (e.g., Caird et al., 2008). Further, participants felt HH phone usage was more visually demanding. This finding could be due to participants factoring in the dialing component, although drivers may still have to dial the phone visually with a HF phone. Further research may be needed to tease this factor apart; however, participants rated the cognitive demand of HH phone higher than HF phone conversations. It is not clear why participants would feel that this is the case, but it could help explain why they thought HH phone was more risky to engage in during a drive. Our participants also rated HF phone conversations as more fair to engage in than HH phone, again probably assuming that HF phone was less risky.

Further, we discovered that passenger conversation was rated as low risk. Specifically, participants rated visual demand and cognitive demand relatively low. This finding was interesting given this was not the case in the literature. White and Caird (2010) found conversations can induce inattentional blindness that leads to looked-but-failed-to-see errors and this task may also add visual distractions if the driver looks away from the road toward the passenger. This may be common because during conversations people often rely on behavioral cues obtained by looking at their speaking partner (e.g. Gu and Badler, 2006). Several studies also found that interactions with passengers can be quite detrimental on driving performance (e.g., Rivardo et al., 2008) and McEvoy et al. (2007) found that crash risk increased twofold when driving with two or more passengers compared to driving alone. This finding may be more critical for our sample, because Lee and Abdel-Aty (2008) noted that crash risk for young drivers only increased when driving with young passengers.

Among the external distractions, billboards were rated as very low risk. During further examinations of this distraction, we noticed that participants rated billboards as substantially lower on visual demand than looking for addresses or signs, bicyclists, motorcyclists, pedestrians, roadside crashes or work zones, writing/sending and reading SMS or email, and no distraction. Although the length of time to look at a billboard can be very short, it is uncertain as to why participants felt that the visual demand was much lower than some of these other distractions. Perhaps it was due to the billboards being seen as passive objects while looking for a sign or address is a task that requires their active engagement to complete. Additionally, billboards are easier to see and read as they have larger font and are more visually salient compared with street signs, which also may have lowered their rating of visual demand. Regardless, billboards and advertisements can garner attention away from driving and still can be risky; therefore, this does not indicate that billboards are objectively safer than searching for signs.

4.2. Potential strategies to mitigate distraction engagement

The next question regarding our findings were how to use this information to curb distracted driving. One strategy that could be effective is to educate drivers about the importance of safety and how their perceptions of risk may differ from objective research. This technique should begin while individuals are learning to drive. This would minimize the potential inoculating effect of exposure on engagement. Overall, participants in the current study felt that they had a large amount of perceived knowledge about the risk of these distractions. The average perceived risk knowledge across all distractions as well as the no distraction scenario was 7.60. This indicates that drivers think they know the risks quite well, but as their perceptions are compared to objective research on driving distraction, it appears that they do not understand the risks as well as they think. Thus, aligning perception with reality may be effective.

Another strategy could be specifically providing exposure to the risk of driving while distracted through experiential learning strategies in realistic driving simulators. If the negative consequences of engagement become more available and salient to younger drivers, the connection between perceived risks may become stronger. One study found that simulation training was effective at decreasing the negative effects of passengers by training effective risk mitigation strategies (Lenné et al., 2011).

4.3. Significance of the current study

External distractions were of particular interest to examine given they have not received much attention in the objective research compared to internal distractions (Rupp, 2012). Whereas Titchener and Wong (2010) included “events near vehicle” as an external distraction, the present study divided that category into several different events, such as emergency vehicles, motorcycles, etc. Given the negative effects external distractions can have on driving performance (Wallace, 2003), safety messages need to be more explicit on their risks. Results were different from Patel et al. (2008) in terms of some of the relationships between the qualitative characteristics with each other, as well as between the qualitative characteristics and risk ratings. This may suggest that how well the qualitative characteristics explain the variance of risk perception may depend on which types of distractions are included. Most of the previous research did not compare the two types of distractions (internal vs. external) specifically. The current study examined a wider array of qualitative characteristics than previously examined, including visual demand and engagement to help explain the risk perceptions. Although Gentzler et al. (2013) focused on personality as a potentially important correlate of risk perceptions; most other studies in this domain have not. Adding engagement was important given the divergent findings between engagement and risk perception. Our study also included a wider breadth of more modern internal distractions (e.g. voice-to-text) which are becoming more common. Finally, we added a "no distraction" scenario as a baseline that was not found in the Patel, Titchener and Wong, White, or Lansdown studies.

Overall, the most critical finding of this study may be the connection between exposure and both engagement and risk perception and that while drivers intellectually understand that driving while distracted is risky, they continue to engage with distractions. These results may indicate that implementing a way to bring people's behaviors in line with their attitudes may be effective at curbing distracted driving among college-aged drivers.

4.4. Limitations and future research

Despite the results of the current study, several potential limitations must be taken into account. The sample examined in the current study differed from previous driver perception studies (Patel et al., 2008; Titchener et al., 2009; Titchener and Wang, 2010; White et al., 2004) by containing a larger proportion of both younger and female drivers. Our results were mostly consistent with previous findings, but perceptions can vary due to gender and age. For example, younger male drivers may be less likely to rate driver distractions as risky since they are more risk and sensation seeking than female or older drivers. We measured both sensation seeking and risk taking as personality variables and while they were related to engagement, they were not statistically related to the perceived risk of the distraction. This relationship may have been stronger if we included more male (higher risk-seeking) and older (lower risk-seeking) drivers; thus this may indicate a restriction of range issue. Additionally, Lesch and Hancock (2004) found that among older drivers, self-confidence in their ability varied based on sex such that older male drivers' ratings of confidence matched their performance, while for older female drivers it did not. Their finding among older adults that there exists a disassociation between perception of ability and individuals' actual ability may impact the link between risk perception and engagement in distraction. For example, older female drivers may be more likely to engage in secondary tasks because they believe their performance is greater than it is actually. Future studies should further investigate these potential differences among genders.

Next, the findings of the current study are based on results from a younger college-aged sample. Previous studies have found that this age group was the most likely to show dissociations between risk and engagement. One study revealed that legislation to prevent texting was ineffective among young drivers (Foss et al., 2009), while other studies such as Atchley et al. (2011) and Nelson et al. (2009) showed that younger drivers not only adopt novel technology more quickly than older drivers, but show stronger disassociations for reactive tasks than proactive ones. This bias may further lower risk perception for distractions that are seen as less voluntary such as external distractions. Overall, while we expect these results to generalize to older drivers because our results support previous research with a wider range of drivers, we believe further research should be conducted to assess possible differences across age groups. Additionally, we believe future research investigating a wider range of distractions and qualitative characteristics based on the methods we present in the current research would be useful to determine other correlates of risk and engagement.

5. Conclusions

While increasing legislation and technological interventions strive to reduce distraction engagement rates, individuals still drive distracted. Furthermore, there are many distractions, especially external ones, which drivers cannot avoid and therefore must manage the risk. The question remains of what can be done to change drivers' attitudes and to reduce engagement in distracted driving. The results of the current study suggest that exposure is the best predictor of engagement, whereas the best predictor of risk is cognitive demand. To enhance more accurate risk perception based on objective driving distraction research, we propose that education and training should emphasize the cognitive demands of distracted driving, covering various types of distractions. If drivers can safely experience the effects of distraction, this may help them understand the seriousness of its effects. This can be safely done in a PC based simulator for instance. Therefore, a way to enhance risk perception would be to center on the cognitive and visual demands of the distraction. For engagement, more research is needed into why exposure seems to be so important. It is hypothesized that social pressure and norms are the biggest factor. Ways to combat this could be through education and safety messaging as well. Another indication of the usefulness of education is with the qualitative characteristic of risk knowledge. For instance, participants did rate more knowledge of internal distractions, which could be indicative of less awareness of the risk of external distractions. Thus, the lack of self-perceived knowledge about some distractions may lead to perceiving lower risks associated with them. Although a plethora of research has indicated the detrimental effects of distracted driving, a great challenge is how to reduce engagement in it. In the same way that public education programs regarding the dangers of drinking and driving changed our culture's attitudes and behaviors, we believe that changing peoples' perceptions and attitudes about distracted driving through education may be the best answer.

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