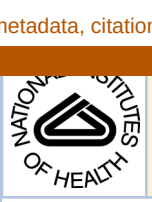

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The Driving Behavior Survey: Scale construction and validation

Joshua D. Clapp[a], **Shira A. Olsen**[b], **J. Gayle Beck**[b], **Sarah A. Palyo**[a], **DeMond M. Grant**[a], **Berglind Gudmundsdottir**[a], and **Luana Marques**[a]

[a] University at Buffalo – SUNY Department of Psychology Park Hall Buffalo, NY, 14260 United States

[b] University of Memphis Department of Psychology 202 Psychology Building Memphis, TN 38152 United States

Abstract

Although long recognized in the clinical literature, problematic behavior characteristic of anxious drivers has received little empirical attention. The current research details development of a measure of anxious driving behavior conducted across three studies. Factor analytic techniques identified three dimensions of maladaptive behaviors across three college samples: anxiety-based performance deficits, exaggerated safety/caution behavior, and anxiety-related hostile/aggressive behavior. Performance deficits evidenced convergent associations with perceived driving skill and were broadly related to driving fear. Safety/caution behaviors demonstrated convergence with overt travel avoidance, although this relationship was inconsistent across studies. Safety/caution scores were associated specifically with accident- and social-related driving fears. Hostile/aggressive behaviors evidenced convergent relationships with driving anger and were associated specifically with accident-related fear. Internal consistencies were adequate, although some test-retest reliabilities were marginal in the unselected college sample. These data provide preliminary evidence for utility of the measure for both research and clinical practice.

Keywords

driving anxiety; driving behavior; assessment; scale development; motor vehicle accidents

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Psychological distress, occupational impairment, and restricted interpersonal functioning as a consequence of driving anxiety is well documented in the clinical and traffic safety

Correspondence concerning this article should be sent to Joshua D. Clapp at: Department of Psychology University of Memphis 202 Psychology Building Memphis, TN 38152 Phone: 901-678-2914 Fax: 901-678-2579 joshclapp@yahoo.com.

Present address: Sarah A. Palyo, Ph.D. San Francisco VA Medical Center 4140 Clement St (116B) San Francisco, CA 94121 United States

Present address: DeMond M. Grant, Ph.D. Oklahoma State University Department of Psychology 205 North Murray Stillwater, OK 74078 United States

Present address: Berglind Gudmundsdottir, Ph.D. Landspitali – University Hospital Fossvogur E – 206 IS – 108 Raykjavik Iceland

Present address: Luana Marques, Ph.D. Center for Anxiety and Traumatic Stress Massachusetts General Hospital Simches Building 185 Cambridge St. Suite 2200 Boston, MA 02114 United States

literatures (e.g., Blanchard & Hickling, 2004; J. Taylor, Deane, & Podd, 2007a; J. Taylor & Paki, 2008). Assessment in this area has largely emphasized the quantification of subjective driving fear and overt travel avoidance (e.g., refusing to drive or ride as a passenger) with considerably less attention given to the behavior of individuals who continue to drive despite feeling anxious. Empirical and anecdotal evidence suggests that anxious drivers engage in maladaptive behaviors that may place themselves and others at increased risk of accidents and violations. The purpose of the current research was to develop an empirical measure designed to assess the occurrence of potentially problematic anxiety-related driving behavior.

Interest in driving-related anxiety and its impact on functioning has surged over the past two decades (e.g., Blanchard & Hickling, 2004; Mayou, Bryant, & Duthie, 1993; J. Taylor, Deane, & Podd, 2002; S. Taylor & Koch, 1995). Much of this literature examines driving anxiety from the perspective of specific phobia and posttraumatic stress disorder (PTSD), but recent data indicates that a more broad perspective on driving-related anxiety is warranted.

First, the negative consequences of driving anxiety appear to extend beyond subjective driving fear and overt travel avoidance. Both empirical reviews and clinical literature note a range of problematic driving behavior (e.g., disorientation, slowing for green lights, driving far below the speed limit) among individuals who continue to drive despite feeling anxious (e.g., Koch & S. Taylor, 1995; S. Taylor & Koch, 1995). Increased occurrence of general driving errors also has been noted among anxious drivers using both self-report and observational methods (e.g., J. Taylor, Deane, & Podd, 2007b; Matthews et al., 1998; Shahar, 2009; Shoham, Rahav, Markovski, Chard, & Baruch, 1984). In a recent example, J. Taylor et al. (2007b) observed anxious drivers and non-anxious controls during a 40-minute driving task. Frequency of observer-rated driving errors was higher among anxious drivers, and anxious drivers rated their own driving skill more poorly than did non-anxious controls. Although theoretical models predict a complex relationship between anxiety and driving performance (see J. Taylor, Deane, & Podd, 2008 for a comprehensive review of this literature), the functional impact of anxiety on overt driving behavior warrants continued investigation.

Second, the population of individuals prone to anxious driving behavior may be larger than previously recognized. Driving anxiety is known to be diagnostically complex and is associated a range of pathologies including specific phobia, PTSD, panic disorder, agoraphobia, social phobia, and generalized anxiety disorder (Blanchard & Hickling, 2004; Ehlers, Hofmann, Herda, & Roth, 1994; J. Taylor et al., 2002; 2007a). Whereas the larger literature typically has examined driving anxiety among accident survivors (e.g., Blanchard & Hickling, 2004; Mayou et al., 1993; S. Taylor & Koch, 1995), motor vehicle trauma is cited as the origin of anxiety in only a subset of anxious drivers (Ehlers et al., 1994; J. Taylor & Deane, 1999). Further comparison of anxious drivers with and without accident histories suggest comparable levels of fear, functional interference, response to fear-related cues, and general help-seeking behavior across groups (J. Taylor & Deane, 1999; 2000). The focus of specific fear in this population is equally diverse. Accident, panic, and social/interpersonal concerns all are known to contribute to general driving fear (Ehlers et al., 1994; 2007; J. Taylor, Deane, & Podd, 2000; 2007a). Evidence of heterogeneity in the comorbidity, etiology, and focus of specific fear in this population supports expanding the investigation of driving anxiety and its impact on driving behavior (J. Taylor & Deane, 2000; J. Taylor et al., 2007b).

The goal of the current research was to create a measure assessing a range of anxious driving behaviors. Assessment efforts in the driving anxiety literature primarily emphasize

the quantification of subjective anxiety and overt travel avoidance (e.g., Ehlers et al., 1994; Ehring, Ehlers, & Glucksman, 2006; Kuch, Cox, & Direnfeld, 1995; Stewart & St. Peter, 2004) although some measures have explored specific subsets of driving behavior. The Safety Behavior Questionnaire (SBQ; Ehring et al., 2006) includes a 14-item scale assessing excessive precautions related to travel. The Fear of Driving Inventory (FDI; Walshe, Lewis, Kim, O'Sullivan, & Wiederhold, 2003), by contrast, is a 20-item scale indexing distress, avoidance, and maladaptive driving strategies associated with travel anxiety. Research with both the SBQ and FDI is promising (Ehlers et al., 2007; Ehring, Ehlers, & Glucksman, 2008; Walshe et al., 2003), but neither measure was developed as a comprehensive index specific to anxious driving behavior. Furthermore, the psychometric properties of the SBQ and FDI remain largely unexamined, and neither measure is available in the public domain. Development of a broad-based measure specific to the assessment of anxious driving behavior is intended to compliment existing measures and to facilitate research on the behavioral consequences of driving anxiety.

Development of the current assessment took place across three separate studies. Study 1 outlines the initial scale construction and an exploratory examination of item factor structure. Study 2 details the inclusion of additional indicators based on the results of Study 1, a reexamination of the factor structure of the revised item pool, and an evaluation of the internal consistency of measure subscales. Associations with driving skill and travel avoidance also are explored. Study 3 continues development efforts through a confirmatory examination of the factor structure derived from Studies 1 and 2. Test-retest reliabilities are provided as well as continued examination of subscales validity. Undergraduate samples were used for initial scale development. Unselected college samples were expected to exhibit considerable variability with respect to reported driving anxiety, problematic driving behavior, and general driving history (e.g., accident involvement). Response variability afforded by large unselected samples is important during the initial development and validation of a new measure (Clark & Watson, 1995). Examination of anxious driving behavior among undergraduate samples also is consistent with a more general effort to broaden the study of driving anxiety (e.g., J. Taylor & Deane, 2000; J. Taylor et al., 2002).

1. Study 1

1.1. Overview

The aim of Study 1 was to generate a broad item pool representative of anxious driving behavior. J. Taylor et al. (2002) note that the existing literature pertaining to driving fear and anxiety is generally limited by a lack of definitional clarity. For the purposes of the present research, anxious driving behavior is conceptualized as an excessive increase, decrease, or disorganization of behavior occurring as a consequence of anxiety during operation of a motor vehicle. The behaviors of interest may be - but are not necessarily - reckless, inappropriate, or dangerous. Resources for initial item development included previous research (e.g., J. Taylor et al., 2007b), empirical reviews (e.g., S. Taylor & Koch, 1995; J. Taylor et al., 2002), relevant clinical materials (e.g., Antony, Craske, & Barlow, 2006; Blanchard & Hickling, 2004), standardized driving assessments (e.g., Practical Driving Assessment), and the authors' clinical experience in the assessment and treatment of driving-related anxiety (Beck et al., 2008; Beck, Coffey, Foy, Keane, & Blanchard, 2009; Clapp & Beck, *in press*; Grant, Beck, Marques, Palyo, & Clapp, 2008). Emphasis was placed on developing a broad range of items with potential relevance to the conceptualization of anxious driving behavior (Clark & Watson, 1995; Loevinger, 1957). Thirty-nine indicators were included in the initial item pool. Given evidence that driving anxiety may be most closely associated with the *frequency* of problematic behaviors (as opposed to specific types of behavior; J. Taylor et al., 2007b), responses to test items emphasized the frequency of behavior occurrence. Instruction sets that accompany a

measure also are important for contextualizing participant response (e.g., J. Taylor & Sullman, 2009). Instructions for the current assessment specifically directed participants to indicate how frequently they engage in each driving behavior during situations that result in anxiety, tension, or discomfort (see Appendix A). Items were rated on a 7-point (*Never* to *Always*) Likert scale.

1.2 Methods

1.2.1 Participants—Two hundred forty-five students recruited from undergraduate psychology courses participated in the study. Students received experimental credit for their participation. Complete data were obtained from approximately 93% (N = 227) of the initial sample. After Bonferroni correction for multiple comparisons ($p \leq .008$), incomplete responders were comparable to complete responders with respect to age, sex, minority status (minority: yes, no), driving frequency, history of moving violations (present, absent), and prior accident involvement (p values ≥ .02). Characteristics of the final sample are summarized in Table 1.

1.2.2. Analytic Strategy—Examination of item factor structure was conducted using SPSS 15.0. Factor extraction was guided both by conceptual considerations and Horn's (1965) parallel analysis, a method used in determining the *maximum* number of factors for extraction (Zwick & Velicer, 1986). In this procedure, eigenvalues extracted from experimental data (i.e., values forming a standard scree plot) are plotted against those extracted from randomly generated data. Components with eigenvalues exceeding those extracted from the random data are considered for retention. Components with eigenvalues less than those extracted from the random data are considered spurious and are not considered for retention. For the current study, ten randomly generated datasets equal in size to the experimental data were constructed. Eigenvalues obtained from principal component analyses (PCA) of each random set was averaged and plotted against eigenvalues obtained from PCA of the experimental data. Guided by recommendations offered by Comrey and Lee (1992), indicators with loadings ≥.45 on a single factor and <.32 on any other were considered for retention. These criteria were used as a conservative attempt to reduce ambiguity surrounding items with marginal or complex loadings. All final solutions were rotated to simple structure using Varimax rotation.[1]

1.3. Results

Item distributions and covariances were examined prior to analysis to determine factorability and concordance with the assumptions of multivariate analysis. All variables approximated normality (skew ≤ 3.0; kurtosis ≤ 8.0; Kline, 2005) with no multivariate outliers (leverage scores ≤ 5 times the mean sample leverage; Brown, 2006). The Kaiser-Meyer-Olkin index of sampling adequacy (KMO = .81) and Bartlett's Test of Sphericity ($\chi^2(741) = 2981.89$; $p < .001$) both suggested the correlation matrix of these data was suitable for factor analysis.

Parallel analysis strongly suggested a 3-factor solution to these data (see Fig.1a). Principal axis factoring with Varimax rotation was used to extract three factors accounting for 34.34% of the variance in the reduced correlation matrix. Communalities (i.e., percentage of indicator variance accounted for by the solution) ranged from .24 to .75. A summary of unique factor loadings is provided in Table 2. Of the initial item pool, twelve indicators loaded uniquely on the first factor. The item, "*I have trouble staying in the correct lane*," best defined this factor with a loading of .74. Subsequent items included various driving mistakes suggesting a dimension of anxiety-based performance errors. Four items loaded uniquely on the second factor with "I maintain a large distance between myself and the

[1]Oblique rotation (i.e. Promax) of data collected in Studies 1 & 2 was functionally identical to those presented in the study.

driver in front of me" evidencing the strongest loading (.58). This group of indicators was hypothesized to represent a dimension of behavior associated with exaggerated safety and/or heightened caution. The final factor contained a total of five indicators. Although "*I talk to someone on my cell phone*," evidenced the strongest loading (.56), subsequent items appear to converge on a series of hostile and/or aggressive behaviors as indicated by the item, "I gesture at the driver/drivers who made me nervous."

Parallel analysis also suggested a possible 4-factor structure to these data. Extraction of four factors produced a solution nearly identical to the 3-factor extraction with only one item ("*I avoid looking in my mirrors*") loading uniquely on the fourth factor. Given these results, the 3-factor solution was chosen for further exploration.

1.4. Summary – Study 1

Results from Study 1 closely parallel data from the existing clinical and driving safety literatures. The range of behavior reported in the current sample is consistent with calls to broaden the examination of driving-related anxiety (J. Taylor et al., 2002). Furthermore, evidence of anxiety-based performance deficits parallel literature suggesting possible skill-based deficits among anxious drivers (J. Taylor et al., 2007; Matthews et al., 1998; Sahar, 2009; Shoham et al., 1984). Behaviors consistent with exaggerated safety/caution, in contrast, are reminiscent of subtle avoidance behaviors noted in the clinical literature (e.g., Clark, 1999; S. Taylor & Koch, 1995). Several items loading on the final factor suggest the occurrence of aggressive and/or hostile behavior in response to driving anxiety. Previous studies have explored the occurrence and treatment of driving-related anger (e.g., Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000), but the role of anxiety in the expression of driving anger has received less empirical attention. As such, the relevance of hostile/aggressive behaviors to the current scale is tenuous and warrants further examination.

2. Study 2

2.1. Overview

The primary aim of Study 2 was to strengthen factors observed in Study 1. Fifteen additional items were generated to augment (a) the dimension of safety/caution behavior noted in Study 1, and (b) a possible dimension of anxiety-based hostile/aggressive behavior. Given their prominence in Study 1, the convergent validity of performance deficit and safety/caution subscales were examined via associations with perceived driving skill and overt travel avoidance, respectively. Specifically, the association between perceived driving skill and performance deficits was hypothesized to be stronger than the association between driving skill and safety/caution behavior. In contrast, the association between travel avoidance and safety/caution behavior was hypothesized to be stronger than the association between travel avoidance and performance deficits. No hypotheses were made with respect to hostile/aggressive behaviors given the exploratory nature of this subscale.

2.2. Methods

2.2.1 Participants—Three hundred students recruited from undergraduate psychology courses received experimental credit for participation in the study. Complete data were obtained from approximately 90% of the sample. Participants with incomplete responses did not differ from those with complete data ($N = 271$) with respect to age, sex, minority status, driving frequency, driving violations, or previous accident involvement (p values $\geq .02$) after correction for multiple comparisons ($p \leq .008$). Characteristics of the final sample are summarized in Table 1.

2.2.2. Measures

Driving Skills Questionnaire (DSQ): The DSQ (McKenna, Stanier, & Lewis, 1991) is a 20-item measure assessing perceived competence in driving abilities. Competence in specific driving situations (e.g., passing, busy town driving) was rated on a 0 (*very poor*) to 100 (*very good*) scale. Total DSQ scores were calculated by dividing the response average by 10. Total scores range from 0 to 10 with higher scores indicating greater perceptions of skill. Internal consistency of the DSQ was excellent (α = .94) in the present sample.

Driving and Riding Avoidance Scale (DRAS): The DRAS (Stewart & St. Peter, 2004) is a 20-item measure intended to assess frequency of overt travel avoidance over the previous week. Avoidance of specific driving scenarios is rated on a 4-point Likert scale (0, *Rarely* to 3, *Most of the time)*. Items are summed to provide a total score (range 0 – 60) with higher scores indicating greater frequency of travel avoidance. Internal consistency for the DRAS in the current sample was good (α = .89).

2.2.3. Analytic Strategy—Factor analysis of the expanded item pool paralleled procedures outlined in Study 1. Examination of the hypothesized associations between behavior subscales (performance deficits and safety/caution behavior) and convergent measures (DSQ and DRAS) was conducted following recommendations offered by Steiger (1980). This approach to comparing correlated correlation coefficients utilizes a modified Hotelling *T* statistic and is intended to avoid inflated Type I error associated with some forms of the r-to-Z transform (Neill & Dunn, 1975; Steiger, 1980).

2.3. Results

2.3.1. Exploratory Factor Analysis—Item distributions and covariances of the sample data indicated suitability for factor analysis. Parallel analyses of the expanded item pool suggested the possibility of 3-, 4-, and 5-factor solutions (see Fig. 1b). The 3-factor extraction accounted for 31.3% of the variance in the reduced correlation matrix with communalities ranging from .28 to .79. Table 2 provides a summary of significant factor loadings obtained in Study 2.[2] Eleven indicators loaded uniquely on the first factor with the item “I let the driver who made me nervous know that I’m upset” holding the strongest loading (.82). Subsequent items on this factor were consistent with anxiety-related hostile/ aggressive behavior. The second factor contained nine items congruent with those loading on the performance deficit subscale from in Study 1. As in Study 1, the item “*I have trouble finding the correct lane*” best characterized this dimension of behavior (.70). The final factor contained indicators common to the safety/caution dimension observed in Study 1. The item “I try to put distance between myself and other cars” best defined this factor (.64).

Four- and five-factor solutions to these data also were examined. The initial three factors of the 4- and 5-factor extractions were generally consistent with those observed in the 3-factor solution. However, the remaining dimensions of the 4- and 5-factor solutions contained few salient loadings and interpretation of the remaining factors was ambiguous.[3] As a consequence, the 3-factor structure was selected for continued exploration.

Based on the results of Studies 1 and 2, indicators were chosen for retention in the final scale (Driving Behavior Survey; DBS). Considerations for retention included magnitude of factor loadings, consistency across samples, and conceptual clarity. The final measure

[2]Subscales in Table 2 are listed in order as extracted via principal axis factoring in Studies 1 & 2, respectively.
[3]The final factor extracted in the 4-factor solution contained four indicators suggesting a blend of performance deficits and avoidance (e.g., I have difficulty adjusting controls because it is too distracting; *I avoid roads with fast moving traffic*). The 5-factor solution, in contrast, contained only two items on the fourth factor and one on the fifth.

included seven items pertaining to anxiety-based performance deficits, seven items indicative of exaggerated safety and/or heightened caution, and seven items characterizing anxiety-based hostile/aggressive behavior (See Appendix A). DBS subscales were calculated as the mean of endorsed items (range 1 – 7) with higher scores indicating greater frequency of anxious behavior. Small to moderate correlations between DBS subscales provide evidence for their validity as distinct behavioral dimensions (see Table 3). Internal consistencies for performance deficit, safety/caution, and hostile/aggressive subscales were . 80, .75, and .87, respectively.

2.3.2. Convergent relationships with driving skill and travel avoidance— Evidence of convergent validity for performance deficit and safety/caution subscales identified in Study 1 was examined via associations with perceived driving skill (DSQ) and overt travel avoidance (DRAS; see Table 3). Driving skill was hypothesized to correlate most strongly with anxiety-based performance deficits whereas travel avoidance was expected to correlate most strongly with exaggerated safety/caution behavior. No alpha adjustments were imposed given the a priori nature of these comparisons. As hypothesized, comparisons suggest a stronger negative relationship between perceived driving skill and anxiety-based performance deficits (r = -.41) relative to both safety/caution (r = -.10; $T(268)$ = -5.21; $p < .001$) and hostile/aggressive subscales (r = -.06; $T(268)$ = -6.06; $p < .001$). Travel avoidance evidenced stronger associations with safety/caution behavior (r = .33) relative to performance deficit (r = .19; $T(268)$ = 1.93; p=.05) and hostile/aggressive subscales (r = .16; $T(268)$ = 2.14; p=.03).

2.4. Summary

Exploratory factor analysis indicate that efforts to bolster the safety/caution and hostile/aggressive dimensions of anxious driving behavior were successful, and factors extracted from the expanded item pool paralleled those observed in Study 1. All DBS scales evidenced adequate internal consistency, and low to moderate inter-scale correlations suggest relatively distinct dimensions of anxiety-based driving behavior. As hypothesized, performance deficit and safety/caution subscales demonstrated convergent relationships with perceptions of driving skill and travel avoidance, respectively.

3. Study 3

3.1. Overview

The aim of Study 3 was to examine the factor structure of the DBS derived from Studies 1 and 2 using a confirmatory factor model. Four-week test-retest reliabilities also were examined in a subset of participants (n = 41). Convergent relationships assessed in Study 2 (i.e., associations with perceived driving skills and travel avoidance) were reexamined for stability, and an index of driving anger was included to determine convergence with the hostile/aggressive behaviors. Given that the focus of fear associated with driving anxiety may be heterogeneous across individuals (e.g., fear of an accident, fear of a panic attack while driving; Ehlers et al., 2007), differential associations between DBS subscales and specific indices of driving-related fear were examined. Associations with driving history and social desirability also were explored.

3.2. Methods

3.2.1 Participants—Two hundred forty-six undergraduates recruited from introductory psychology courses participated in the study. All students received experimental credit for their participation. Complete data were obtained from approximately 99% of the initial sample (N = 244). Demographic characteristics of the sample are summarized in Table 1.

3.2.2. Measures—Consistent with Study 2, participants completed both the DSQ and DRAS. The following measures were included for Study 3:

Driving Anger Scale (DAS): The DAS (Deffenbacher, Oetting, & Lynch, 1994) is a 14-item scale assessing anger across various driving situations. Items are rated on a 5-point Likert scale (1, *not at all* to 5, *very much*). Total scores are calculated as the sum of items with higher scores reflecting greater levels of trait driving anger. Internal consistency in the current sample was .84. *Driving Cognitions Questionnaire (DCQ).* The DCQ (Ehlers et al., 2007) is a 20-item measure assessing three specific dimensions of driving-related fear: panic-related concerns (7 items), accident-related concerns (7 items), and social fears (6 items). Frequency of occurrence is rated on a 5-point Likert scale (0, *Never* to 4, *Always*) with subscale and total scores calculated as item sums. Higher DCQ scores reflect greater frequency of specific driving-related fear cognitions. Internal consistencies for DCQ panic, accident, social, and total scores in the present sample were .89, .85, .80, and .93, respectively.

Balanced Inventory of Desirable Responding (BIDR): The BIDR (Paulhus, 1984) is a 40-item measure intended to assess two unique components of social desirability: self-deception and impression-management. Impression management is conceptualized as a deliberate tendency for favorable self-description whereas self-deception is believed to reflect honest, but positively biased, self-report (Paulhus, 1984; 1991). BIDR items are rated on a 7-point Likert scale ranging from 1 (*not true*) to 7 (*very true*). Impression management and self-deception scales contain 20 items each and are scored as the sum of scale items. Internal consistencies for BIDR impression-management and self-deception scales in the present sample were .76 and .69, respectively.

3.2.3. Analytic Strategy—Given results of Studies 1 and 2, a 3-factor confirmatory model was specified with performance deficit, exaggerated safety/caution, and hostile/aggressive factors each containing seven unique indicators (see Table 4). Latent factors were allowed to covary, and measurement errors were assumed to be uncorrelated. Items selected as marker indicators for latent factors were chosen based on consistency and magnitude of loadings across Studies 1 and 2. The resulting model was overidentified with 186 *df*.

MPlus 3.13 was used to examine the variance-covariance matrix of the sample data using maximum likelihood estimation. Indices of model fit included the root-mean-square of approximation (RMSEA), standardized root-mean-square residual (SRMR), comparative fit index (CFI), and Tucker-Lewis index (TLI). RMSEA values less than .08, SRMR values less than .10, and CFI and TLI values greater than .90 were considered as criterion for adequate model fit (Bentler, 1990; Browne & Cudeck, 1993; Kline, 2005). RMSEA less than .06, SRMR less than .08, and CFI and TLI greater than .95 were used to designate close fit (Hu & Bentler, 1999).

3.3. Results

3.3.1. Confirmatory Factor Analysis—Initial examination of the hypothesized 3-factor structure ($\chi^2(186) = 431.29$; $p < .001$) provided conflicting results regarding the adequacy of model fit. RMSEA (.07; CI_{90} = .06, .08) and SRMR (.07) values indicate adequate fit whereas CFI (.85) and TLI (.83) values suggested the specified model was implausible given the data. All indicators demonstrated substantial associations with their respective factors (β = .43 to .81), and modification indices provided no evidence of complex loadings (i.e., indicators loading on multiple latent factors). Examination of inter-item correlations, however, indicated relatively weak correlations among between-scale items (average inter-item correlation = .18). Weak associations among observed variables may systematically

attenuate CFI and TLI values (Kenny, 2009; Tucker & Lewis, 1973), and the relative independence (i.e., low correlation) of items loading on separate dimensions of anxious behavior likely contribute to discrepancies noted across indices of model fit.

Taking into account independence among inter-scale items, modification indices were reevaluated to determine areas of localized strain. Modification indices indicated that allowing errors terms from two items on the performance deficit subscale to covary (*I forget where I am driving to* and *I lose track of where I'm going*) would produce a substantial reduction in the model χ^2 ($\Delta\chi^2 = 93.9$). Because of the conceptual similarities between these items and the impact on overall fit, the model was respecified to allow covariance between these errors. Analysis of the revised model indicated acceptable fit to the sample data ($\chi^2(185) = 323.68$, $p < .001$; RMSEA = .06 [CI_{90} = .05, .07]; SRMR = .06; CFI = .92; TLI = .90). Factor loadings, standard errors, and latent factor correlations for the final model are provided in Table 4.[4]

3.3.2. Reliability and Convergent Validity—Internal consistency coefficients for performance deficits (α = .77), safety/caution (α = .78), and hostile/aggressive (α = .86) subscales were adequate and consistent with Study 2. More modest associations were noted across 4-week test-retest reliabilities (performance deficits = .61; safety/caution = .68; hostile/aggressive = .89). Comparison of individual test-retest means suggest relative stability for performance deficit ($t(40) = -1.97$; $p = .06$) and safety/caution ($t(40) = .10$; $p = .92$) subscales. Scores on the hostile/aggressive subscale, in contrast, evidenced a slight increase from Time 1 ($M = 2.56$) to Time 2 ($M = 2.81$; $t(40) = 2.92$; $p = .01$).

Examination of convergent associations again determined that perceived driving skill held a stronger association with anxiety-based performance deficits ($r = -.43$) than with safety/caution ($r = -.11$; $T(237) = -4.08$; $p < .001$) and hostile/aggressive subscales ($r = -.01$; $T(237) = -6.18$; $p < .001$; see Table 3). Driving anger (DAS) demonstrated a stronger relationship with hostile/aggressive behaviors ($r = .43$) than with performance deficits ($r = .23$; $T(237) = 2.91$; $p = .004$) and caution/safety behaviors ($r = .03$; $T(237) = 5.18$; $p < .001$). In contrast to Study 2, associations with overt travel avoidance did not differ across DBS subscales (p values ≥ .34).

3.3.3. Differences across accident and traffic citation history—Consistent with previous research, no differences in DBS scores were noted across participants with and without an accident history (p values ≥ .51). However, individuals who reported having a prior moving citation endorsed greater levels of hostile/aggressive driving behavior than did individuals with no previous violations ($t(243) = -2.17$; $p = .03$). No differences in performance deficits ($t(243) = -1.71$; $p = .09$) or safety/caution behaviors ($t(243) = 1.68$; $p = .11$) were observed across citation history.

3.3.4. Associations with social desirability—Associations with indices of social desirability are provided in Table 3. The self-deception scale of the BIDR evidenced a negative correlation with anxiety-based performance deficits. Impression management, in contrast, demonstrated a significant, albeit small, negative association with hostile/aggressive behaviors.

3.3.5. Associations with driving-related fears—Differential associations were noted between DBS subscales and specific dimensions of driving-related fear (see Table 5). Performance deficits evidenced the most general association, demonstrating relationships

[4]The variance-covariance matrix used in the estimation of the confirmatory model is available from the first author upon request.

with greater panic-, accident-, and social-related driving fears. Exaggerated safety/caution behavior, in contrast, was associated only with accident- and social-related driving fears. Hostile/aggressive behaviors evidenced a unique association with accident-related concerns.

3.4. Summary

Results from the confirmatory analysis support the hypothesized factor structure derived from Studies 1 and 2. Internal consistencies were comparable to those from the previous study although 4-week test-retest reliabilities evidenced some variability across DBS subscales. Convergent associations were observed for performance deficit and hostile/aggressive behaviors. Convergent associations between safety/caution behaviors and travel avoidance, however, were not replicated. With the exception of more frequent hostile/aggressive behaviors among participants reporting a history of moving violations, neither moving violations nor accident history were associated with elevations in anxious driving behavior. Differential associations with specific driving fears also were noted. Specifically, performance deficits demonstrated the most general associations with driving anxiety while hostile/aggressive behaviors were unique to accident-related fears.

4. Discussion

The current research details development of a broad-based measure specific to the assessment of anxious driving behavior. Factor analytic procedures identified three distinct dimensions of potentially problematic behavior: anxiety-based performance deficits, exaggerated safety/caution behavior, and hostile/aggressive behavior. Anxiety-based performance deficits emerged as a strong factor in the initial exploratory analysis. Indicators from this subscale suggest anxiety responses marked by disorganized behavior and increased frequency of driving errors. Consistent with this conceptualization, performance deficit scores demonstrated convergent relationships with lower perceptions of overall driving skill. These data converge with previous research indicating greater frequency of driving errors and lower perceptions of skill among anxious drivers (Matthews et al., 1998; Sahar, 2009; J. Taylor et al., 2007).

Associations between anxiety-based performance deficits and perceptions of driving skill suggest that skills-based interventions may facilitate treatment for a subset of anxious drivers. Noting that driving performance is dependent on a relatively complex skill set, J. Taylor et al. (2002; 2008) posit that skills training may bolster driving competence and confidence in anxious drivers, serving to enhance overall treatment efficacy. The relationship of performance deficits with accident, panic, and social/interpersonal concerns suggest that skills-based interventions may be beneficial irrespective of the specific focus of driving fear.

Exaggerated safety/caution behaviors also emerged as a characteristic response to driving anxiety. Indicators from this subscale involve distancing from other vehicles as well as potentially excessive reductions in speed. Although receiving little attention in the empirical literature, these kinds of behaviors often are conceptualized as subtle avoidance/safety efforts (e.g., S. Taylor & Koch, 1995). Safety behaviors like those noted in the current measure are thought to contribute to the maintenance of anxiety reactions and interrupt processes involved in fear extinction (Clark, 1999; Salkovskis, 1991; Hermans, Craske, Mineka, & Lovibond, 2006). To the extent that exaggerated safety/caution behaviors reduce the experience of anxiety among fearful drivers, these reactions may negatively impact the efficacy of exposure-based interventions. Given prominence of exposure-based techniques in the treatment of driving anxiety (e.g., Beck et al., 2009; Blanchard & Hickling, 2004), exaggerated safety/caution may serve as an index of treatment-interference behavior and provide an alternative indicator of treatment-related change.

The final dimension of anxious behavior extracted in these analyses involved a collation of hostile/aggressive reactions. Anxiety-based hostile/aggressive behaviors held a unique association with accident-related fear and evidenced strong convergent relationships with general driving anger. Previous research has documented elevated trait anxiety among angry drivers (Deffenbacher et al., 2000; Deffenbacher, Lynch, Filetti, Dahlen, & Oetting, 2003), and theoretical models postulate that trait anxiety may exacerbate aggressive reactions to frustrating traffic conditions (Berkowitz, 1990). Consistent with conceptualizations of driving anger as a trait-like individual difference factor, hostile/aggressive behaviors demonstrated the strongest internal consistency and test-retest reliability of any DBS subscale. Associations between hostile/aggressive driving behavior and history of moving violations also parallel data linking anger to negative driving outcomes (e.g., Deffenbacher et al., 2003; Underwood, Chapman, Wright, & Crundall, 1999).

Existing research has targeted the characteristics and treatment of general driving anger (Deffenbacher et al. 2000; Deffenbacher et al. 2003), but the specific role of anger in the maintenance and expression of driving anxiety remains largely unexplored. For individuals who engage in hostile/aggressive driving behavior as a direct function of anxiety, reductions in anxiety via exposure-based interventions may indirectly contribute to reductions in aggressive/hostile driving behaviors. Among individuals whose aggressive driving behavior is more closely related to general trait-anger, integration of anger-focused interventions (Deffenbacher et al., 2003) may be more appropriate. Assuming differentiation in the etiology of aggressive driving behavior, the current assessment holds potential for case conceptualization, treatment planning, and outcome monitoring.

Consideration of the strengths and limitations of the present research is relevant for ongoing validation of the DBS. College students utilized in this research demonstrated considerable response variability across multiple development samples. In addition, similarities across replication samples permitted an assessment of the stability of measure structure and convergent associations. Unfortunately, between-sample similarities also limit generalization of these data. Relative to the larger population of motorists, young drivers typically are characterized by less driving experience, higher levels of sensation seeking, lower perceptions of risk, greater occurrence of accidents, and more frequent risk taking (e.g., Arnett, Offer, & Fine, 1997; Machin & Sankey, 2008; Ulleberg, 2002). Incorporation of more diverse samples, especially with respect to age, education, and ethnicity will be important in the ongoing validation of this measure.

Inclusion of individuals specifically selected for high levels of driving anxiety also will be important for ongoing validation of the DBS. Inconsistencies in the relationship between travel avoidance and safety/caution behavior as well as low test-retest reliabilities for both the performance deficit and safety/caution subscales temper conclusions regarding the validity of the DBS. Whereas a normal distribution of scores is needed for initial scale development, inclusion of a subgroup reporting high levels of driving anxiety may provide a more powerful test of the reliability and validity of these particular subscales. Consistent with this argument, S. Taylor and Kuch (1995) provide evidence that characteristics of driving anxiety demonstrate greater temporal stability in help-seeking relative to non-clinical samples.

An additional limitation of the current research is the reliance on self-report data. Impression management evidenced an inverse relationship specific to hostile/aggressive behaviors while self-deception demonstrated an inverse association specific to performance deficits. Interestingly, impression management and self-deception evidenced an identical pattern of associations with the DAS and DSQ, measures selected to converge with hostile/aggressive and performance deficits subscales. This pattern of associations suggests similar influences

of social desirability in existing measures of related constructs. As such, incorporation of observational data or informant reports would be a methodological improvement within this literature more generally. Research suggesting concordance between observer and self-rated driving skill provides some evidence for the validity of self-report driving measures (J. Taylor et al., 2007b); however, systematic inclusion of multimethod assessment would strengthen ongoing examination of the DBS.

The current research takes steps toward the operationalization and assessment of three dimensions of anxiety-related driving behavior. Although this scale warrants additional psychometric examination, the DBS holds potential as an alternative indicator of treatment-related change among individuals reporting driving-related fears. Given that driving anxiety as a construct cuts across a number of diagnostic categories (e.g., agoraphobia, driving phobia, PTSD subsequent to motor vehicle trauma), this measure also may be used as a screening device within general clinical settings. It is clear that the behavior of those individuals who continue to drive despite feeling anxious is an important area of investigation, although one that has received relatively little attention. The present data suggest that individuals may manifest a variety of potentially disruptive behaviors as a consequence of anxiety. Future studies examining additional measurement properties of the DBS are needed, with particular attention to the clinical utility of this scale.

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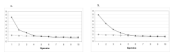

Figure 1.

a. Eigenvalues for principal components analyses of Study 1 (39 items) and random data generated for parallel analysis

b. Eigenvalues for principal components analyses of Study 2 (44 items) and random data generated for parallel analysis

Note: Initial eigenvalues from PCA in Study 1: 7.28, 3.49, 2.63, 1.78, 1.56, 1.41, 1.29, 1.26, 1.14, 1.10; Initial eigenvalues from PCA in Study 2: 7.85, 5.28, 3.48, 2.47, 1.88, 1.58, 1.51, 1.38, 1.35, 1.30

Table 1

Demographics

	Study 1	Study 2	Study 3
N	227	274	244
Age	19.1 (2.6)	19.2 (1.9)	19.0 (1.3)
Sex (% male)	51.5%	43.2%	66.8%
Race/Ethnicity			
Caucasian	79.7%	77.1%	81.6%
African American	5.3%	8.5%	5.3%
Hispanic	3.5%	0.7%	3.3%
Asian	5.7%	8.9%	7.0%
Other	5.3%	4.8%	2.8%
Age received license	16.7 (1.3)	16.8 (1.0)	16.6 (0.7)
Attended drivers school (% yes)	59.0%	62.7%	61.1%
Driving frequency			
never	0.4%	0.7%	0.8%
once every few months	0.9%	2.2%	7.4%
once a month	1.3%	3.7%	7.0%
once a week	3.5%	1.8%	4.5%
few times a week	15.9%	13.7%	16.0%
daily	77.5%	77.9%	64.3%
Moving violation (% yes)	51.1%	45.8%	49.0%
number of violations	2.2 (2.0)	2.3 (1.8)	2.3 (2.0)
MVA history (% yes)	35.7%	41.7%	43.9%

Table 2

Factor loadings from Study 1 & Study 2[a]

Item	Study 1			Study 2[b]		
	DEF	CAUT	ANG	ANG	DEF	CAUT
I have trouble finding the correct lane	.74				.71	
I have trouble staying in the correct lane	.73				.62	
I have difficulty merging into traffic	.66				.58	
I have difficulty adjusting the controls (e.g., temperature, radio) because it's too distracting	.63					
I press the wrong pedal	.62					
I lose track of where I am going	.61				.50	
I forget where I am driving to	.54				.47	
I apply the brakes repeatedly	.53					
I pull off the road	.50					
I stop talking with passengers	.47					
I forget to make appropriate adjustments in speed	.47				.55	
I forget to use my turning signal	.46					
I maintain a large distance between myself and the driver in front of me		.58				.58
I decrease my speed until I feel comfortable		.56				.48
I slow down when approaching intersections even when the light is green		.51				.48
I repeatedly look in the rearview mirror		.46				
I talk to someone on my cell phone			.56			
I gesture at the driver/drivers who made me nervous			.54	.69		
I break suddenly if I am being tailgated			.52			
I make sudden turns			.46			
I yell at the driver who made me nervous			.45	.59		
I drift into other lanes					.59	
I wait long periods of time before entering an intersection					.50	
I avoid looking in my mirrors					.46	
I try to put distance between myself and other cars						.64
I slow down when approaching green lights						.49

Item	Study 1			Study 2[b]		
	DEF	CAUT	ANG	ANG	DEF	CAUT
I let the driver who made me nervous know that I'm upset				.81		
I try to find ways to let other drivers know that they are making me nervous				.74		
I honk my horn at the driver who made me nervous				.72		
I swear/use profanity while I am driving				.64		
I pound on the steering wheel when I'm nervous				.57		
I think of ways to get even with other drivers				.57		
I hope that the driver/driver's who made me nervous will get pulled over				.57		
I tailgate the driver who made me nervous				.57		
I complain about the drivers who made me nervous				.56		
I maintain my speed in order to calm myself down						.54
During bad weather, I drive more cautiously than other vehicles on the road						.54
I try to stay away from other cars						.49

Note: DEF = DBS anxiety-based performance deficits; CAUT = DBS exaggerated safety/caution behaviors; ANG = DBS anxiety-based aggressive/hostile behaviors

[a] Items from DEF, CAUT, and ANG factors are consistent across studies although order of factor extraction varies from Study 1 to Study 2

[b] Indicators below the horizontal line are those additional items generated for Study 2

Table 3

Means, standard deviations, and intercorrelations between Driving Behavior Survey (DBS) subscales, convergent measures, and indices of social desirability

Study 2 (*N* = 274)	DEF	CAUT	ANG	DSQ	DRAS	*M*	*SD*
DEF						2.02	0.71
CAUT	.21**					3.88	0.86
ANG	.27**	.06				2.68	1.14
DSQ	-.46**	-.10	-.06			8.36	1.08
DRAS	.19**	.33**	.16**	-.26**		7.81	8.20

Study 3 (*N* = 244)	DEF	CAUT	ANG	DSQ	DRAS	DAS	*M*	*SD*
DEF							1.95	0.67
CAUT	.13*						3.87	0.93
ANG	.32**	.15*					2.81	1.13
DSQ	-.43**	-.11	-.01				8.50	1.07
DRAS	.22**	.16*	.08	-.32**			7.19	7.94
DAS	.23**	.03	.43**	-.14*	.18**		45.84	9.20
BIDR-SD	-.41**	-.04	-.02	.41**	-.10	-.12	87.09	12.41
BIDR-IM	-.12	.10	-.28**	.04	-.01	-.29**	70.47	15.40

Note: DEF = DBS anxiety-based performance deficits; CAUT = DBS exaggerated safety/caution behaviors; ANG = DBS anxiety-based aggressive/hostile behaviors; DSQ = Driving Skills Questionnaire; DRAS = Driving and Riding Avoidance Scale; DAS = Driving Anger Scale; BIDR-SD = Balanced Inventory of Desirable Responding – Self-deception; BIDR-IM = Balanced Inventory of Desirable Responding – Impression management

* $p < .05$

** $p < .01$

Table 4

Factor loadings and correlations for the respecified 3-factor model[a]

Scale	Loading	Std. error	Std. loading
Performance Deficits			
I have trouble finding the correct lane	1.00	0.00	.63
I have trouble staying in the correct lane	1.22	0.14	.82
I drift into other lanes	1.14	0.14	.71
I have difficulty merging into traffic	1.26	0.17	.57
I forget where I am driving to	0.86	0.14	.46
I forget to make appropriate adjustments in speed	0.99	0.18	.41
I lose track of where I'm going	0.71	0.16	.33
Exaggerated Safety/Caution Behavior			
I maintain a large distance between myself and the driver in front of me	1.00	0.00	.64
I try to put distance between myself and other cars	1.18	0.14	.68
I try to stay away from other cars	1.14	0.15	.66
I decrease my speed until I feel comfortable	1.06	0.15	.58
I maintain my speed in order to calm myself down	0.99	0.14	.58
During bad weather, I drive more cautiously than other vehicles on the road	0.99	0.15	.51
I slow down when approaching intersections even when the light is green	0.83	0.14	.45
Hostile/Aggressive Behavior			
I make gestures at the driver/drivers who made me nervous	1.00	0.00	.75
I let the driver who made me nervous know that I am upset	1.02	0.08	.81
I try to find ways to let other drivers know that they are making me nervous	0.99	0.08	.80
I yell at the driver/drivers who made me nervous	0.91	0.10	.64
I honk my horn at the driver who made me nervous	0.99	0.10	.68
I swear/use profanity while I am driving	0.98	0.10	.63
I pound on the steering wheel when I am nervous	0.59	0.08	.49

Relationships among factors[b]	DEF	CAUT	ANG
DEF	**0.27**	0.07	0.20
CAUT	.16	**0.63**	0.13
ANG	.33	.14	**1.28**

Note: DEF = DBS anxiety-based performance deficits; CAUT = DBS exaggerated safety/caution behaviors; ANG = DBS anxiety-based aggressive/hostile behaviors

[a] The error covariance included in the respecified model was equal to .57 (r = .52)

[b] Diagonal contains factor variances (in bold); upper triangle contains covariances; lower triangle contains latent correlations; association between DEF & ANG scales significant at $p < .001$

Table 5

Means, standard deviations, and intercorrelations between Driving Behavior Survey (DBS) subscales and Driving Cognitions Questionnaire (DCQ) subscales

Study 3 (*N* = 271)	**DEF**	**CAUT**	**ANG**	***M***	***SD***
DCQ panic	.32**	.12	.05	3.02	3.82
DCQ accident concerns	.36**	.21**	.14*	6.49	4.67
DCQ social concerns	.33**	.18**	.10	4.32	3.63
DCQ total	.38**	.19**	.11	13.93	10.80

Note: DEF = DBS anxiety-based performance deficits; CAUT = DBS exaggerated safety/caution behaviors; ANG = DBS anxiety-based aggressive/hostile behaviors

* $p < .05$

** $p < .01$

APPENDIX A

Driving Behavior Survey Often times situations occur while people are driving which make them nervous (e.g., weather conditions, heavy traffic, near accidents, etc.). Below is a list of behaviors that may or may not be relevant to you in these situations. Based on your personal experience, please indicate how frequently you perform each of these items when a stressful driving situation occurs which makes you nervous, anxious, tense, or uncomfortable. Please indicate what you *generally* do, not what you think you should do.

	Never	Very Infrequently	Infrequently	Sometimes	Frequently	Very Frequently	Always
1. I lose track of where I am going.	1	2	3	4	5	6	7
2. I yell at the driver/drivers who make me nervous.	1	2	3	4	5	6	7
3. I slow down when approaching intersections, even when the light is green.	1	2	3	4	5	6	7
4. I have trouble staying in the correct lane.	1	2	3	4	5	6	7
5. I drift into other lanes.	1	2	3	4	5	6	7
6. I forget to make appropriate adjustments in speed.	1	2	3	4	5	6	7
7. I let the driver who made me nervous know that I am upset.	1	2	3	4	5	6	7
8. I maintain a large distance between myself and the driver in front of me.	1	2	3	4	5	6	7
9. I forget where I am driving to.	1	2	3	4	5	6	7
10. I make gestures at the driver/drivers who made me nervous.	1	2	3	4	5	6	7
11. I try to put distance between myself and other cars.	1	2	3	4	5	6	7
12. I maintain my speed in order to calm myself down.	1	2	3	4	5	6	7
13. I try to stay away from other cars.	1	2	3	4	5	6	7
14. I have trouble finding the correct lane.	1	2	3	4	5	6	7
15. I pound on the steering wheel when I'm nervous.	1	2	3	4	5	6	7
16. I decrease my speed until I feel comfortable.	1	2	3	4	5	6	7
17. I honk my horn at the driver who made me nervous.	1	2	3	4	5	6	7
18. I try to find ways to let other drivers know that they are making me nervous.	1	2	3	4	5	6	7
19. During bad weather, I drive more cautiously than other vehicles on the road.	1	2	3	4	5	6	7
20. I swear/use profanity while I am driving	1	2	3	4	5	6	7
21. I have difficulty merging into traffic.	1	2	3	4	5	6	7

Anxiety-based performance deficits: 1, 4, 5, 6, 9, 14, 21

Exaggerated safety/caution behavior: 3, 8, 11, 12, 13, 16, 19

Hostile/aggressive behaviors: 2, 7, 10, 15, 17, 18, 20

Note: DBS subscales scored as the mean of endorsed items