

Driving anger, sensation seeking, impulsiveness, and boredom proneness in the prediction of unsafe driving

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Abstract

The present study investigated the potential contribution of sensation seeking, impulsiveness, and boredom proneness to driving anger in the prediction of aggressive and risky driving. Two hundred and twenty-four college student participants completed measures of trait driving anger, aggressive and risky driving, driving anger expression, sensation seeking, impulsiveness, and boredom proneness. Findings provided additional support for the utility of the Driving Anger Scale (DAS; Deffenbacher, J.L., Oetting, E.R., Lynch, R.S., Development of a driving anger scale, *Psychological Reports*, 74, 1994, 83–91.) in predicting unsafe driving. In addition, hierarchical multiple regression analyses demonstrated that sensation seeking, impulsiveness, and boredom proneness provided incremental improvements beyond the DAS in the prediction of crash-related conditions, aggressive driving, risky driving, and driving anger expression. Results support the use of multiple predictors in understanding unsafe driving behavior.

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1. Introduction

Despite efforts to improve automobile safety and decrease unsafe driving practices, motor vehicle accidents remain a serious public health problem (Hilton and Shankar, 2003; Rathbone and Huckabee, 1999; United States General Accounting Office, 2003). According to the National Highway Traffic Safety Administration (NHTSA, 2003), automobile accidents are the leading cause of death in the United States for persons between the ages of 4 and 33, resulting in 42,643 deaths and 2,899,000 injuries during 2003. In addition to the many lives lost, motor vehicle accidents have considerable financial costs in the form of medical and administrative expenses, employer costs and loss of productivity, and property damage. For example, motor vehicle crashes cost

the United States approximately \$230.6 billion in 2000 alone (NHTSA, 2003).

Considerable research has focused on predicting motor vehicle accidents. In a recent report to Congress, the US General Accounting Office (GAO; 2003) noted, “human factors are seen as the most prevalent, according to data, experts, and studies, in contributing to crashes, followed by roadway environment and vehicle factors” (p. 2). While respecting the importance of environmental factors, psychological research has generally focused on driver characteristics such as demographic, personality, cognitive, and information processing variables (Arthur et al., 1991). Although it is widely recognized that driving is a complex behavior, and accidents have multiple determinants (Hemenway and Solnick, 1993; Peck, 1993), potential predictors are often studied in isolation, and there have been relatively few attempts to combine multiple predictors in psychological studies of driving. This has led to important lines of research that have had surprisingly little

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overlap. The present study sought to combine four predictors of driving behavior that have been studied separately to date: trait driving anger, sensation seeking, impulsiveness, and boredom proneness.

Stimulated by data suggesting an increase in the most extreme forms of aggressive driving (i.e., attempting to injure or kill another person or damaging property in response to a traffic dispute) (American Automobile Association, 1997), the role of anger and aggressive driving in automobile accidents has received increased attention from both the media and from researchers. Recent data show that even among non-clinical samples, driving anger and aggressive driving are fairly common occurrences (Neighbors et al., 2002). In addition, a growing body of research now supports the utility of the Driving Anger Scale (DAS; Deffenbacher et al., 1994) in predicting anger toward other drivers, impatience with traffic, aggressive and risky driving, and traffic violations (Blanchard et al., 2000; Deffenbacher et al., 2000, 2001; Knee et al., 2001; Lajunen and Parker, 2001; Underwood et al., 1999). Using the DAS to form groups of high and low anger drivers, Deffenbacher's research group has demonstrated that high anger drivers are approximately 3.5–4.0 times more likely to engage in aggressive behavior while driving and 1.5–2.0 times more likely to engage in risky non-aggressive driving behavior (e.g., not wearing a seatbelt, exceeding the speed limit, etc.) than low anger drivers (Deffenbacher et al., in press; Deffenbacher et al., 2003a, 2003b; Deffenbacher et al., 2000, 2001).

Sensation seeking, defined as a personality trait involving the degree to which one desires novel and intense stimuli (Arnett, 1994; Zuckerman, 1990), is another factor that has received considerable attention for its role in driving behavior. Sensation seeking has been associated with drunk driving, exceeding the speed limit, racing other drivers, passing in no-passing zones, and a variety of other risky driving behaviors (Arnett, 1990, 1994, 1996; Arnett et al., 1997; Burns and Wilde, 1995; Clément and Jonah, 1984; Furnham and Saipé, 1993; Greene et al., 2000). Across the 40 studies he reviewed, Jonah (1997) noted that sensation seeking accounted for between 10–15% of the variance in risky driving. He also pointed out that the majority of studies found a positive relationship between sensation seeking and collision involvement.

Impulsiveness is another component of risk-taking that has received attention in the accident prevention literature. Impulsiveness is conceptually similar to sensation seeking, however, impulsiveness deals with one's *control* over one's thoughts and behaviors (Barratt, 1972) while sensation seeking refers to one's *preference* for novel experiences and a willingness to take risks (Zuckerman, 1994). Thus, high sensation seeking might lead to risk taking because of the thrill it provides (Arnett, 1994); impulsiveness might lead to risk-taking because the individual simply lacks the self-control to refrain from engaging in it (Barratt, 1994). Although early measures of impulsiveness overlapped with sensation seeking scales, especially the disinhibition component of sensa-

tion seeking (Barratt and Patton, 1983), later versions have refined impulsiveness as a distinct construct (Patton et al., 1995). Impulsiveness has been associated with drunk driving, reduced seatbelt use, impaired driver behavior, reduced ability to perceive traffic signs, and accident rates (Loo, 1979; Hansen, 1988; Stanford et al., 1996). Moreover, impulsiveness is thought to be associated with the type of impulsive aggression that characterizes most aggressive driving. Although it has not been studied in the context of aggressive driving, impulsiveness is related to general anger and aggression (Stanford and Barratt, 1992) and driving anger (Deffenbacher et al., 2003a, 2003b).

Although it has received considerably less attention in the literature than driving anger, sensation seeking, or impulsiveness, the construct of boredom proneness (i.e., one's propensity to experience feelings of boredom) has also been associated with unsafe driving behavior (Arnett, 1990; Furnham and Saipé, 1993; Verwey and Zaidel, 2000). However, each of these studies used the boredom susceptibility subscale of Zuckerman's (1971) sensation seeking questionnaire. Significant problems with Zuckerman's scale have been identified (Arnett, 1994), and most of the current boredom proneness literature uses the boredom proneness scale (BPS; Farmer and Sunberg, 1986), a measure which is weakly related to Zuckerman's Boredom Susceptibility subscale ($r = 0.25$). Although the BPS is correlated with measures of general anger and aggression (Dahlen et al., 2003; Rupp and Vodanovich, 1997), it has not yet been studied in the context of aggressive or risky driving. Therefore, the present study included the BPS on an exploratory basis.

The present study was conducted to determine whether sensation seeking, impulsiveness, and boredom proneness would provide incremental validity beyond the DAS in the prediction of unsafe driving. To maximize comparability of the present results with the previous DAS literature, the dependent measures included the driving survey (Deffenbacher et al., 2001) and the driving anger expression inventory (Deffenbacher et al., 2002). These instruments permitted us to evaluate the incremental validity of sensation seeking, impulsiveness, and boredom proneness in predicting crash-related conditions, aggressive driving, risky driving, and driving anger expression.

2. Method

2.1. Participants

Participants were 224 (70% female) undergraduate volunteers from psychology and social and rehabilitation services classes at the University of Southern Mississippi (median age = 19). Approximately 59.4% identified themselves as Caucasian, 36.2% as African American, 2.2% as Asian/Pacific Islander, 1.3% Hispanic, and 0.9% other. Participants were tested in group sessions lasting approximately 45 min and received research credit for their participation.

2.2. Instruments

2.2.1. Driving anger scale (DAS)

The propensity to become angry while driving was measured using the 14-item short form of the DAS (Deffenbacher et al., 1994). Items describe potentially anger provoking scenarios that might occur while someone is driving. Respondents rate each item as to the degree to which the situation would anger them using a five-point Likert scale (1 = “not at all” to 5 = “very much”). Cluster analysis of the 33-item long form resulted in six clusters: hostile gestures, illegal driving, police presence, slow driving, discourtesy, and traffic obstructions. The short form of the DAS was developed by selecting items from each cluster that were highly correlated with the cluster total and the total score of the long form. The 14-item version has strong internal consistency ($\alpha = 0.80$) and is highly correlated with the long form ($r = 0.95$). The short form does not permit reliable differentiation of the various forms of driving anger, providing only an overall score. The DAS has been validated in a number of studies which have documented relationships between DAS scores and general trait anger, aggressive and risky driving, and crash-related outcomes (Deffenbacher et al., 2000, 2001).

2.2.2. Driving anger expression inventory (DAX)

Individual differences in anger expression while driving were measured using the 49-item DAX (Deffenbacher et al., 2002). Items describe ways in which people react when angered while driving, and respondents indicate on a four-point Likert scale (1 = “almost never” to 4 = “almost always”) how often they react in a similar manner. The instrument yields a total score and four subscale scores: verbally aggressive expression (e.g., yelling, cursing, etc.), physically aggressive expression (e.g., getting out of one’s car to confront another driver, starting physical fights, etc.), use of the vehicle to express anger (e.g., cutting off another driver, slowing down to frustrate another driver, etc.), and adaptive/constructive expression (e.g., paying closer attention to driving safely, trying to relax, etc.). The DAX subscales have internal consistencies 0.81 and 0.90 and have been validated through their relationships with driving anger, trait anger, aggressive driving, and risky driving (Deffenbacher et al., 2002).

2.2.3. Driving survey

The frequency of problematic driving behavior and adverse outcomes were measured with the driving survey (Deffenbacher et al., 2001). First, six items measured crash-related conditions (i.e., losing concentration, having a minor loss of control, having a “close call,” receiving a moving violation, having a minor accident, and having a major accident). The first three crash-related condition items used a three-month time frame, and the last three referred to lifetime occurrences. Second, 13 items assessed the frequency of aggressive driving during the last three months (e.g., yelling at another driver, broken part of a vehicle in anger, etc.). Third, 16 items measured risky, non-aggressive driving behavior over the last

three months (e.g., speeding, driving without a seatbelt, etc.). Items were rated from 0 to 5+ with 5+ treated as 5 in analyses. Internal consistencies for aggressive driving and risky driving range between 0.83 and 0.89, however, crash-related items do not generally form a reliable scale and are usually analyzed individually (Deffenbacher et al., 2001). Research in which the DAS has been used to identify high-anger and low-anger drivers has supported meaningful differences on each of the three Driving Survey scales (Deffenbacher et al., 2000).

2.2.4. Arnett inventory of sensation seeking (AISS)

Sensation seeking was measured using the 20-item AISS (Arnett, 1994). Respondents rate the degree to which each item is characteristic of them on a 4-point Likert scale ranging from 1 (does not describe me at all) to 4 (describes me very well). The AISS has adequate internal consistency ($\alpha = 0.70$) and has been validated through relationships with other sensation seeking scales and self-reported risky behavior, including aggression and reckless driving (Arnett, 1994, 1996; Arnett et al., 1997).

2.2.5. Barratt impulsiveness scale—version 11 (BIS-11)

Impulsiveness was measured with the 30-item BIS-11 (Patton et al., 1995). Items are scored on a 4-point Likert scale, ranging from 1 (“rarely/never”) to 4 (“almost always/always”), with higher scores indicating greater impulsiveness. Using college student samples, internal consistencies range from 0.80 to 0.82 (Patton et al., 1995; Stanford et al., 1996). Evidence for the validity of the BIS-11 comes from its association with risk-taking and its ability to differentiate normal from clinical samples known to be more impulsive (Patton et al., 1995; Stanford et al., 1996).

2.2.6. Boredom proneness scale (BPS)

The propensity to experience boredom was assessed with Farmer and Sundberg’s (1986) 28-item BPS. Consistent with previous research using the BPS (e.g., McLeod and Vodanovich, 1991; Polly et al., 1993; Rupp and Vodanovich, 1997; Vodanovich and Kass, 1990; Watt and Blanchard, 1994; Watt and Ewing, 1996), the original true-false format was changed to a 7-point Likert scale in order to increase its sensitivity. Respondents indicated their agreement with each item using a 1 (“highly disagree”) to 7 (“highly agree”) scale. The two factors that have been replicated across studies (e.g., Ahmed, 1990; McLeod and Vodanovich, 1991; Vodanovich and Kass, 1990) are labeled external stimulation (BPext) and internal stimulation (BPint). BPext measures boredom due to the lack of external stimulation, and BPint measures boredom due to a lack of internal stimulation. Internal consistencies using the modified version of the BPS range from 0.79 to 0.84 (McLeod and Vodanovich, 1991; Polly et al., 1993; Rupp and Vodanovich, 1997; Vodanovich and Kass, 1990; Watt and Blanchard, 1994; Watt and Ewing, 1996). Evidence of the validity has been provided through relationships with other measures of boredom and similar constructs (Ahmed,

1990; Farmer and Sunberg, 1986; Rupp and Vodanovich, 1997; Watt and Blanchard, 1994). In addition, BPexts and BPints have different correlates (e.g., Kass et al., 2001; Rupp and Vodanovich, 1997; Watt and Blanchard, 1994), suggesting that boredom proneness is a multidimensional construct.

2.3. Procedure

Participants completed the measures as part of a larger study on boredom proneness. Questionnaires were administered in group sessions (40–100 people) lasting approximately 45 min.

3. Results

Means and standard deviations for all variables are presented in Table 1 by gender. A one-way (Gender) MANCOVA in which participant age served as a covariate was conducted on all variables to explore potential gender differences, $F(17, 200) = 2.70$, $p < 0.001$ (effect size = 0.19). When controlling for age, significant univariate gender effects were obtained on the AISS, BPSeXT, and the moving tickets item from the Driving Survey, $F_s(1, 216) = 13.85, 4.62$, and 6.78 , $p_s < 0.05$ (effect sizes = 0.06, 0.02, and 0.03, respectively). Men scored higher on each of these measures than women.

Bivariate correlations were computed to explore the interrelationships among variables (Table 2). The BIS-11, AISS,

and BPSeXT scales were positively correlated with each other. In addition, the BIS-11 and BPSeXT were related to the DAS while the AISS and BPSint were unrelated to the DAS. DAS scores were positively correlated with maladaptive forms of driving anger expression, three of the six crash-related condition items, aggressive driving, and risky driving. Both the AISS and BIS-11 were positively related to each of the three maladaptive forms of driving anger expression, loss of concentration, minor loss of control, moving tickets, aggressive driving, and risky driving, and were inversely related to adaptive/constructive driving anger expression. In addition, the AISS was related to major accidents. Similarly, BPSeXT was positively correlated with physically aggressive driving anger expression, use of the vehicle to express anger, minor loss of control, close calls, moving tickets, aggressive driving, and risky driving, and was inversely related to adaptive driving anger expression. In contrast, BPSint was related (inversely) only to adaptive/constructive driving anger expression.

Multiple regression analyses were conducted on the aggressive and risky driving subscales of the Driving Survey, each of the six crash-related condition items, and each of the four DAX subscales (Table 3). Participant gender and age were entered on Step 1. The DAS was entered on Step 2. The AISS, BIS-11, and BPSeXT and BPSint subscales of the BPS were entered on Step 3 using the forward stepwise procedure. This method of analysis was selected in order to permit the identification of the best set of predictors beyond participant gender, age, and DAS scores.

Table 1
Means, standard deviations, and age-adjusted means for men and women

Measure	Men			Women		
	Means	S.D.	Adjusted means	Means	S.D.	Adjusted means
Driving anger scale	45.55	9.91	46.06	46.20	10.70	46.00
Sensation seeking	54.69	7.46	54.74	50.61	7.58	50.47
Impulsiveness	67.24	9.34	67.01	68.92	9.37	68.83
Boredom proneness						
BPSTot	94.36	18.10	93.75	91.82	18.47	91.93
BPSeXT	30.40	7.72	30.03	27.47	7.44	27.55
BPSint	22.95	6.20	23.04	23.23	6.89	23.22
Driving survey						
Crash-related conditions						
Lost concentration	3.31	1.82	3.26	3.38	1.65	3.40
Minor loss of control	2.10	1.68	2.08	1.85	1.59	1.86
Close call	1.46	1.49	1.52	1.46	1.32	1.45
Moving tickets	1.54	1.77	1.47	0.89	1.20	0.92
Minor accidents	0.78	1.01	0.77	0.98	1.00	0.99
Major accidents	0.43	0.92	0.45	0.30	0.61	0.31
Aggressive driving	12.96	13.07	13.11	13.39	10.05	13.32
Risky driving	30.19	15.89	31.10	27.06	14.46	26.66
Driving anger expression						
Physically aggressive	13.19	3.14	13.20	12.59	3.06	12.59
Verbally aggressive	26.24	8.54	26.52	25.45	8.06	25.47
Use of the vehicle	17.90	5.79	18.18	17.76	5.34	17.65
Adaptive/constructive	32.45	8.50	32.62	35.07	8.14	35.02

Note: Adjusted means (adjusted mean) are adjusted based on the participants' age. BPSTot = boredom proneness scale total score; BPSeXT = boredom proneness scale external stimulation factor; BPSint = boredom proneness scale internal stimulation factor.

Table 2
Intercorrelations among variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. DAS	–													
2. DAX-PA	0.25**	–												
3. DAX-VA	0.51**	0.46**	–											
4. DAX-UV	0.50**	0.59**	0.60**	–										
5. DAX-A/C	–0.12	–0.16*	–0.26**	–0.22**	–									
6. Lost concentration	0.24**	–0.07	0.15*	0.17**	–0.13	–								
7. Loss of control	0.25**	0.16*	0.20**	0.30**	–0.15*	0.40**	–							
8. Close call	0.26**	0.15*	0.20**	0.29**	–0.01	0.26**	0.42**	–						
9. Aggressive driving	0.43**	0.55**	0.60**	0.62**	–0.19**	0.16*	0.31**	0.42**	–					
10. Risky driving	0.39**	0.35**	0.38**	0.60**	–0.14*	0.33**	0.45**	0.48**	0.52**	–				
11. BPSext	0.19**	0.15*	0.13	0.15*	–0.18**	0.05	0.16*	0.21**	0.18**	0.20**	–			
12. BPSint	0.02	–0.01	–0.04	0.01	–0.19**	–0.01	0.08	0.07	–0.06	0.00	0.09	–		
13. AISS	0.07	0.25**	0.24**	0.23**	–0.13*	0.15*	0.22**	0.10	0.20**	0.33**	0.28**	–0.19**	–	
14. BIS-11	0.21**	0.20**	0.17*	0.32**	–0.16*	0.19**	0.21**	0.21**	0.23**	0.35**	0.45**	0.12	0.25**	–

Note: DAS = driving anger scale; DAX-PA = driving anger expression inventory – physically aggressive expression; DAX-VA = driving anger expression inventory – verbally aggressive expression; DAX-UV = driving anger expression inventory – use of the vehicle; DAX-A/C = driving anger expression inventory – adaptive/constructive expression; BPSext = boredom proneness scale – external stimulation; BPSint = boredom proneness scale – internal stimulation; AISS = Arnett inventory of sensation seeking; BIS-11 = Barratt impulsiveness scale-11. ** $p < 0.01$. * $p < 0.05$.

On the Driving Survey, the two crash-related condition items dealing with the loss of concentration while driving and minor losses of vehicular control were both predicted by the DAS and AISS. The “close calls” item was predicted by the DAS and BPSext. The moving tickets item was predicted by gender (i.e., men reported more lifetime moving violations) and the BIS-11. None of the variables included in the present study predicted minor or major accidents. Aggressive driving was predicted by the DAS and AISS. Risky driving was predicted by age (i.e., increasing age was associated with decreased risky driving behavior), the DAS, BIS-11, and AISS. On the DAX, physically aggressive and verbally aggressive driving anger expression were predicted by the DAS and AISS. Use of the vehicle to express anger was predicted by the DAS, BIS-11, and AISS. Finally, con-

structive/adaptive driving anger expression was predicted by BPSint and the AISS (i.e., higher BPSint and AISS scores were associated with lower constructive/adaptive anger expression).

4. Discussion

Findings demonstrated that the addition of other personality traits generally improved the prediction of unsafe driving behavior beyond driving anger alone. Although the DAS explained the most variance in unsafe driving behaviors, sensation seeking, impulsiveness and boredom proneness all explained additional variance in certain dependent variables. Sensation seeking appeared to be the most useful variable

Table 3
Summary of multiple regressions on driving behavior and driving anger expression

Measure	Variables in equation ^a	R
Driving survey		
Crash-related conditions		
Lost concentration	DAS (0.24, 6%), AISS (0.15, 2%)	0.29*
Minor loss of control	DAS (0.23, 5%), AISS (0.20, 4%)	0.32**
Close call	DAS (0.21, 4%), BPSext (0.18, 3%)	0.32**
Moving tickets	Gender (–0.20, 4%), BIS-11 (0.26, 6%)	0.33**
Minor accidents	N/A	0.14
Major accidents	N/A	0.09
Aggressive driving	DAS (0.42, 17%), AISS (0.19, 3%)	0.47**
Risky driving	Age (–0.14, 2%), DAS (0.32, 10%), BIS-11 (0.23, 4%), AISS (0.23, 4%)	0.55**
Driving anger expression inventory		
Physical aggression	DAS (0.24, 6%), AISS (0.23, 5%)	0.35**
Verbal aggression	DAS (0.50, 25%), AISS (0.21, 4%)	0.55**
Use of the vehicle	DAS (0.44, 18%) BIS-11 (0.19, 3%), AISS (0.15, 2%)	0.57**
Constructive/adaptive	BPSint (–0.22, 4%), AISS (–0.14, 2%)	0.31*

Note: DAS = driving anger scale; BIS-11 = Barratt impulsiveness scale-11; AISS = Arnett inventory of sensation seeking; BPSint = boredom proneness scale internal stimulation. The significance levels reported for the R values is based on whether the R^2 change significance level when the last variable entered the regression. * $p < 0.05$. ** $p < 0.01$.

^a Only variables contributing significant variance to equations are listed. The first figure in parentheses is the β weight, and the second is the unique variance accounted for by that variable.

after driving anger, as it predicted the largest number of variables. Impulsiveness aided in the prediction of lifetime moving violations, risky driving, and the use of the vehicle to express anger. Finally, external boredom proneness predicted close calls, and internal boredom proneness predicted constructive/adaptive anger expression.

The present study provided further support for the utility of the DAS in predicting unsafe driving. Consistent with previous research (e.g., Deffenbacher et al., 2000, 2001; Deffenbacher et al., 2003a, 2003b; Lajunen and Parker, 2001; Underwood et al., 1999), one's propensity to experience angry feelings while driving predicted lapses in concentration while driving, minor losses of vehicular control, close calls, aggressive driving, risky driving, physically aggressive driving anger expression, verbally aggressive driving anger expression, and use of the vehicle to express anger. Thus, even when controlling for respondent gender and age, the DAS explained between 4 and 25% of the variance in most dependent variables. However, it is worth noting that the DAS did not predict lifetime moving tickets, accidents, or constructive/adaptive driving anger expression.

The finding that sensation seeking predicted risky driving was consistent with previous research (e.g., Arnett, 1994, 1996; Arnett et al., 1997; Burns and Wilde, 1995; Furnham and Saïpe, 1993; Greene et al., 2000). However, the present study suggests a broader role for sensation seeking, as it also predicted aggressive driving, maladaptive driving anger expression, and certain crash-related conditions. Independent of gender, age, and trait driving anger, sensation seeking predicted lapses in concentration, minor losses of vehicular control, aggressive driving, risky driving, physically and verbally aggressive driving anger expression, use of the vehicle to express anger, and constructive/adaptive driving anger expression. By itself, the AISS accounted for between 2 and 5% of the variance in these variables. Given that sensation seeking was unrelated to driving anger and only modestly related to impulsiveness and boredom proneness, it appears that it is explaining variance in risky driving that is untapped by measures of these other constructs. High sensation seekers may perceive less risk in high-risk driving situations (Arnett, 1990) or may be more willing to accept the risk in order to experience the thrill associated with risky behavior (Jonah, 1997).

The role of impulsiveness was more limited. Consistent with previous research, impulsiveness was related to risky driving (Loo, 1979; Stanford et al., 1996) and driving anger (Deffenbacher et al., 2003a, 2003b). In addition, the present study found that the BIS-11 was modestly correlated with aggressive driving and provided incremental validity (3–6% of the variance) beyond driving anger in the prediction of moving tickets, risky driving, and use of the vehicle to express anger. These findings are noteworthy in two respects. First, given the importance of impulsiveness in aggression forms of aggression (Barratt, 1994), it was surprising that impulsiveness was not more strongly related to aggressive driving. Since most examples of aggressive driving seem to fit under

the category of impulsive aggression, a greater role for impulsiveness was expected. However, impulsiveness did contribute to the prediction of using the vehicle to express anger, which is probably the clearest example of impulsive driving aggression measured in the present study. Second, because much of the previous literature on impulsiveness and driving relied on instruments that were confounded with sensation seeking (Barratt, 1994; Patton et al., 1995), it is noteworthy that the present results were obtained with a purer measure of impulsiveness. Consistent with Patton and colleagues' (1995) data, impulsiveness was only weakly related to sensation seeking ($r = 0.25$).

Consistent with the limited research on boredom proneness and aggression (e.g., Dahlen et al., 2003; Rupp and Vodanovich, 1997), the present study found that external boredom proneness was modestly related to driving anger and aggressive driving. Although the predictive utility of boredom proneness in the regressions was quite limited, external boredom proneness contributed to the prediction of close calls. This suggests that persons who are likely to become bored in the absence of highly stimulating external stimuli might be more likely to experience more close calls or near misses while driving. In addition, internal boredom proneness predicted reduced constructive/adaptive driving anger expression. Thus, persons who have greater difficulty keeping themselves interested or entertained may be less able to access adaptive coping resources (e.g., reminding themselves to calm down, turning on the radio to help themselves relax, etc.). Moreover, these findings provide additional support for viewing boredom proneness as a multidimensional construct.

An important limitation of the present study was its reliance on self-report measures. First, access to official data regarding moving violations or accident history would be preferable to participant self-report. Second, the present findings would be strengthened if they could be replicated using a driving simulator or behavioral observation during real-world driving. A related limitation was the reliance on retrospective as opposed to longitudinal data. In addition, it is important to expand the literature on motor vehicle accident prevention to non-college samples. Similarly, given that the present sample was predominately young (median age = 19) women (70%), results may be less applicable to the general driver population. Because years of driving experience may influence driving behavior, samples with a larger age range are needed so that individual differences in experience can be measured. In addition, the heavily female sample used here may not provide an accurate reflection of the gender differences that might be evident in a more balanced sample. Finally, although disappointing, it hardly surprises that motor vehicle accidents were not predicted by any combination of variables. Accidents are notoriously difficult to predict due to their low base rates, and as Peck (1993) noted, accidents represent "the consequences or outcomes of the interaction of a driver's behavior with external events, including the behavior of other drivers" (p. 147).

In summary, the present study contributes to an improved understanding of unsafe driving behavior by demonstrating the incremental validity of sensation seeking, impulsiveness, and boredom proneness beyond driving anger in predicting aggressive and risky driving. It is suggested that the study of driving behavior in general, and aggressive driving in particular, would benefit from increased use of multiple predictors.

References

- Ahmed, S.M.S., 1990. Psychometric properties of the boredom proneness scale. *Percept. Motor Skills* 71, 963–966.
- American Automobile Association (1997). *Aggressive driving: Three studies*. Washington, DC: American Automobile Association Foundation for Traffic Safety.
- Arnett, J., 1990. Drunk driving, sensation seeking, and egocentrism among adolescents. *Personal. Individ. Differ.* 11, 541–546.
- Arnett, J., 1994. Sensation seeking: a new conceptualization and a new scale. *Personal. Individ. Differ.* 16, 289–296.
- Arnett, J.J., 1996. Sensation seeking, aggressiveness, and adolescent reckless behavior. *Personal. Individ. Differ.* 20, 693–702.
- Arnett, J.J., Offer, D., Fine, M.A., 1997. Reckless driving in adolescence: 'State' and 'trait' factors. *Accid. Anal. Prev.* 29, 57–63.
- Arthur Jr., W., Barrett, G.V., Alexander, R.A., 1991. Prediction of vehicular accident involvement: a meta-analysis. *Human Perform.* 4, 89–105.
- Barratt, E.S., 1972. Anxiety and impulsiveness: toward a neuropsychological model. In: Spielberger, C. (Ed.), *Current Trends in Theory and Research*, Vol. 1. Academic Press, New York, pp. 195–222.
- Barratt, E.S., 1994. Impulsiveness and aggression. In: Monahan, J., Steadman, H.J. (Eds.), *Violence and mental disorder: developments in risk assessment*. University of Chicago Press, Chicago, pp. 61–79.
- Barratt, E.S., Patton, J.H., 1983. Impulsivity: cognitive, behavioural, and psychophysiological correlates. In: Zuckerman, M. (Ed.), *Biological Bases of Sensation Seeking, Impulsivity and Anxiety*. Hillsdale, NJ: Erlbaum, pp. 77–116.
- Blanchard, E.B., Barton, K.A., Malta, L., 2000. Psychometric properties of a measure of aggressive driving: the Larson Driver's stress profile. *Psychol. Rep.* 87, 881–892.
- Burns, P.C., Wilde, G.J.S., 1995. Risk taking in male taxi drivers: relationships among personality, observational data and driver records. *Personal. Individ. Differ.* 18, 267–278.
- Clément, R., Jonah, B.A., 1984. Field dependence, sensation seeking and driving behavior. *Personal. Individ. Differ.* 5, 87–93.
- Dahlen, E.R., Martin, R.C., Ragan, K., Kuhlman, M. (2003 August). Boredom proneness and impulsiveness in anger and aggression. Poster session presented at the 111th Annual Convention of the American Psychological Association Convention, Toronto, ON.
- Deffenbacher, J.L., Deffenbacher, D.M., Lynch, R.S., Richards, T.L. Anger, aggression, and risky behavior. A comparison of high and low anger drivers. *Behaviour Research and Therapy*, (in press).
- Deffenbacher, J.L., Huff, M.E., Lynch, R.S., Oetting, E.R., Salvatore, N.F., 2000. Characteristics and treatment of high-anger drivers. *J. Counsel. Psychol.* 47, 5–17.
- Deffenbacher, J.L., Lynch, R.S., Filetti, L.B., Dahlen, E.R., Oetting, E.R., 2003a. Anger, aggression, risky behavior, and crash-related outcomes in three groups of drivers. *Behav. Res. Therapy* 41, 333–349.
- Deffenbacher, J.L., Richards, T.L., Filetti, L.B., Lynch, R.S., 2003. Angry drivers: a test of State-Trait theory. Manuscript submitted for publication.
- Deffenbacher, J.L., Lynch, R.S., Oetting, E.R., Swaim, R.C., 2002. The driving anger expression inventory: a measure of how people express their anger on the road. *Behav. Res. Therapy* 40, 717–737.
- Deffenbacher, J.L., Lynch, R.S., Oetting, E.R., Yingling, D.A., 2001. Driving anger: correlates and a test of state-trait theory. *Personal. Individ. Differ.* 31, 1321–1331.
- Deffenbacher, J.L., Oetting, E.R., Lynch, R.S., 1994. Development of a driving anger scale. *Psychol. Rep.* 74, 83–91.
- Farmer, R., Sunberg, N.D., 1986. Boredom proneness—the development and correlates of a new scale. *J. Personal. Assess.* 50, 4–17.
- Furnham, A., Saip, J., 1993. Personality correlates of convicted drivers. *Personal. Individ. Differ.* 14, 326–329.
- Greene, K., Krcmar, M., Walters, L.H., Rubin, D.L., Hale, J.L., 2000. Targeting adolescent risk-taking behaviors: the contribution of egocentrism and sensation-seeking. *J. Adolesc.* 23, 439–461.
- Hansen, C.P., 1988. Personality characteristics of the accident involved employee. *J. Business Psychol.* 2, 246–365.
- Hemenway, D., Solnick, S.J., 1993. Fuzzy dice, dream cars, and indecent gestures: correlates of driver behavior. *Accid. Anal. Prev.* 25, 161–170.
- Hilton, J., Shankar, U., 2003. Motor vehicle traffic crash injury and fatality estimates—2003 early assessment, Washington, DC: National Highway Traffic Safety Administration. (NTIS No. DOT HS 809 586).
- Jonah, B.A., 1997. Sensation seeking and risky driving: a review and synthesis of the literature. *Accid. Anal. Prev.* 29, 651–665.
- Kass, S.J., Vodanovich, S.J., Callender, A., 2001. State-trait boredom: relationship to absenteeism, tenure, and job satisfaction. *J. Business Psychol.* 16, 317–327.
- Knee, C.R., Neighbors, C., Vietor, N.A., 2001. Self-determination theory as a framework for understanding road rage. *J. Appl. Social Psychol.* 31, 889–904.
- Lajunen, T., Parker, D., 2001. Are aggressive people aggressive drivers? A study of the relationship between self-reported general aggressiveness, driver anger and aggressive driving. *Accid. Anal. Prev.* 33, 243–255.
- Loo, R., 1979. Role of primary personality factors in the perception of traffic signs and driver violations and accidents. *Accid. Anal. Prev.* 11, 125–127.
- McLeod, C.R., Vodanovich, S.J., 1991. The relationship between self-actualization and boredom proneness. *J. Social Behav. Personal.* 6, 137–146.
- National Highway Traffic Safety Administration, 2003. *Traffic safety facts 2003*. Washington, DC: National Center for Statistics and Analysis.
- Neighbors, C., Vietor, N.A., Knee, C.R., 2002. A motivational model of driving anger and aggression. *Personal. Social Psychol. Bull.* 28, 324–335.
- Patton, J.H., Stanford, M.S., Barratt, E.S., 1995. Factor structure of the Barratt impulsiveness scale. *J. Clin. Psychol.* 51, 768–774.
- Peck, R.C., 1993. The identification of multiple accident correlates in high risk drivers with specific emphasis on the role of age, experience, and prior traffic violation frequency. *Alcohol Drugs Driv.* 9, 145–166.
- Polly, L.M., Vodanovich, S.J., Watt, J.D., Blanchard, M.J., 1993. The effects of attributional processes on boredom proneness. *J. Social Behav. Personal.* 8, 123–132.
- Rathbone, D.B., Huckabee, J.C., 1999. Controlling road rage: a literature review and pilot study. In: *The AAA Foundation for Traffic Safety*.
- Rupp, D.E., Vodanovich, S.J., 1997. The role of boredom proneness in self-reported anger and aggression. *J. Social Behav. Personal.* 12, 925–936.
- Stanford, M.S., Barratt, E.S., 1992. Impulsivity and the multi-impulsive personality disorder. *Personal. Individ. Differ.* 13, 831–834.
- Stanford, M.S., Greve, K.W., Boudreanx, J.K., Mathias, C.W., Brumbe-low, J.L., 1996. Impulsiveness and risk-taking behavior: comparison of high-school and college students using the Barratt impulsiveness Scale. *Personal. Individ. Differ.* 21, 1075–1073.
- Underwood, G., Chapman, P., Wright, S., Crundall, D., 1999. Anger while driving. *Transport. Res. Part F: Traffic Psychol. Behav.* 2F, 55–68.
- United States General Accounting Office. 2003. *Highway safety: Research continues on a variety of factors that contribute to motor vehicle crashes* (GAO-03-436). Washington, DC.

- Verwey, W.B., Zaidel, D.M., 2000. Predicting drowsiness accidents from personal attributes, eye blinks and ongoing driving behaviour. *Personal. Individ. Differ.* 28, 123–142.
- Vodanovich, S.J., Kass, S.J., 1990. A factor analytic study of the boredom proneness scale. *J. Personal. Assess.* 55, 115–123.
- Watt, J.D., Blanchard, M.J., 1994. Boredom proneness and the need for cognition. *J. Res. Personal.* 28, 44–51.
- Watt, J.D., Ewing, J.E., 1996. Toward the development and validation of a measure of sexual boredom. *J. Sex Res.* 33, 57–66.
- Zuckerman, M., 1990. The psychophysiology of sensation seeking. *J. Personal.* 58, 313–345.
- Zuckerman, M., 1994. *Behavioral Expressions and Biosocial Bases of Sensation Seeking*. Cambridge University Press, New York.