Title:

Validation of the Australian Propensity for Angry Driving Scale (Aus-PADS)

Authors:

Nerida L. Leal & Nancy A. Pachana

Correspondence:

Nerida L. Leal
Centre for Accident Research and Road Safety – Queensland (CARRS-Q),
Queensland University of Technology,
130 Victoria Park Road
Kelvin Grove QLD 4059 Australia

Abstract:

The present study used a university sample to assess the test-retest reliability and validity of the Australian Propensity for Angry Driving Scale (Aus-PADS). The scale has stability over time, and convergent validity was established, as Aus-PADS scores correlated significantly with established anger and impulsivity measures. Discriminant validity was also established, as Aus-PADS scores did not correlate with venturesomeness scores. The Aus-PADS has demonstrated criterion validity, as scores were correlated with behavioural measures, such as yelling at other drivers, gesturing at other drivers, and feeling angry but not doing anything. Aus-PADS scores reliably predicted the frequency of these behaviours over and above other study variables. No significant relationship between aggressive driving and crash involvement was observed. It was concluded that the Aus-PADS is a reliable and valid tool appropriate for use in Australian research, and that the potential relationship between aggressive driving and crash involvement warrants further investigation with a more representative (and diverse) driver sample.

Keywords:

road rage; angry driving; aggressive driving; survey; questionnaire; Australia.

1. Introduction

Some research has suggested that aggressive driving may affect concentration (Deffenbacher, Lynch, Oetting, & Yingling, 2001), which has important implications for road safety professionals and the general community. However, the relationship between aggressive driving and road traffic crashes is controversial (Jonah, 1997). While some studies have found no difference in crashes between high and low anger drivers (e.g., Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000; Deffenbacher et al., 2001), others have found that motorists high in aggression are prone to have more crashes (e.g., Lowenstein, 1997; Parry, 1968; Wells-Parker et al., 2002). While it is unclear whether aggressive driving increases the frequency of crashes, any such risk is a concern and worthy of further consideration.

In order to explore the relationship between aggressive driving and crash involvement, an appropriate measure of aggressive driving must be identified. In the general aggressive driving literature, a variety of measures have been used, including self-reported aggressive driving (Hennessy & Wiesenthal, 1997, 1999; Perry & Baldwin, 2000; Stokols, Novaco, Stokols, & Campbell, 1978; Wilson & Jonah, 1988), or even behavioural measures such as horn-honking frequency (Kenrick & MacFarlane, 1986; Shinar, 1998). The Driving Behavior Inventory (Gulian, Debney, Glendon, Davies, & Matthews, 1989) and Driving Anger Scale (Deffenbacher, Oetting, & Lynch, 1994) are more objective measures available for use in aggressive driving research, however these scales assess driver experience of stress or anger, rather than what drivers may do in given situations. As driving anger may not be congruent with aggressive behavioural response (Lajunen & Parker, 2001), the use of an objective measure that captures both situational driving anger and aggressive behavioural

response would better facilitate an analysis of the relationship between aggressive driving and crash involvement.

The Propensity for Angry Driving Scale (PADS) (DePasquale, Geller, Clarke, & Littleton, 2001) is a 19-item, single-factor scale that assesses how drivers would respond in a number of potentially aggression-invoking driving situations, from a list of four fixed responses. The scoring technique was devised by a pilot study ($N = 51$) where the severity of each of the four responses to each item was rated from 1 (*very mild*) to 7 (*very severe*). The mean ratings in this study are used as the scores for selecting that option, and higher scores reflect higher severity. Thus the PADS tells not only what the respondent would *do* in the given situation, but also gives an indication of the comparative degree of *anger experienced.* The reliability and validity of the scale was established at development (DePasquale et al., 2001), and in further studies (Dahlen & Ragan, 2004), even when slight changes were made to the scale for use in the United Kingdom (Maxwell, Grant, & Lipkin, 2005).

As the PADS is an American scale, and the scoring technique was based on a pilot study with an American driver sample, it was argued that the scale would require changes before being used in Australian research (Leal & Pachana, 2008), similar to those made in a study that used the scale with a sample of British drivers (Maxwell et al., 2005). An adapted form of the original scale was completed by 439 Australian drivers. Factor analysis using Principal Axis Factoring was performed, resulting in a 15-item scale (the Australian Propensity for Angry Driving Scale [Aus-PADS]) with a Cronbach's alpha of .824 ($N = 433$) (see Leal & Pachana, 2008 for a complete description of the adaptation process).

The overall purpose of the present study was to determine whether the Aus-PADS (Leal & Pachana, 2008), like the original scale, is a reliable and valid measure, and to use Aus-PADS scores to explore the relationship between aggressive driving and crash involvement within an Australian sample.

It was expected that Aus-PADS scores would be stable over time, demonstrated through adequate test retest reliability. As the correlation between original scale scores administered one month apart was .91 (DePasquale et al., 2001), a similar correlation between Aus-PADS scores was expected in this study.

It was also expected that the Aus-PADS would be validated via demonstrations of construct and criterion validity, as the validity of the original scale was established by the authors (DePasquale et al., 2001) and other researchers who used the scale in different settings (Dahlen & Ragan, 2004; Maxwell et al., 2005).

Construct validity is established by demonstrating both convergent and discriminant validity (Murphy & Davidshofer, 2001). If aggressive driving is general aggression specific to the driving context, then Aus-PADS scores should correlate with other situational anger measures. In this study, convergent validity was tested by correlating Aus-PADS scores with score on the Novaco Anger Inventory (Short Form), which also assesses situational anger. Further, given the relationship between anger and impulsivity (Ramirez & Andreu, 2006), Aus-PADS scores should also correlate with scores on the Impulsivity subscale of Eysenck's I_7 Impulsivity Questionnaire, as was the case with the original scale (DePasquale et al., 2001). The second aspect of construct validity, discriminant validity, is demonstrated by non-significant correlations between scale scores that measure unrelated constructs (Murphy & Davidshofer, 2001). As the original scale was shown to be unrelated to scores on the Venturesomeness subscale of Eysenck's I_7 Impulsivity Questionnaire (DePasquale et al., 2001), no relationship was expected between Aus-PADS scores and Venturesomeness scores in this study. Criterion validity relates to real world examples of the behaviour or construct a scale purports to measure (Murphy & Davidshofer, 2001). In this case, if the Aus-PADS has adequate criterion validity, then scores on the scale should correlate with behavioural measures of aggressive driving. Thus it was expected that similar to the original scale

(DePasquale et al., 2001), Aus-PADS scores would be associated with self-reported frequency of angry or hostile behaviours performed while driving. An additional measure of criterion validity unique to this study was the experience of anger arousal, as aggression may not always be expressed overtly (Dollard et al., 1939). This was also expected to be associated with Aus-PADS scores.

Finally, it was expected that a relationship between aggressive driving and crash involvement would be observed using an objective measure of situational driving anger appropriate for use with an Australian driver sample and self-reported crash involvement.

2. Methodology

2.1. Participants

Participants in this study were drawn from a pool of 439 participants (139 male, 289 female, 11 did not specify gender) who held a valid driver's licence and had a minimum of one year unsupervised driving experience from an earlier study (Leal & Pachana, 2008). Of these, 172 (64 males and 108 females) provided additional data. These participants ranged in age from 17 to 48 years (M = 21.52, SD = 5.42), and their driving experience ranged from 1 to 27 years (M = 4.03, SD = 4.66). Participants were undergraduate psychology students at the University of Queensland, Australia. First year students received course credit for their participation, while third year volunteers were offered a small chocolate. The data gathered from the 439 participants in the earlier study (Leal & Pachana, 2008) relating to behavioural measures of aggressive driving and crash involvement was also analysed.

2.2. Measures

2.2.1. Australian Propensity for Angry Driving Scale (Aus-PADS)

The Aus-PADS is 15-item questionnaire, published in full with a scoring key as Appendix A in Leal and Pachana (2008). In line with the original scale (DePasquale et al., 2001), the scoring technique for the Aus-PADS was developed by calculating the mean severity rating as applied by a sample of 33 drivers on a Likert scale from 1 (*very mild*) to 7 (*very severe*). Total scores on the Aus-PADS can range from 26.18 to 86.05, with higher scores indicating a greater propensity for angry driving. The scale has an acceptable Cronbach's alpha of .824 ($N = 433$) (Leal & Pachana, 2008). An example item from the scale is "You are driving on a single lane road. For no apparent reason the car in front of you is constantly braking and accelerating, causing you to drive in the same manner. How do you respond?" Response options for this item are: (a) Honk your horn and loudly curse at the driver (scores 4.58 points); (b) Slow down a little and keep a safe distance (scores 1.58 points); (c) Deliberately tailgate the car and occasionally lay on the horn (scores 5.48 points); and (d) Curse to yourself but continue at the pace set by the other driver (scores 2.21 points).

2.2.2. Validity measures

The Novaco Anger Inventory (Short Form) (Novaco, 1975) is a 25-item scale with a reported reliability (Cronbach's alpha) of .92 ($N = 58$), and demonstrated construct validity (Huss, Leak, & Davis, 1993). The scale requires respondents to imagine that the 25 everyday situations are actually happening to them, before indicating the degree to which they would feel angry or annoyed on a five-point scale from 1 (*very little*) to 5 (*very much*). An example item from the scale is "While you are struggling to carry four cups of coffee to your table at a

cafeteria, someone bumps into you, spilling the coffee". No items on the scale are reverse-scored. Item scores are summed to give a total score.

The Eysenck I_7 Impulsiveness Questionnaire (Eysenck, Pearson, Easting, & Allsopp, 1985) is a 54-item inventory with three subscales: Impulsiveness, Venturesomeness, and Empathy. The reported reliabilities (Cronbach's alphas) of the scales are .84, .85, and .69 respectively (N = 1 320) (Eysenck et al., 1985). Participants in Study 2 were only required to complete the Impulsiveness (19 items) and Venturesomeness (16 items) subscales, answering by circling "yes" or "no" after each question. An example item from the Impulsiveness subscale is "Do you generally do and say things without stopping to think?", while an example from the Venturesomeness subscale is "Do you welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional?". Participants score one point for each "yes" response, except for the reverse-scored items, where one point is scored for a "no" response. Three Impulsiveness items are reverse-scored, for example "Do you usually think carefully before doing anything?", while five Venturesomeness items are reverse-scored, for example "Usually do you prefer to stick to brands you know are reliable, to trying new ones on the chance of finding something better?". The total Impulsiveness and Venturesomeness scores were calculated by summing item points.

For each of the three self-reported behavioural measures (yelling at other drivers, making obscene gestures at other drivers, and feeling angry but doing nothing), participants estimated the frequency of engaging in these behaviours over the previous month. A time limit was set to facilitate recall, and a more accurate estimate, and these variables were scored continuously. This is in contrast to the measurement of the first two behavioural measures of the original scale, where no time limit was set, and interval scoring was used (DePasquale et al., 2001).

2.2.3. Crash involvement

Crash involvement was measured by three questions. First, participants were asked whether they had been involved in a crash as a driver. Those who answered "yes" were then asked to indicate the number of crashes they had been involved in, and the number of these in which they were at fault.

2.3. Procedure

Before the study commenced, the experimenter checked that all participants had participated in the previous study (Leal & Pachana, 2008), which required them to be licensed drivers with a minimum of one year unsupervised driving experience. In this initial study, participants were given the Aus-PADS (Leal & Pachana, 2008) and were asked to select which of the four responses to each item was closest to their likely response should they be presented with that situation. They also completed the crash involvement and criterion validity questions, and noted their age and gender.

One hundred of the participants returned an average of three weeks later to complete the Aus-PADS again, so that their two scores could be correlated to establish the test retest reliability of the scale. Rather than priming participants at Time 1 to completing the same scale for a second time, participants were simply invited to attend a second session to complete "another" scale. This control technique was employed as an attempt to reduce recall or consistency bias.

A total of 126 of the participants completed the additional scales to establish construct validity. These participants were also instructed to circle the number that most closely corresponded to their level of anger to the 25 Novaco situations, and to circle "yes" or "no" in

response to each of the questions from Eysenck's Impulsiveness and Venturesomeness subscales.

Participants checked that they had answered every question and were thanked for their time and participation.

The questionnaires were entered into statistics package SPSS for analysis. Responses to the 15 driving situations (i.e., a, b, c, or d) in the Aus-PADS were transformed into numeric values in the data file as per the Aus-PADS scoring key (Leal & Pachana, 2008). Novaco item scores were summed in the data file to give the total anger score. Impulsiveness and Venturesomeness subscale total scores were also calculated in the data file by summing the item scores.

3. Results

3.1. Reliability

The descriptive statistics of both the first and second administrations of the Aus-PADS are presented in Table 1. One case was deleted due to missing data on the first administration of the scale.

(Table 1 inserted here)

Pearson's *r* is the appropriate correlation coefficient to test the linear relationship between two variables of interval or ratio data that is distributed normally (Field, 2005). Analysis of a scatterplot of Aus-PADS scores at Time 1 and Time 2 revealed a positive linear trend, and descriptive statistics revealed that scores at both administrations were distributed

normally. Pearson's *r* statistic was then calculated, and revealed that there was a very strong significant positive correlation between Aus-PADS scores at Time 1 and Time 2, $r(96) = .953$, $p < .001$. That is, the test-retest reliability of the Aus-PADS was demonstrated, as there was very little change in scores across the two testing sessions.

3.2. Validity

Table 2 outlines descriptive statistics and the obtained Cronbach's alphas for each of the scales used to assess the validity of the Aus-PADS. The alphas obtained in the present study are comparable to reported values (Eysenck et al., 1985; Novaco, 1975), indicating that the measures were appropriate for use with the present sample.

(Table 2 inserted here)

The validity scale data met the assumptions of Pearson's *r*. However, as the criterion validity data was positively skewed, the relationship between Aus-PADS scores and these variables was tested with Spearman's rho (ρ), a non-parametric equivalent of Pearson's *r* that assesses the strength of relationship between skewed data sets by converting scores into ranks (Field, 2005). Table 3 reports the zero-order correlations among all of the variables. These analyses revealed that there were small but significant correlations between Aus-PADS scores and scores on both of the convergent validity measures, the discriminant validity measure, and each of the behavioural measures of aggressive driving (yelling, gesturing, and feeling angry but doing nothing).

(Table 3 inserted here)

As the data met all statistical assumptions, three sequential regression analyses were then conducted to determine whether the Aus-PADS could significantly predict the frequency of each of the criterion validity measures over and above demographic and other study variables. Age and gender (female = 1, male = 2) were entered at Step 1, Novaco Anger Inventory scores, Impulsivity scores and Venturesomeness scores were entered at Step 2, and Aus-PADS scores were entered at Step 3 in each analysis. Although none of the variables entered at Step 2 were significantly associated with the criterion measures, all study variables were included in the regression analyses as they were significantly related to Aus-PADS scores, giving conservative estimates of R^2 change. The results of these analyses are presented in Table 4, and show that in each of these analyses, the Aus-PADS was the only significant predictor of these behaviours, predicting an additional 6.2, 9.1 and 12.1 percent of variance respectively.

(Table 4 inserted here)

3.3. Crash involvement

The appropriate statistic to compare means drawn from two independent samples is the *t* test, assuming the data is normally distributed and the samples are drawn from populations with equal variances (Aron, Aron, & Coups, 2009). While the within group variance of crash-involved and non crash-involved drivers was similar (p = .81), skewness

and kurtosis statistics revealed that the distribution of Aus-PADS scores within each group was slightly positively skewed. However, as the homogeneity of variance assumption was met, and the *t* test is robust to slight breaches of the normality assumption when the skew is similar (Aron et al., 2009), a *t* test was performed as planned. It was found that there was no difference in Aus-PADS scores between participants who had (n = 237, M = 39.19, SD = 8.97) or had not (n = 191, M = 39.76, SD = 8.73) been involved in a crash, $t(420) = 0.66$, p = .509.

Table 5 reports descriptive statistics for crash-involved respondents. When crash-involved participants reported the number of crashes they had been involved in, this data was found to be heavily positively skewed, as most drivers (n = 131) reported being involved in only one crash. Thus the data was analysed using Spearman's rho. This correlation was not significant, $\rho(234) = .09$, p = .189.

As the number of crashes in which crash-involved respondents reported being at fault was also heavily positively skewed, the relationship between Aus-PADS scores and the number of crashes in which the respondent was at fault was analysed using Spearman's rho. The relationship approached significance, $\rho(234) = .123$, p = .059.

4. Discussion

The purpose of this study was to establish the reliability and validity of the Aus-PADS (Leal & Pachana, 2008), and to explore the relationship between aggressive driving (as measured by the Aus-PADS) and crash involvement.

The strong positive correlation between Aus-PADS scores at Time 1 and Time 2 is comparable to the reported test-retest reliability of the PADS, where $r(38) = .91$ (DePasquale

et al., 2001). However, when such a large correlation is obtained, the possibility of an order effect must be considered. Recall bias was controlled by not priming them to completing the same scale. While none of the participants commented on completing the same scale, a formal check was not conducted. Future research could confirm the reliability of this scale by testing participants over a longer time period.

The constructive validity of the original scale has been established with a variety of general anger and driving anger scales (Dahlen & Ragan, 2004; DePasquale et al., 2001; Maxwell et al., 2005). In this study, the convergent validity of the Aus-PADS was demonstrated, as scale scores were significantly associated with Novaco Anger Inventory scores (Novaco, 1975) and Impulsiveness scores (Eysenck et al., 1985). The correlation with Novaco scores was expected, as both the Novaco and the Aus-PADS ask respondents to imagine themselves in the given situations, thus stressing the importance of the context in understanding driving anger. The correlation with Impulsiveness scores was also expected, as it is consistent with the findings of the PADS study (DePasquale et al., 2001).

The correlation between Aus-PADS and Venturesomeness scores (Eysenck et al., 1985) was not expected, as no such relationship was revealed in the original PADS study, however there were gender effects for both variables. Males scored significantly higher than females on the Venturesomeness scale ($t(123) = -4.47$, $p < .001$) and the Aus-PADS ($t(420) = -3.51$, $p < .001$). Thus a partial correlation analysis was conducted to determine whether gender was a mediating variable. This analysis revealed that after controlling for gender, the relationship was no longer significant, consistent with predictions and previous research, $r(123) = .14$, $p = .119$[1]. Thus the construct validity of the scale was confirmed.

Importantly for road safety researchers, the criterion validity of the Aus-PADS was also established in this study, as Aus-PADS scores were significantly associated with self-

[1] As a precaution, post hoc partial correlation analyses controlling for gender were then performed for all variables, but this did not affect any other results, as gender effects were not observed for any other variables.

reported frequency of yelling at other drivers, gesturing at other drivers, and feeling angry but doing nothing in the previous month. Further, Aus-PADS scores predicted small but significant variability in each of these behaviours over and above demographic and other study variables. This suggests that the Aus-PADS is an appropriate measure for use in aggressive driving research in Australia.

However, although the correlations between Aus-PADS scores and the first two criterion measures were significant, they were considerably smaller than those found by DePasquale and colleagues (2001) (.52 and .60). This is surprising given the larger sample used in the present study, as this should result in greater power to detect a significant relationship. Different scoring techniques were used, as the present study scored the behavioural measures continuously, whereas the PADS study used an ordinal scale. However, recoding the data from this study into the same scale as the PADS study did not affect the correlation coefficients. Thus the difference may be due to the time limit of one month imposed in the present study, while no limit was set for the PADS study (DePasquale et al., 2001). Finally, the utility of the third measure of criterion validity was established, as this was the most frequently reported in the sample.

Contrary to previous literature that has suggested aggressive driving is associated with crash-involvement (e.g., Lowenstein, 1997; Parry, 1968; Wells-Parker et al., 2002), this relationship was not supported in the present study, however the relationship between Aus-PADS scores and the number of crashes in which participants reported being at fault approached significance. As it is intuitively plausible that aggressive driving may lead to lapses in concentration, which may in turn lead to increasing the possibility of crash involvement, it is possible that there is a relationship that was not able to be observed in this study due to low variability in the data. That is, more than half of the crash-involved respondents had only been involved in one crash (55%). There was similarly low variability

in the number of crashes in which crash-involved respondents reported being at fault, with 56.9% reporting being at fault, and 76.5% of these drivers had only been involved in one crash.

As crashes are relatively rare events, large samples of drivers with varied crash involvement histories are required to accurately measure the relationship between aggressive driving and crashes among the driving population. Although this study is consistent with a number of previous studies that have found no relationship (e.g., Deffenbacher et al., 2000; Deffenbacher et al., 2001), due to the serious and negative nature of this potential consequence of aggressive driving, further research on the relationship with a sample with adequate variability and power is warranted. A sample of drivers with more driving experience (who therefore have had more opportunity to become involved in a crash) should have more variability than that used in this study.

It may also be of interest to assess different types of crashes (e.g., injury crashes and those involving property damage only) and also near misses, in addition to the relationship between aggressive driving and traffic violations. An interesting avenue for future research is to explore whether it is the behaviour or the driver that is most important in the aggressive driving – crash involvement relationship. That is, is it aggressive driving that is related to crash involvement (e.g., as a result in lapses in concentration), or are drivers likely to become involved in crashes also more likely to drive aggressively? Or a combination of both factors?

Finally, as age and gender have been shown to be related to aggression generally, aggressive driving, crash involvement, and traffic infringements, the use of a representative sample of drivers and inclusion of these characteristics as variables in research exploring the relationship between aggressive driving and crash involvement is important.

5. Conclusions

This study has shown that the Aus-PADS (Leal & Pachana, 2008) is a reliable and valid tool appropriate for use in Australian aggressive driving research. However, using a sample of drivers with a broader range of ages in future research will better allow researchers to explore the relationship between aggressive driving and crash involvement, as drawing participants from a university population resulted in a sample that over-represented both women and young people. Thus the sample used in this study was not representative of Queensland, or Australian drivers. While this is unlikely to affect estimates of the correlations between Aus-PADS scores and scores on other variables, findings should be replicated using a more representative sample of drivers. However, as the psychometric properties of adaptations of the scale have been demonstrated in the United States, the United Kingdom and Australia, perhaps the focus should now shift to the use of the appropriate form of the scale in larger research projects. These studies should investigate the role of aggressive driving in crashes and other traffic incidents to inform interventions that can target this problem and improve road safety.

Acknowledgements

The authors wish to thank Judy Fleiter and Angela Nielson for their thoughtful comments on earlier drafts.

References

Aron, A., Aron, E. N., & Coups, E. J. (2009). *Statistics for Psychology*. Upper Saddle River, N.J.: Pearson Education.

Dahlen, E. R., & Ragan, K. M. (2004). Validation of the Propensity for Angry Driving Scale. *Journal of Safety Research, 35*(5), 557-563.

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*(1), 5-17.

Deffenbacher, J. L., Lynch, R. S., Oetting, E. R., & Yingling, D. A. (2001). Driving anger: Correlates and a test of state-trait theory. *Personality and Individual Differences, 31*(8), 1321-1331.

Deffenbacher, J. L., Oetting, E. R., & Lynch, R. S. (1994). Development of a driving anger scale. *Psychological Reports, 74*(1), 83-91.

DePasquale, J. P., Geller, E. S., Clarke, S. W., & Littleton, L. C. (2001). Measuring road rage - Development of the propensity for angry driving scale. *Journal of Safety Research, 32*(1), 1-16.

Dollard, J., Doob, L. W., Miller, N. E., Mowrer, O. H., Sears, R. R., Ford, C. S., et al. (1939). *Frustration and aggression.* Oxford: Yale Univ. Press.

Eysenck, S. B., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. *Personality and Individual Differences, 6*(5), 613-619.

Field, A. (2005). *Discovering statistics using SPSS* (2nd ed.). London: SAGE Publications.

Gulian, E., Debney, L. M., Glendon, A. I., Davies, D. R., & Matthews, G. (1989). Coping with driver stress. In F. J. McGuigan, W. E. Sime & J. M. Wallace (Eds.), *Stress and tension control 3: Stress management.* (pp. 173-186). New York: Plenum Press.

Hennessy, D. A., & Wiesenthal, D. L. (1997). The relationship between traffic congestion, driver stress and direct versus indirect coping behaviours. *Ergonomics, 40*(3), 348-361.

Hennessy, D. A., & Wiesenthal, D. L. (1999). Traffic congestion, driver stress, and driver aggression. *Aggressive Behavior, 25*(6), 409-423.

Huss, M. T., Leak, G. K., & Davis, S. F. (1993). A validation study of the Novaco Anger Inventory. *Bulletin of the Psychonomic Society, 31*(4), 279-281.

Jonah, B. A. (1997). Sensation seeking and risky driving: A review and synthesis of the literature. *Accident Analysis & Prevention, 29*(5), 651-665.

Kenrick, D. T., & MacFarlane, S. W. (1986). Ambient temperature and horn honking: A field study of the heat/aggression relationship. *Environment and Behavior, 18*(2), 179-191.

Lajunen, T., & Parker, D. (2001). Are aggressive people aggressive drivers? A study of the relationship between self-reported general aggressiveness, driver anger and aggressive driving. *Accident Analysis & Prevention, 33*(2), 243-255.

Leal, N. L., & Pachana, N. A. (2008). Adapting the Propensity for Angry Driving Scale for use in Australian research. *Accident Analysis & Prevention, 40*, 2008-2014.

Lowenstein, L. F. (1997). Research into causes and manifestations of aggression in car driving. *Police Journal, 70*(3), 263-270.

Maxwell, J. P., Grant, S., & Lipkin, S. (2005). Further validation of the propensity for angry driving scale in British drivers. *Personality and Individual Differences, 38*(1), 213-224.

Murphy, K. R., & Davidshofer, C. O. (2001). *Psychological testing: Principles and applications* (5th ed.). Upper Saddle River, N.J.: Prentice-Hall.

Novaco, R. W. (1975). *Anger control: The development and evaluation of an experimental treatment.* Oxford: Lexington.

Parry, M. H. (1968). *Aggression on the road: A pilot study of behaviour in the driving situation*. London: Tavistock Publications.

Perry, A. R., & Baldwin, D. A. (2000). Further evidence of associations of type A personality scores and driving-related attitudes and behaviors. *Perceptual and Motor Skills, 91*(1), 147-154.

Ramirez, J. M., & Andreu, J. M. (2006). Aggression, and some related psychological constructs (anger, hostility, and impulsivity): Some comments from a research project. *Neuroscience and Biobehavioral Reviews, 30*, 276-291.

Shinar, D. (1998). Aggressive driving: The contribution of the drivers and the situation. *Transportation Research Part F: Traffic Psychology and Behaviour, 1*(2), 137-159.

Stokols, D., Novaco, R. W., Stokols, J., & Campbell, J. (1978). Traffic congestion, Type A behavior, and stress. *Journal of Applied Psychology, 63*(4), 467-480.

Wells-Parker, E., Ceminsky, J., Hallberg, V., Snow, R. W., Dunaway, G., Guiling, S., et al. (2002). An exploratory study of the relationship between road rage and crash experience in a representative sample of US drivers. *Accident Analysis & Prevention, 34*(3), 271-278.

Wilson, R. J., & Jonah, B. A. (1988). The application of Problem Behavior Theory to the understanding of risky driving. *Alcohol, Drugs & Driving, 4*(3), 173-191.

Table 1

Descriptive statistics for the first and second administrations of the Aus-PADS

					Percentiles		
	A	*N*	Mean	*SD*	25th	75th	Range
Time 1	.85	98	40.01	9.86	32.46	44.77	27.03 – 72.88
Time 2	.87	99	39.01	10.03	30.75	45.61	26.18 – 68.45

Table 2

Descriptive statistics for convergent, discriminant and criterion validity measures

	Mean	*SD*	*N*	Obtained α
Novaco Anger	81.47	13.44	126	.89
Impulsiveness	7.73	4.06	126	.79
Venturesomeness	10.83	3.58	126	.81
Yelling at others	3.06	11.82	421	~
Gesturing at others	1.49	5.40	421	~
Feel angry, do nothing	9.33	14.78	421	~

Table 3

Zero-order correlation matrix

Variable	1	2	3	4	5	6	7
1. Age	~						
2. Novaco Anger [a]	-.16	~					
3. Impulsiveness [a]	-.17	.11	~				
4. Venturesomeness [a]	-.05	-.16	.20*	~			
5. Yelling at others [b]	-.13**	.08	.22*	.13	~		
6. Gesturing at others [b]	-.09	.14	.18*	.17	.47***	~	
7. Feel angry, do nothing [b]	-.13**	.04	.11	.00	.38***	.34***	~
8. Aus-PADS	-.25***	.29**	.32***	.23*	.37***	.35***	.19***

* $p < .05$; ** $p < .01$; *** $p < .001$

[a] Correlations with these variables based on $N = 126$

[b] Correlations with these variables based on $N = 421$

Table 4

Prediction of yelling at others, gesturing at others, and feeling angry but doing nothing in the last month using Aus-PADS scores ($N = 126$)

Variable/s	Total R^2	ΔR^2	F change
DV: Frequency of yelling at others			
Age, Gender	.031	.031	1.969
Anger, Impulsiveness, Venturesomeness	.046	.015	0.636
Aus-PADS	.108	.062	8.311**
DV: Frequency of gesturing at others			
Age, Gender	.032	.032	2.011
Anger, Impulsiveness, Venturesomeness	.063	.031	1.344
Aus-PADS	.154	.091	12.726**
DV: Frequency of feeling angry, but doing nothing			
Age, Gender	.011	.011	0.678
Anger, Impulsiveness, Venturesomeness	.036	.025	1.043
Aus-PADS	.158	.121	17.156***

** $p < .01$; *** $p < .001$

Table 5

Descriptive statistics for crash-involved respondents

		Aus-PADS	
	N	Mean	*SD*
Number of crashes			
1	131	38.55	8.59
2	59	39.18	9.32
3	24	40.51	9.33
4	15	41.82	10.15
5	4	40.30	11.20
6	2	37.26	3.08
11	1	47.40	~
Number of crashes at fault			
0	101	38.02	8.22
1	103	39.46	8.93
2	24	41.67	9.84
3	6	41.35	13.97
4	2	46.03	15.49