
A Motivational Model of Driving Anger and Aggression

Clayton Neighbors

University of Washington

Nathaniel A. Vietor

C. Raymond Knee

University of Houston

This article proposed a motivational model of driving anger and aggression, derived from self-determination theory, suggesting that trait motivation affects motivation in specific driving situations, which in turn predicts driving anger and subsequent aggression. Individuals higher in controlled orientation were predicted to experience more feelings of pressure and ego-defensiveness while driving, leading to more anger and aggression. Participants included 111 individuals who kept structured daily records of all instances in which they experienced driving anger throughout a 10-day period. Participants reported experiencing anger on slightly more than a daily basis, on average, and responding with varying levels of aggression. Results provided strong support for the authors' motivational framework suggesting that individuals who generally feel controlled tend to experience more pressure and ego-defensiveness, which leads to more anger and aggression while driving.

Aggressive driving has become an increasingly common occurrence (American Automobile Association, 1997). Although many states have responded by enacting legislation aimed at curtailing aggressive driving (Rathbone & Huckabee, 1999), research focusing on the etiology of aggressive driving and what makes some people more aggressive than others continues to be sparse. Previous efforts to identify predictors of driving anger and aggression have examined both situational and personality explanations but have typically been theoretically lean. The majority of research examining situations has explored the impact of traffic congestion or travel impedance, which is conceptually similar. The frustration-aggression link (Dollard, Doob, Miller, Mowrer, & Sears, 1939) has been offered as a reasonable explanation for the link between traffic congestion and aggressive behavior (Shinar, 1998). More recent theoretical accounts of frustration-aggression suggest that the causal link between congestion and aggression is likely due to

the activation of negative affect and anger (Berkowitz, 1993). In support of this perspective, traffic congestion and travel impedance have been linked to higher levels of aggressive driving (Hennessy & Wiesenthal, 1999) and both self-reported (Hennessy & Wiesenthal, 1997, 1999; Wiesenthal, Hennessy, & Totten, 2000) and physiological measures of stress (Novaco, Stokols, Campbell, & Stokols, 1979; Schaeffer, Street, Singer, & Baum, 1988; Stokols, Novaco, Stokols, & Campbell, 1978). Other situational factors associated with driving aggression include hotter temperatures (Kenrick & MacFarlane, 1986), anonymity (Ellison, Govern, Petri, & Figler, 1995), and the presence of aggressive stimuli (Turner, Layton, & Simons, 1976).

Personality explanations of driving anger have tended to endorse a state-trait approach when explaining driving anger and aggression. Deffenbacher and colleagues have identified trait differences in driving anger (Deffenbacher, Oetting, & Lynch, 1994) and have shown that individuals who are higher in trait driving anger experience more frequent and intense anger, more aggressive and risky driving behavior, and have more accidents (Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000). Similarly, trait differences in driving stress have been positively associated with state stress while driving (Hennessy & Wiesenthal, 1997, 1999). An extension of this approach is the notion that trait driving stress, anger, and/or aggression are indicative of more global underlying traits

Authors' Note: The authors would like to thank the editor and four anonymous reviewers for their helpful comments in the preparation of this article. The authors also extend special thanks to the Interpersonal Relations and Motivation Research Group at the University of Houston. Correspondence should be sent to Clayton Neighbors, University of Washington, Department of Psychology, Box 351525, Seattle, WA 98195-1525; e-mail: claytonn@u.washington.edu.

PSPB, Vol. 28 No. 3, March 2002 324-335

© 2002 by the Society for Personality and Social Psychology, Inc.

such as general aggression and/or hostility (Donovan & Marlatt, 1982; Donovan, Umlauf, & Salzberg, 1988). Furthermore, trait aggression and stress have been positively associated with number of traffic accidents (Selzer & Vinokur, 1974). Other, seemingly pertinent, theoretical explanations of aggression have not been directly examined in the context of driving anger and aggression. In particular, theories discussing aggression as it relates to ego-threat (Baumeister, Bushman, & Campbell, 2000), threats to social identity (Tedeschi & Felson, 1994), and emotional reactivity (Caprara, Perugini, & Barbaranelli, 1994) have been largely ignored in the context of driving anger and aggression.

The present research was designed to propose and test a theoretical framework that integrates and extends previous research on driving anger and aggression. We derived a motivational framework for understanding driving anger and aggression from self-determination theory incorporating global and situation-specific motivations.

Self-Determination

Self-determination theory (Deci & Ryan, 1985b, 1987, 1991) is a motivational theory that has provided a useful framework for understanding behaviors in many domains, including education (Grolnick & Ryan, 1987; Ryan & Connell, 1989), medical training (Williams & Deci, 1996, 1998), work (Deci, Connell, & Ryan, 1989; Ilardi, Leone, Kasser, & Ryan, 1993), and romantic relationships (Blais, Sabourin, Boucher, & Vallerand, 1990; Hodgins, Koestner, & Duncan, 1996; Knee, Patrick, Vietor, Nanayakkara, & Neighbors, 2000). In addition, self-determination theory has been applied to specific health-related behaviors, including adherence to medical prescriptions (Williams, Rodin, Ryan, Grolnick, & Deci, 1998), drinking behavior (Knee & Neighbors, in press; Ryan, Plant, & O'Malley, 1995), and weight loss (Williams, Grow, Freedman, Ryan, & Deci, 1996).

Among the assumptions of self-determination theory is that individuals differ in their general motivational orientations (Deci & Ryan, 1985a, 1985b). These individual differences are in part due to differential exposure to autonomy-supportive versus controlling environments as well as developmental differences in organismic integration (Deci & Ryan, 1985b). Controlled orientation is a global motivational orientation associated with experiencing a lack of true choice and a general tendency to perceive pressure from one's environment as well as a contingency-based sense of self-worth that results in rigid ego-defensiveness (Deci & Ryan, 1985a, 1985b; Hodgins & Knee, in press).¹ Previous research has shown that controlled orientation is positively associated with both driving anger and aggressive driving (Knee, Neighbors, & Vietor, 2001). Theoretically, two aspects of controlled

orientation can be distinguished: (a) an orientation toward pressure and stress and (b) ego-defensiveness.

Pressure. Controlled individuals tend to regulate their behavior according to pressures toward specific behaviors and outcomes (Deci & Ryan, 1985b). These pressures may originate in the environment (e.g., threats or deadlines) or may originate within the individual in the form of internalized introjections (e.g., feeling that one "should" or "ought" to perform in some specific way). Controlled individuals also may be more affected by perceived pressure; for example, Knee and Neighbors (in press) found that nonfraternity college students who were higher in controlled orientation were more susceptible to the effects of peer pressure to drink. This general orientation toward pressure is conceptually and empirically linked to increased levels of stress. Pressure arising from both internal and external sources has been associated with feelings of stress and tension (Ryan, 1982; Ryan, Mims, & Koestner, 1983). In addition, controlled orientation has been associated with displaying the Type-A coronary-prone behavior pattern (Deci & Ryan, 1985a).

Ego-defensiveness. In addition to orienting oneself toward pressures, controlled individuals tend to approach events in an ego-involved fashion, with their esteem on the line (Ryan, 1982). Controlled individuals show ego-defensiveness and reactivity in a variety of contexts (Hodgins & Knee, in press). Controlled orientation has been associated with defensiveness in impression management, social interactions, and coping (Hodgins et al., 1996; Hodgins, Liebeskind, & Schwartz, 1996; Knee & Zuckerman, 1996, 1998) as well as with higher levels of public self-consciousness (Deci & Ryan, 1985a).

Both pressure and ego-defensiveness may play key roles in determining driving anger and associated aggression. Consistent with this idea, Knee et al. (2000) found that individuals who were higher in controlled orientation had higher levels of trait driving anger and reported more aggressive driving behavior. Furthermore, trait driving anger was found to mediate the relationship between self-determination and aggressive driving, suggesting that less self-determined individuals drive more aggressively, in large part, because of their tendency to become angry while driving. Although providing an important first step in understanding the motivational origins of aggressive driving, this research was limited in that it examined motivation and driving anger only at the trait level.

Vallerand (1997) proposed a hierarchical model of motivation and persuasively argued the importance of simultaneously examining motivation at both the trait (global) level and more specific levels related to the context and situation. According to Vallerand's model, there are both top-down and bottom-up effects of motivation.

Top-down effects describe the impact that global motivation has on context-specific or situational motivation. Thus, an individual who is generally controlled in his or her orientation toward events is likely to be more ego-defensive and feel more pressured within a given context, such as driving, and will in turn be more likely to feel stressed and respond defensively to specific events that occur while driving. Bottom-up effects suggest the reverse: Experiencing pressure and ego-defensiveness across many driving situations will, over time, affect one's overall motivation for driving and, in turn, one's global motivational orientation. Whereas top-down effects may provide a motivational explanation of behavior in the present, bottom-up effects require relatively long periods of time and/or many situations to become apparent.

Consistent with Vallerand's (1997) framework, we suggest that an understanding of the motivational causes of aggressive driving behavior must address individuals' global motivation as well as their motivation in specific driving circumstances. Thus, although individuals do differ in the extent to which they are generally pressured or ego-defensive across situations, some situations cause more stress and reactivity than others. Thus, it is important to gauge one's motivation in response to specific driving situations in addition to general motivational tendencies. Although previous research has examined the relationship between stress and anger in driving situations (Hennessy & Wiesenthal, 1997, 1999; Schaeffer et al., 1988), no published research (to our knowledge) has examined anger caused by ego-defensiveness in response to specific driving events. We suggest that, although high levels of stress do produce more driving anger and aggressive responses, anger is also, and perhaps more frequently, aroused by ego-defensive reactions to other drivers (e.g., perceiving another driver's actions as being personally directed at the self). Moreover, feeling pressure or stress because one is late for an appointment may predispose one to become angry and/or aggressive but "that idiot who won't stop riding your bumper" will almost certainly cause anger and perhaps retaliation. Consistent with self-determination theory (Deci & Ryan, 1985b) and Vallerand's (1997) framework, we proposed a hierarchical motivational model of driving anger suggesting that both global motivation and situation-specific motivation would account for driving anger, which would, in turn, predict aggressive driving.

Proposed Theoretical Model

Figure 1 presents the theoretical framework underlying our research. Our model is consistent with previous research on driving anger and aggression in that we believe that trait characteristics play a significant role in determining subjective experience within given situations. However, we believe that a motivational frame-

work can be more effectively applied to describe this process and integrate previous research.

According to this framework, trait motivation (trait self-determination), operationalized as controlled orientation, refers to a general tendency to feel pressure and stress and to display ego-defensiveness across many types of situations. We suggest that trait motivation affects motivation within specific situations. Thus, we predicted that individuals who were higher in controlled orientation would feel more pressure and stress and would be more ego-defensive and reactive in specific driving situations (Hypothesis 1). Consistent with previous research, we believed that subjective experiences associated with driving events would be associated with anger. Thus, we predicted that situational motivation, operationalized as ego-defensiveness, and feeling pressured would be associated with higher levels of driving anger (Hypothesis 2). Also consistent with previous research, we predicted that higher levels of anger experienced while driving would be associated with subjective reports of driving aggression and with aggressive actions as measured by specific behaviors (Hypothesis 3). Implicit in our framework is the assumption that relations between situational motivation and aggressive driving would be in large part due to driving anger as a mediator (Hypothesis 4). Similarly, we presumed that relations between trait motivation and driving anger would be largely due to situational motivation serving as a mediating variable (Hypothesis 5).

METHOD

Participants

Participants were 111 (28 men and 83 women) undergraduate psychology students at a large, southwestern urban university. The average age of participants was 23.6 years ($SD = 6.09$). The sample was ethnically diverse with 39.6% Caucasian, 13.5% Asian, 19.8% Hispanic, 22.5% African American, and 4.5% who chose "other." Of the students at this university, 93% are commuters, and the participants in this study drove a median number of 8 to 12 hours weekly. They received extra credit in their coursework for their participation.

Procedure

In Phase 1, participants were given a battery of questionnaires in a Latin square design to measure their self-determination as well as other constructs included for other purposes. In addition, demographic variables were assessed, such as age, ethnicity, sex, driving habits and experience, and past experience with driving anger. In Phase 2, participants were given diary records (see appendix) to be completed after each occurrence of driving anger throughout a period of 10 days. Participants completed one diary record after each incident of driving

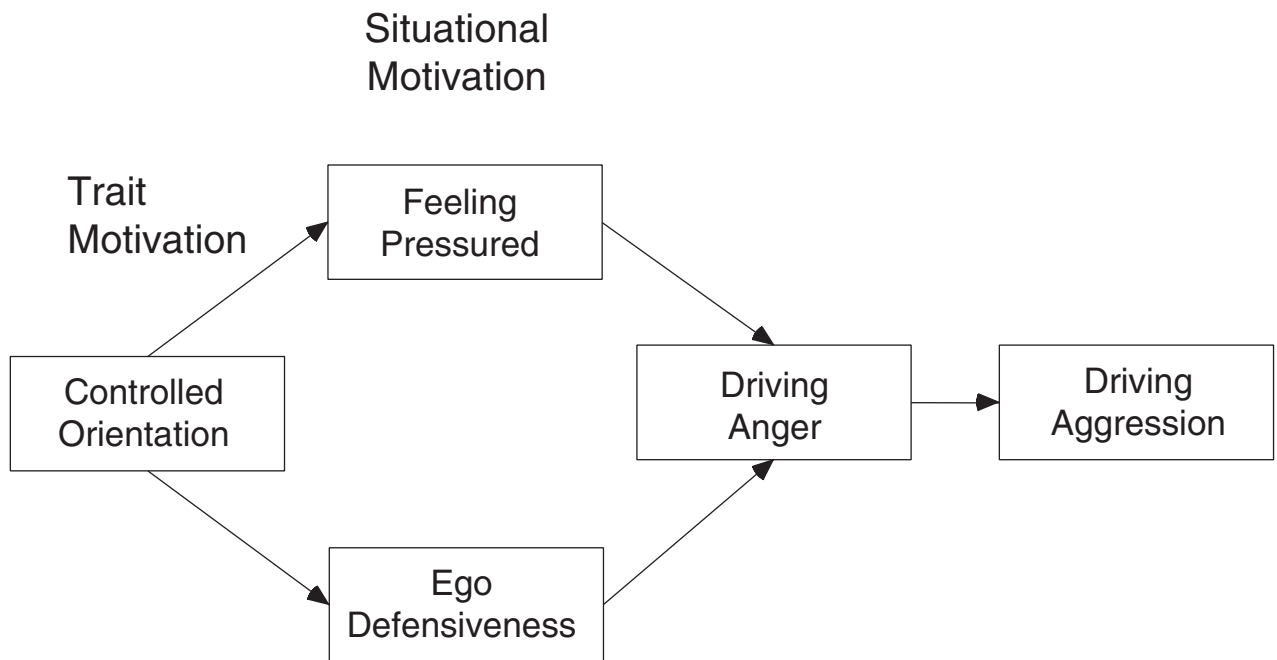


Figure 1 Theoretical motivational model of aggressive driving.

anger. If the participant drove but experienced no anger during a given day, the participant completed one record at the end of the day and specified this. If the participant did not drive at all during the day, they were instructed to complete one record specifying that they did not drive on that day. These driving records assessed the time and nature of the incident, the extent to which the participant felt the incident had been directed at them personally, how angry they became, their levels of stress and pressure before the incident occurred, their behavioral responses to the incident, and their feelings about their responses. In Phase 3, participants completed a follow-up questionnaire assessing accuracy of responses.

Measures

Trait-motivation (controlled orientation). The General Causality Orientations Scale (GCOS) (Deci & Ryan, 1985a) is a trait measure of self-determination that includes three subscales measuring a controlled orientation, an autonomous orientation, and an impersonal orientation. We were only concerned with the controlled orientation in the present research. We measured the controlled orientation using a revised version of the GCOS. The original GCOS consisted of 12 scenarios, 8 of which were achievement related. The revised scale employed here was an expanded version that included an additional 5 scenarios that were explicitly interpersonal (Hodgins et al., 1996; Ryan, 1989). Each of the 17

scenarios is followed by a controlled response to which respondents rate how characteristic this type of response would be for him or her. For example, one of the scenarios and its controlled response is as follows: "Your friend has a habit that annoys you to the point of making you angry. It is likely that you would . . ." The controlled orientation is then measured by the response, "point it out each time you notice it, that way maybe he (she) will stop doing it." Participants rate each response on a scale from 1 (*very unlikely*) to 7 (*very likely*). Scores are computed by averaging respondents' ratings across all 17 scenarios. Internal reliability (Cronbach's alpha) in this study was .78.

Situational motivation. Motivation at the situational level was assessed in each instance of reported driving anger. Two indices were constructed to conceptually translate trait motivation (controlled orientation) to situation-specific motivation. Accordingly, feeling more pressure and more ego-defensive indicated lower levels of self-determined motivation at the situational level.

Feeling pressured. Four items (6 to 9) were included on the driving anger records to measure pressure. Participants were asked to what extent they were in a rush, in danger of being late for an appointment, feeling pressure, and feeling stress before the event that caused them to become angry. Internal reliability (Cronbach's alpha) was .88.

Ego-defensiveness. Ego-defensiveness was assessed by one item (3), which asked the extent to which participants perceived the action that angered them as being directed at them personally. All responses were given on 7-point scales.

Driving anger. Driving anger was assessed with two items on the driving anger record (4 and 5). One item addressed the intensity of anger experienced, whereas the other measured duration of anger. Intensity was measured on a 7-point scale (1 = *not very angry at all*, 7 = *extremely angry*). Duration was assessed by having respondents circle one of nine time periods and was scored from 1 (*less than 2 minutes*) to 9 (*longer than most of the day*). Responses from these two items were standardized and summed to create a measure of driving anger.

Aggressive driving. Aggressive driving was measured in two ways, henceforth referred to as subjective aggression and aggressive actions. Subjective aggression was measured by having participants rate how aggressive their responses were with four items on the driving anger record (Item 10 reversed, 11, 13, and 14 reversed). Two items asked how participants' anger affected their driving, whereas the other two asked participants to rate the aggressiveness of their response. Internal reliability (Cronbach's alpha) was .72. Aggressive actions provided a more objective measure of aggressive driving and was based on the aggressiveness of the specific actions (Item 12) participants reported engaging in as a result of their anger. An index was created by assigning a weight to each action based on how aggressive the action was. Weights were based on independent ratings from five raters who rated each action from 1 to 5 (where 5 was *most aggressive*). Interrater reliability for the ratings was .93. The weights assigned for each action are shown in Table 1. The aggressive actions score was calculated as the sum of the weights for all actions that were reported; for example, if an individual reported yelling, honking, and tailgating in response to an event, the aggression score was calculated by summing the three weights (2.8 + 2.87 + 4.40 = 10.07).

Follow-up questionnaire. Six items addressed accuracy of responses on the driving anger records. All items were on a 7-point scale. The follow-up questionnaire assessed participants' perceptions of overall accuracy of records (two items), estimated percentage of driving anger events recorded, difficulty of keeping records, and estimated impact of keeping records on driving anger.

RESULTS

Analysis

Due to the nested nature of data, with individuals completing a variable number of records per day and

TABLE 1: Weights Assigned to Aggressive Actions

Action	Aggression Weight
Tailgated	4.40
Refused lane access	4.40
Tapped/hit brakes	4.33
Sped up	3.20
Slowed down	3.13
Name calling	3.07
Honking	2.87
Flashed lights	2.87
Yelling	2.80
Made gestures	2.67
Muttered comments	1.60
No action at all	1.13

NOTE: Weights were assigned according to the mean ratings of five independent raters where interrater reliability was .93.

TABLE 2: Zero-Order Correlations Among Variables Included in Hypotheses

Measure	1	2	3	4	5	6
Controlled orientation	—					
Ego-defensiveness	.24*	—				
Feeling pressured	.22*	-.06	—			
Driving anger	.28**	.45***	.11	—		
Subjective aggression	.18†	.32***	.19*	.41***	—	
Aggressive actions	.10	.40***	.03	.47***	.53***	—

NOTE: *N*s ranged from 100 to 105, depending on missing data. † $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

across the 10-day period, hypotheses were tested analyzing the first record completed by each individual and separately by computing means for each individual averaging across their respective records. The latter results are not reported because results were largely redundant, with most standardized estimates varying only at the second or third decimal place. Some of the participants had missing data on one or more variables. Pairwise deletion was used throughout the analyses. Discrepancies in degrees of freedom are indicative of missing values with *N*s ranging from 100 to 105 for all analyses. Table 2 provides zero-order correlations among variables included in the hypotheses.

Participants reported in the follow-up questionnaire that they recorded an average of 85% ($SD = 17\%$) of their driving anger incidents and that they were relatively accurate in their reporting ($M = 5.52$, $SD = 1.11$ on a 7-point scale). In addition, participants reported that keeping the records did not heavily influence their frequency of experiencing driving anger ($M = 2.40$, $SD = 1.56$ on a 7-point scale).

Anger. A total of 775 driving anger records were completed. The average number of days that participants

drove and kept records was 8.45 ($SD = 2.46$) and the average number of driving anger events recorded was 9.40 ($SD = 4.18$). Thus, in this sample, individuals reported experiencing driving anger a little more than once per day ($M = 1.12$, $SD = .39$). Overall, reported anger lasted an average of between 2 to 5 minutes and 5 to 10 minutes and was relatively intense ($M = 4.98$, $SD = 1.41$).

What made people angry? Slightly less than half of all events (46.5%) were described as fitting more than one category ($M = 1.59$, $SD = .74$). Overall, participants categorized 59.1% of events as being due to discourtesy. In addition, participants categorized 43.5% of all events as being due to dangerous driving by other motorists. The only other type of event classified in more than 10% of records was slow traffic due to volume (15.5%) (See Table 3 for other frequency information.)

Aggressive responses. The majority (69.4%) of driving anger events resulted in more than one response ($M = 2.52$, $SD = 1.60$). More than half of people's responses to events involved muttering comments (53.5%). Other typical responses (see Table 4) included name-calling (28.8%), making gestures (28.1%), refusing lane access to other drivers (24.0%), and honking (23.0%).

Hypotheses

Hypothesis 1 predicted that controlled orientation would predict motivation in specific driving instances. Consistent with prediction, controlled orientation was associated with ego defensiveness, $r(100) = .24$, $p < .05$, and feeling pressured, $r(101) = .22$, $p < .05$. Hypothesis 2 was that ego-defensiveness and feeling pressured would be associated with more driving anger. Multiple regression predicting driving anger from ego-defensiveness and feeling pressured revealed that driving anger was strongly predicted by ego-defensiveness and marginally predicted by feeling pressured (see Table 5). Hypothesis 3 was that driving anger would be associated with more aggressive driving. Consistent with our prediction, driving anger was strongly associated with both subjective aggression, $r(104) = .41$, $p < .001$, and aggressive actions, $r(104) = .47$, $p < .001$.

Driving anger as a mediator. Hypothesis 4 was that driving anger would mediate the relationship between situational motivation and aggressive driving. We evaluated mediation according to Baron and Kenny's (1986) criteria, which suggests mediation when there are significant associations between (a) the predictor and the criterion, (b) the predictor and the mediator, (c) the mediator and the criterion controlling for the predictor, and (d) the relation between the predictor and criterion is no longer significant or is substantially reduced when controlling for the mediator. Complete mediation is indicated

TABLE 3: Frequency of Anger-Causing Events

Type of Event	Overall Proportion of Records Where Item Was Endorsed (%)	Number of Respondents Who Recorded This Event at Least Once (N = 111)
	Another driver was discourteous	59.1
Another driver was driving dangerously	43.5	45
Slow traffic due to volume/traffic jam	15.5	20
Slow traffic due to obstruction or wreck	6.3	2
Slow traffic due to roadwork	5.7	2
Someone was honking	3.7	4
Police presence	2.6	2
Other	22.2	23

TABLE 4: Frequency of Responses

Type of Event	Overall Proportion of Records Where Item Was Endorsed (%)	Number of Respondents Who Recorded This Event at Least Once (N = 111)
	Muttered comments	53.5
Name calling	28.8	39
Yelling	28.1	26
Made gesture(s)	24.0	18
Sped up	24.0	23
Honking	23.0	16
Slowed down	17.2	20
Tailgated	15.1	12
Tapped or hit brakes	14.6	17
Refused lane access to other driver	6.7	8
Flashed lights	5.9	11
No action at all	5.4	5
Other	11.4	13

when all four steps are met, whereas partial mediation is indicated when Steps 1 through 3 are met but not Step 4 (Kenny, Kashy, & Bolger, 1998).

Because feeling pressured was not significantly associated with driving anger, we only tested driving anger as a mediator of the relationship between ego-defensiveness and aggressive driving. We first examined mediation with subjective aggression as the criterion. Conditions 1 and 2 were met with ego-defensiveness significantly related to subjective aggression, $r(104) = .32$, $p < .001$, and to driving anger, $r(104) = .45$, $p < .001$. Condition 3 was also met with driving anger predicting subjective aggression, $t(1, 101) = 3.95$, $p < .001$, $\beta = .39$, controlling for ego-defensiveness. Condition 4 also was satisfied, meeting the requirements of full mediation with ego-defensive-

TABLE 5: Driving Anger as a Function of Situational Motivation

Variable	Unstandardized Estimate	SE	t	p Value	Standardized Estimate	Squared Semi-Partial Correlation
Ego-defensiveness	.38	.07	5.21	<.001	.46	.21
Feeling pressured	.15	.09	1.68	.09	.15	.03

NOTE: $R^2 = .22$, $N = 104$.

ness no longer statistically significant, $t(1, 101) = 1.50$, $p = ns$, $\beta = .15$, after controlling for driving anger.

The same approach was taken to examine driving anger as a mediator of the relationship between ego-involvement and aggressive action. Conditions 1 and 2 were met with ego-defensiveness significantly related to aggressive action, $r(103) = .40$, $p < .001$, and to driving anger, $r(104) = .45$, $p < .001$. Condition 3 was satisfied with driving anger predicting aggressive action controlling for ego-defensiveness, $t(1, 100) = 3.98$, $p < .001$, $\beta = .38$. The test of Condition 4 revealed that whereas the effect of ego-defensiveness on aggressive action remained statistically significant, controlling for driving anger, $t(1, 100) = 2.39$, $p < .05$, $\beta = .23$, this effect was substantially reduced, indicating partial mediation. A modification of the Sobel (1982) test (Kenny et al., 1998) confirmed that this reduction was statistically significant, $z = 2.64$, $p < .01$.

Trait motivation as a mediator. Hypothesis 5 was that situational motivation would mediate the relationship between trait motivation (controlled orientation) and driving anger. Again, we did not include feeling pressured in the analysis because of its weak relationship with driving anger. Conditions 1 and 2 were both met with controlled orientation being associated with driving anger, $r(101) = .28$, $p < .01$, and ego-defensiveness, $r(100) = .24$, $p = .01$. Condition 3 was satisfied in that ego-defensiveness was significantly associated with driving anger, $t(1, 99) = 4.46$, $p < .001$, $\beta = .41$, after partialling controlled orientation. A test of Condition 4 indicated that controlled orientation was still significantly associated with driving anger, $t(1, 99) = 2.22$, $p < .05$, $\beta = .20$, but was substantially reduced, $z = 2.20$, $p = .01$, indicating partial mediation.

Model fit. The overall fit of our theoretical model was tested with AMOS 4.0 (Arbuckle & Wothke, 1999). Subjective aggression and aggressive action were specified as indicators of a latent variable driving aggression. Listwise deletion resulted in an N of 99. Our model fit the data well, $\chi^2(8, N = 99) = 13.69$, $p = ns$, Goodness of Fit Index (GFI) = .96, Comparative Fit Index (CFI) = .94. Standardized regression weights are presented in Figure 2. All paths were significant at $p < .05$, with the exception of the path from feeling pressured to driving anger, where $p = .05$.

Congestion Versus Other Drivers as Cause of Anger

We conducted a series of analyses to examine how motivation, driving anger, and driving aggression varied as a function of the type of event that caused individuals to get angry (Item 2 in appendix). Records where either slow traffic due to roadwork, obstruction, or wreck or volume/traffic jam were reported as being the cause of anger were classified as events where anger was a result of congestion. Records where another driver's dangerousness, discourtesy, or honking was listed as the reason for anger were classified as events where another driver's actions caused anger. Neither driving anger nor subjective aggression varied as a function of type of event. Events in which another driver's actions caused anger were associated with more aggressive actions, $t(1, 101) = 2.86$, $p < .01$, $\beta = .29$. Similarly, ego-defensiveness was positively associated with describing anger as a result of another driver's actions, $t(1, 101) = 2.20$, $p < .05$, $\beta = .23$. Feeling pressured was associated with describing anger as a result of congestion, $t(1, 102) = 1.95$, $p = .05$, $\beta = .20$.

DISCUSSION

The present research provided a rich description of driving anger and aggressive driving as they occur on a daily basis among college students and provided a theoretical motivational model for understanding driving anger and aggressive driving behavior. Overall, we found strong support for our framework, with all five hypotheses receiving support. Consistent with our hypothesis and previous research, driving anger was associated with higher levels of driving aggression, whether measured by subjective aggression ratings of participants or by an index of aggression based on reported actions. Also consistent with our predictions, and previous research, we found that subjective experiences at the situational level, which we operationalized as ego-defensiveness and feeling pressured, resulted in higher levels of driving anger, although only weakly with feeling pressured. Similarly, we found evidence that individuals higher in controlled orientation, who generally experience a lack of choice, perceived more pressure and exhibited more ego-defensiveness in specific driving situations. In addition, consistent with our motivational framework, the relationship

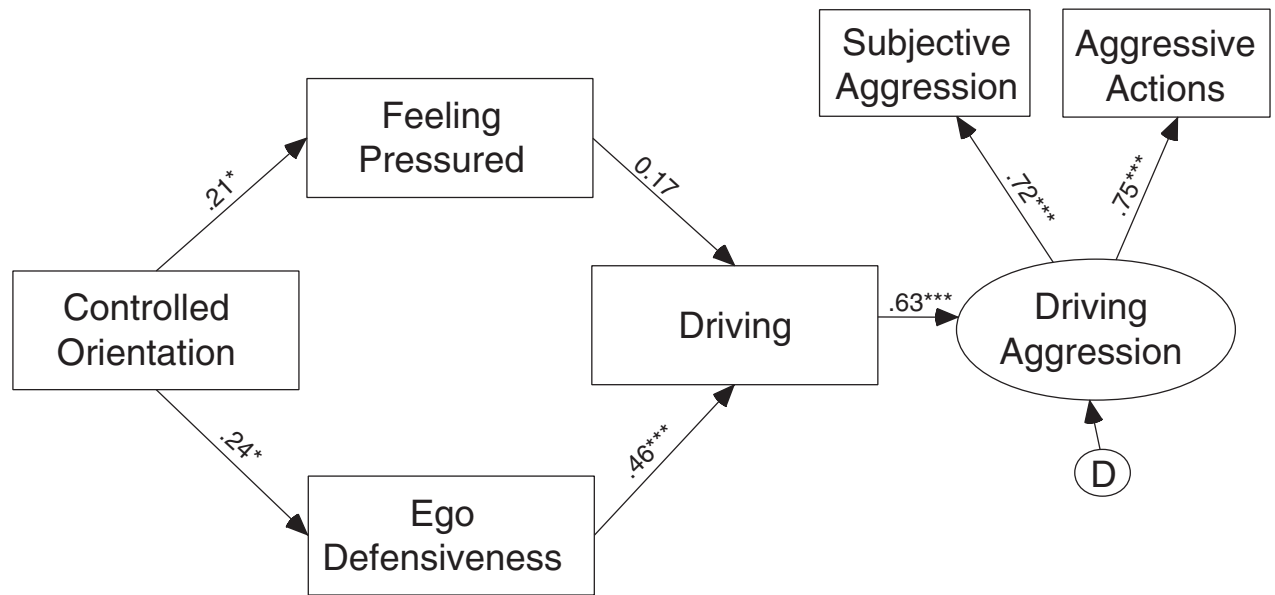


Figure 2 Standardized coefficients for motivational model of aggressive driving.

between ego-defensiveness and aggressive driving was in large part due to driving anger as a mediating variable of this relationship. Similarly, the relationship between trait motivation and driving anger was largely explained, but not entirely, by ego-defensiveness in specific driving situations.

Our findings complement and extend previous work on driving anger and aggression. Whereas previous research examined driving anger, stress, and aggression at both trait and state levels (Deffenbacher et al., 2000; Hennessy & Wiesenthal, 1997, 1999), the present research is unique in exploring the impact of motivation at multiple levels on driving anger and aggression.

Our findings are consistent with previous work focusing on congestion, travel impedance, and time urgency as a source of stress and subsequent aggression (Hennessy & Wiesenthal, 1997, 1999; Novaco et al., 1979; Schaeffer et al., 1988; Stokols et al., 1978; Wiesenthal et al., 2000). Consistent with this area of research, we found that slow traffic was linked to greater feelings of pressure and stress. Surprisingly, feelings of pressure and stress, although associated with more subjective aggression, were only weakly, if at all, associated with driving anger. In addition, feeling pressured did not translate into more aggressive action. Perhaps of greater interest, however, is the finding that ego-defensiveness was associated with driving anger and subsequent aggression. Specifically, viewing events as being personally directed at the self was associated with higher levels of anger and subsequent aggression. Furthermore, the effects related to ego-

defensiveness appeared to be substantially larger than the effects related to feeling pressured and stressed.

Taken together, these results suggest that "road rage" is more often caused by perceiving the actions of other drivers as personal affronts and subsequently retaliating to vindicate one's self-esteem rather than being caused by traffic congestion or general feelings of stress and pressure. These findings are consistent with previous research suggesting that aggression often stems from emotional reactivity (Caprara et al., 1994), perceived threats to self-esteem (Baumeister et al., 2000), and social identity (Tedeschi & Felson, 1994). These findings also are consistent with recent work in self-determination theory, which has shown controlled orientation to be associated with ego-defensive and reactive behavior (e.g., Hodgins & Knee, in press). Self-determination can be defined as actively choosing behaviors based on one's integrated and core values. Defensively reacting to perceived threats or challenges to one's ego based on feeling that one's ego is threatened or challenged are at the other end of the continuum. Similar to previous research that has examined behavioral consequences of self-determination, our results suggest that there are important consequences associated with perceiving pressure from one's environment and with approaching situations in an ego-involved manner. Our research suggests, however, that at least in the driving context, it is the ego-involvement component that plays the larger role, being strongly associated with driving anger, subjective aggression, and aggressive actions.

The present research extends self-determination theory by defining the controlled orientation construct in terms of two theoretically distinguishable aspects: pressure and ego-defensiveness. Our findings also agree with the notion that an understanding of behavior from a motivational perspective can best be achieved by examining motivation at multiple levels (e.g., global, contextual, and situational).

Limitations

Our theoretical framework received strong support, but it is important to identify some of the limitations associated with our approach. First, our sample, although ethnically diverse, consisted only of college students and may not be representative of a more general population. Other limitations concern the use of the diary procedure in that anger, feeling of pressure, ego-defensiveness, and aggressiveness are all measured via self-report and retrospectively versus concurrently (Ericsson & Simon, 1980, 1993). In addition, reports of anger and responses to anger were recorded at the same time, possibly resulting in inflated correlations among them. Despite these limitations, the diary method has advantages over other methods of studying driving anger and aggression in that the events that participants respond to are actual events that they experienced rather than vignettes where they must imagine both being in a particular situation as well as how they would respond in the situation.

Conclusions

Given that driving anger, stress, and aggression have been associated with traffic violations, accidents, and physical health (Deffenbacher et al., 2000; Knee & Neighbors, in press; Novaco et al., 1979; Schaeffer et al., 1988; Selzer & Vinokur, 1974; Stokols et al., 1978), it is surprising and unfortunate that there continues to be a dearth of research in this area. This lack of attention might be understandable if becoming angry while driving was a relatively rare occurrence, but this does not appear to be the case. In our study, participants on average reported incidents of driving anger on slightly more than a daily basis. Furthermore, becoming angry was almost always accompanied by some type of behavioral response, which varied from less aggressive verbal responses to potentially dangerous actions such as tailgating and refusing lane access to other drivers. In addition to results described herein, a number of interesting observations were made

in perusing open-ended descriptions of driving anger events that may provide avenues for future research on driving anger and aggression. First, the vast majority of aggressive responses reported were moderate in comparison to the extreme incidents often reported in the media, but even in our relatively small sample, we observed a report of an individual admitting to slashing tires in anger over a stolen parking spot. Our observations also revealed that anger and aggression are probably reciprocal and fundamentally interpersonal in nature. For example, one respondent reported becoming angry because a "guy honked at me, at the light, because I didn't dart off when it turned green," whereas another individual became angry because a "person didn't start up when the light was green" and responded by honking. In addition, numerous reports of anger were associated with drivers "forcing themselves in," whereas other reports concerned other drivers "not letting me in."

Implications and Future Directions

Our own findings suggest a number of possible intervention strategies for reducing driving anger and associated aggression as well as possible directions for future research. First, we found that less-self-determined individuals may be particularly prone to experience driving anger, which suggests a possible screening criteria for identifying individuals who are at higher risk for experiencing road rage. Second, there are obvious practical suggestions for preventing driving anger (e.g., allow extra travel time to avoid time urgency, avoid driving while under stress, drive nonreactively by viewing the driving experience objectively rather than a contest against opponents, resisting the urge to "get even"). Listening to music also might alleviate driving anger and aggression, especially under high-stress conditions (Wiesenthal et al., 2000). This strategy might be particularly effective among individuals who chronically experience stress and pressure. In addition, the finding that perceiving events as directed at the self was associated with higher levels of anger suggests that incorporating attribution processes may account for additional variance. Specifically, it would be useful to determine whether attributional dimensions such as perceived controllability and intentionality mediate the anger experienced in response to other drivers' behaviors, as in other conflict situations (Betancourt & Blair, 1992; Weiner, 1985).

APPENDIX

Date: _____ Time event occurred: _____ am pm Time record was completed: _____ am pm Code: _____

WHAT MADE YOU ANGRY?

1. Briefly describe what caused you to become angry (write on back if necessary).

2. Specifically what was it that made you angry? (circle all that apply)

another driver was driving dangerously another driver was discourteous police presence

slow traffic due to roadwork slow traffic due to obstruction or wreck slow traffic due to volume/traffic jam

someone was honking other (describe): _____

3. To what extent did you perceive the action that caused you to become angry as being directed at you personally?

not at all 1 2 3 4 5 6 7 very much

4. How angry did you become?

not very angry at all 1 2 3 4 5 6 7 extremely angry

5. Approximately how long did your anger last? (Circle your best estimate)

less than 2 minutes 2-5 minutes 5-10 minutes

10-15 minutes 15-30 minutes 30 minutes to 1 hour

1 to 3 hours most of the day longer

HOW WERE YOU FEELING BEFORE THE INCIDENT THAT CAUSED YOU TO BECOME ANGRY?

6. To what extent were you in a rush before you became angry?

not at all in a rush 1 2 3 4 5 6 7 I was in a big rush

7. To what extent were you in danger of being late for something at the point when you became angry?

I was in no danger of being late 1 2 3 4 5 6 7 I was certain to be late

8. To what extent were you feeling stress before the incident occurred that caused you to become angry?

no stress 1 2 3 4 5 6 7 extreme stress

9. To what extent were you feeling pressure before the incident occurred that caused you to become angry?

no pressure 1 2 3 4 5 6 7 extreme pressure

HOW DID YOUR ANGER AFFECT YOUR DRIVING?

10. To what extent did you drive more carefully while you were angry?

not at all carefully 1 2 3 4 5 6 7 much more carefully

11. To what extent did you drive more aggressively while you were angry?

not at all aggressive 1 2 3 4 5 6 7 much more aggressively

HOW DID YOU RESPOND TO THE EVENT THAT CAUSED YOU TO BECOME ANGRY?

12. What specific responses did you engage in? (circle all that apply)

made gesture(s) yelling honking name calling

muttered comments taigated sped up slowed down

refused lane access to other driver tapped or hit brakes flashed lights no action at all

other (describe) _____

13. How aggressive would you rate your response?

not aggressive at all 1 2 3 4 5 6 7 extremely aggressive

14. How passive would you rate your response?

not passive at all 1 2 3 4 5 6 7 extremely passive

HOW DID YOUR RESPONSE TO THE SITUATION MAKE YOU FEEL?

15. To what extent did your response make you feel like you "got even" with another driver?

not at all 1 2 3 4 5 6 7 very much

16. To what extent did you feel good about your response?

not at all 1 2 3 4 5 6 7 very much

17. To what extent did you feel bad about your response?

not at all 1 2 3 4 5 6 7 very much

18. To what extent did you feel guilty about the response you made?

not at all 1 2 3 4 5 6 7 very much

NOTE

1. Although originally termed "control orientation" (Deci & Ryan, 1985a), we have chosen the term "controlled orientation" in an effort to help reduce confusion of this orientation with the numerous other "control" constructs (see Skinner, 1996, for a review of this issue).

REFERENCES

- American Automobile Association. (1997). *Aggressive driving: Three studies*. Washington, DC: American Automobile Association Foundation for Traffic Safety.
- Arbuckle, J. L., & Wothke, W. (1999). *Amos 4.0 user's guide*. Chicago: SPSS, Inc.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173-1182.
- Baumeister, R. F., Bushman, B. J., & Campbell, W. K. (2000). Self-esteem, narcissism, and aggression: Does violence result from low self-esteem or from threatened egotism. *Current Directions in Psychological Science, 9*, 26-29.
- Berkowitz, L. (1993). *Aggression: Its causes, consequences, and control*. New York: McGraw-Hill.
- Betancourt, H., & Blair, I. (1992). A cognition (attribution)-emotion model of violence in conflict situations. *Personality and Social Psychology Bulletin, 18*(3), 343-350.
- Blais, M. R., Sabourin, S., Boucher, C., & Vallerand, R. J. (1990). Toward a motivational model of couple happiness. *Journal of Personality and Social Psychology, 59*, 1021-1031.
- Caprara, G. V., Perugini, M., & Barbaranelli, C. (1994). Studies of individual differences in aggression. In M. Potegal (Ed.), *The dynamics of aggression: Biological and social processes in dyads and groups* (pp. 123-153). Hillsdale, NJ: Lawrence Erlbaum.
- Deci, E. L., Connell, J. P., & Ryan, R. M. (1989). Self-determination in a work organization. *Journal of Applied Psychology, 74*, 580-590.
- Deci, E. L., & Ryan, R. M. (1985a). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality, 19*, 109-134.
- Deci, E. L., & Ryan, R. M. (1985b). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.
- Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology, 53*, 1024-1037.
- Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R. Dienstbar (Ed.), *Nebraska symposium on motivation* (Vol. 38, pp. 237-288). Lincoln: University of Nebraska Press.
- Deffenbacher, J. L., Huff, M. E., Lynch, R. S., Oetting, E. R., & Salvatore, N. F. (2000). Characteristics and treatment of high-anger drivers. *Journal of Counseling Psychology, 47*, 5-17.
- Deffenbacher, J. L., Oetting, E. R., & Lynch, R. S. (1994). Development of a driving anger scale. *Psychological Reports, 74*, 83-91.
- Dollard, J., Doob, L. W., Miller, N. P., Mowrer, O. H., & Sears, R. R. (1939). *Frustration and aggression*. New Haven, CT: Yale University Press.
- Donovan, D. M., & Marlatt, G. A. (1982). Personality subtypes among DWI offenders: Relationship to drinking behavior and driving risk. *Journal of Consulting and Clinical Psychology, 50*, 241-249.
- Donovan, D. M., Umlauf, R. L., & Salzberg, P. M. (1988). Derivation of personality subtypes among high-risk drivers. *Alcohol, Drugs, and Driving, 4*(3-4), 233-244.
- Ellison, P. A., Govern, J. M., Petri, H. L., & Figler, M. H. (1995). Anonymity and aggressive driving behavior: A field study. *Journal of Social Behavior and Personality, 10*, 265-272.
- Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review, 87*, 215-251.
- Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis: Verbal reports as data* (Rev. ed.). Cambridge, MA: MIT Press.
- Grolnick, W. S., & Ryan, R. M. (1987). Autonomy in children's learning: An experimental and individual difference investigation. *Journal of Personality and Social Psychology, 52*, 890-898.
- Hennessy, D. A., & Wiesensthal, D. L. (1997). The relationship between traffic congestion, driver stress and direct versus indirect coping behaviors. *Ergonomics, 40*, 348-361.
- Hennessy, D. A., & Wiesensthal, D. L. (1999). Traffic congestion, driver stress, and driver aggression. *Aggressive Behavior, 25*, 409-423.
- Hodgins, H. S., & Knee, C. R. (in press). The integrating self and conscious experience. In E. L. Deci & R. M. Ryan (Eds.), *The motivation and self-determination of behavior: Theoretical and applied issues*. Rochester, NY: University of Rochester Press.
- Hodgins, H. S., Koestner, R., & Duncan, N. (1996). On the compatibility of autonomy and relatedness. *Personality and Social Psychology Bulletin, 22*, 227-237.
- Hodgins, H. S., Liebeskind, E., & Schwartz, W. (1996). Getting out of hot water: Facework in social predicaments. *Journal of Personality and Social Psychology, 71*, 300-314.
- Ilardi, B. C., Leone, D., Kasser, R., & Ryan, R. M. (1993). Employee and supervisor ratings of motivation: Main effects and discrepancies associated with job satisfaction and adjustment in a factory setting. *Journal of Applied Social Psychology, 23*, 1789-1805.
- Kenny, D. A., Kashy, D. A., & Bolger, N. (1998). Data analysis in social psychology. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (Vol. 2, 4th ed., pp. 233-265). Boston: McGraw-Hill.
- Kenrick, D. T., & MacFarlane, S. W. (1986). Ambient temperature and horn honking: A field study of the heat/aggression relationship. *Environment and Behavior, 18*, 179-181.
- Knee, C. R., & Neighbors, C. (in press). Feeling controlled, perception of peer pressure, and drinking among college students. *Journal of Applied Social Psychology*.
- Knee, C. R., Neighbors, C., & Vietor, N. A. (2001). Self-determination theory as a framework for understanding road rage. *Journal of Applied Social Psychology, 31*, 889-904.
- Knee, C. R., Patrick, H., Vietor, N. A., Nanayakkara, A., & Neighbors, C. (2000). *Self-determination as growth motivation in romantic relationships*. Manuscript submitted for publication.
- Knee, C. R., & Zuckerman, M. (1996). Causality orientations and the disappearance of the self-serving bias. *Journal of Research in Personality, 30*, 76-87.
- Knee, C. R., & Zuckerman, M. (1998). A nondefensive personality: Autonomy and control as moderators of defensive coping and self-handicapping. *Journal of Research in Personality, 32*, 115-130.
- Novaco, R. M., Stokols, D., Campbell, J., & Stokols, J. (1979). Transportation, stress, and community psychology. *American Journal of Community Psychology, 7*(4), 361-380.
- Rathbone, D. B., & Huckabee, J. C. (1999). *Controlling road rage: A literature review and pilot study*. Washington, DC: American Automobile Association Foundation for Traffic Safety.
- Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology, 43*, 450-461.
- Ryan, R. M. (1989). *The revised general causality orientation scale*. Unpublished manuscript, University of Rochester.
- Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology, 57*, 749-761.
- Ryan, R. M., Mims, V., & Koestner, R. (1983). Relations of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. *Journal of Personality and Social Psychology, 45*, 736-750.
- Ryan, R. M., Plant, R. W., & O'Malley, S. (1995). Initial motivations for alcohol treatment: Relations with patient characteristics, treatment involvement, and dropout. *Addictive Behaviors, 20*(3), 279-297.
- Schaeffer, M. H., Street, S. W., Singer, J. E., & Baum, A. (1988). Effects of control on the stress reactions of commuters. *Journal of Applied Social Psychology, 18*, 944-957.
- Selzer, M. L., & Vinokur, A. (1974). Life events, subjective stress, and traffic accidents. *American Journal of Psychiatry, 131*(8), 903-906.
- Shinar, D. (1998). Aggressive driving: The contribution of the drivers and the situation. *Transportation Research Part F, 1F*(2), 137-160.

- Skinner, E. A. (1996). A guide to constructs of control. *Journal of Personality and Social Psychology Bulletin*, *71*, 549-570.
- Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological methodology 1982* (pp. 290-312). Washington, DC: American Sociological Association.
- Stokols, D., Novaco, R. W., Stokols, J., & Campbell, J. (1978). Traffic congestion, Type A behavior, and stress. *Journal of Applied Psychology*, *63*, 467-480.
- Tedeschi, J. T., & Felson, R. B. (1994). *Violence, aggression, and coercive actions*. Washington, DC: American Psychological Association.
- Turner, C. W., Layton, J. F., & Simons, L. S. (1976). Naturalistic studies of aggressive behavior: Aggressive stimuli, victim visibility, and horn honking. *Journal of Personality and Social Psychology*, *31*, 1098-1107.
- Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 29, pp. 271-360). New York: Academic Press.
- Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, *92*(4), 548-573.
- Wiesenthal, D. L., Hennessy, D. A., & Totten, B. (2000). The influence of music on driver stress. *Journal of Applied Social Psychology*, *30*(8), 1709-1719.
- Williams, G. C., & Deci, E. L. (1996). Internalization of biopsychosocial values by medical students: A test of self-determination theory. *Journal of Personality and Social Psychology*, *70*, 767-779.
- Williams, G. C., & Deci, E. L. (1998). The importance of supporting autonomy in medical education. *Annals of Internal Medicine*, *129*, 303-308.
- Williams, G. C., Grow, V. M., Freedman, Z., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight-loss and weight loss maintenance. *Journal of Personality and Social Psychology*, *70*, 115-126.
- Williams, G. C., Rodin, G. C., Ryan, R. M., Grolnick, W. S., & Deci, E. L. (1998). Autonomous regulation and long-term medication adherence in adult outpatients. *Health Psychology*, *17*, 269-276.

Received September 6, 2000

Revision accepted April 16, 2001