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The influence of sensitivity to reward and punishment, propensity for sensation seeking, depression and anxiety on the risk behaviour of novice drivers: A path model

Scott-Parker, B¹., Watson, B¹., King, M. J¹., Hyde, M. K².

¹Centre for Accident Research and Road Safety – Queensland, Queensland University of Technology, K Block, 130 Victoria Park Road, Kelvin Grove, Queensland, 4059, Australia.

²School of Psychology and Counselling, Queensland University of Technology, Queensland, Australia, O Block B Wing Victoria Park Road, Kelvin Grove, Queensland, 4059, Australia.

Abstract

Young novice drivers are significantly more likely to be killed or injured in car crashes than older, experienced drivers. Graduated driver licensing (GDL) which allows the novice to gain driving experience under less-risky circumstances has resulted in reduced crash incidence; however the driver's psychological traits are ignored. This paper explores the relationships between gender, age, anxiety, depression, sensitivity to reward and punishment, sensation seeking propensity and risky driving. Participants were 761 young drivers aged 17-24 years ($M = 19.00$, $SD = 1.56$) with a Provisional (intermediate) driver's licence who completed an online survey comprising sociodemographic questions, the Impulsive Sensation Seeking Scale, Kessler's Psychological Distress Scale, the Sensitivity to Punishment and Sensitivity to Reward Questionnaire, and the Behaviour of Young Novice Drivers Scale. Path analysis revealed depression, reward sensitivity and sensation seeking propensity predicted the self-reported risky behaviour of the young novice drivers. Gender was a moderator; and the anxiety level of female drivers also influenced their risky driving. Interventions do not directly consider the role of rewards and sensation seeking, or the young person's mental health. An approach which does

take these variables into account may contribute to improved road safety outcomes for both young and older road users.

Keywords

Sensitivity to Reward, Sensitivity to Punishment, Young Drivers, Impulsive Sensation Seeking, Risky Behaviour, Psychological Distress, Depression, Anxiety

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The young novice driver

Novice drivers in motorised countries are typically adolescents. They have a disproportionately high rate of involvement in road crashes, a phenomenon which remains even in the context of steadily-reducing crash rates for all drivers in recent years. Research undertaken within countries that are members of the OECD has also shown that for each young driver fatally injured in a crash, another 1.3 persons on average are killed as a result of the crash (OECD, 2006). Between 1 July 1998 and 30 June 2008, there were 27 856 young drivers aged 16-24 years involved in a car crash in Queensland, Australia. Seventy percent of the young drivers with an intermediate (Provisional) driver's licence were deemed to be at-fault in these crashes, compared to 58% of drivers with a full (Open) driver's licence. Over half of these crashes resulted in injury or fatality to the young driver, and two thirds of the drivers killed were male even though there are similar numbers of male and female young drivers. Young male novice drivers were also more likely to be at fault than females (Department of Transport and Main Roads, 2010).

A number of characteristics of the young novice driver have been found to place them at higher risk of injury or death from a car crash. These include their still-maturing brain (Steinberg, 2008) and, relatedly, a normatively typical (Bonino, Cattelino, & Ciairino, 2003) propensity for undertaking risky behaviour (Jonah, 1997); an overestimation of skills combined with an underestimation of risks (Weinstein, 1980) and underdeveloped hazard perception skills (Borowsky, Shinar, & Oron-Gilad, 2010); and driving in risky conditions (Hasselberg &

Laflamme, 2009) such as under the influence of drugs and alcohol and whilst not wearing a seatbelt. Young novice drivers are also influenced by the attitudes and behaviours of their parents and their peers (Scott-Parker, Watson, & King, 2009a, b). Specifically, risky driving modelled by parents is likely to be imitated by the young novice (Taubman-Ben-Ari, Mikulincer, & Gillath, 2005) and young drivers report feeling pressured to comply with requests to undertake risky behaviour by their peer passengers (Regan & Mitsopoulos, 2001).

Interventions targeting risky young novice driver behaviour

Numerous interventions targeting risky young novice driver behaviour have been developed and implemented around the world, including media campaigns, driver education and training, in-car technologies, and licensing programs such as graduated driver licensing (GDL). Media campaigns traditionally utilise fear-based approaches (Lewis, Watson, & White, 2009) and have not been found to be effective in changing young novice driver risky behaviour. Driver education and training focusing on vehicle handling skills has been found to be ineffective and at times counterproductive as it appears to make the young novice driver more accepting of driving risks (Hedlund, 2007). In-car technologies such as speed governors appear promising (OECD, 2003); however, the cost of such interventions may be prohibitive for families of young drivers. There is increasing evidence confirming the effectiveness of GDL which acts as a form of exposure control by allowing novices to gain more driving experience over an extended period in lower-risk circumstances. These programs vary widely by jurisdiction; however extended Learner and intermediate periods with greater restrictions such as passenger limits and night driving curfews have been shown to result in the greatest improvements in young novice driver road safety (Williams, Chaudhary, Tefft, & Tison, 2010). Reported non-compliance by young novice drivers (e.g., in New Zealand, Harre, Field, & Kirkwood, 1996) and haphazard

enforcement (Rice, Peek-Asa, & Kraus, 2004), the issuing of warnings instead of punishment for infringement of road rules (Rhodes, Brown, & Edison, 2005), and failure to detect noncompliance (Scott-Parker, Watson, King, & Hyde, under review) weaken such interventions.

Road safety researchers have begun to consider the nature and the breadth of the psychosocial influences, including the individual's personality traits, upon the risky behaviour of the young novice driver in an attempt to better understand how to reduce their involvement in road crashes. Risky driving behaviour has been found to be associated with the individual's propensity for sensation seeking (Jonah, 1997; Scott-Parker et al., 2009a) and their psychological distress as indicated by anxiety and depression (Scott-Parker, Watson, King, & Hyde, in press). Rewards associated with driving including the experience of pleasurable sensations such as excitement (Bonino et al., 2005; Scott-Parker et al., 2009a; Sullman, 2006) and status among peers (Cavallo, Montero, Sangster, & Maunders, 1997; Regan & Mitsopoulos, 2001; Scott-Parker et al., 2009a, b; Scott-Parker, Watson, King, & Hyde, under review), also appear to influence the driving behaviour of the young novice. To the authors' knowledge, research exploring the young driver's personal propensity for sensation seeking within the context of the influence of other psychological traits and states such as sensitivity to punishment, sensitivity to reward and their self-reported psychological distress has not been undertaken. Such research may reveal avenues of intervention targeting the risky behaviour of young novice drivers.

Sensitivity to punishments and rewards and the young novice driver

The role of individual sensitivity to rewards and punishments in risky behaviour has been explored for a range of behaviours. Although the constructs have been operationalised generally as sensitivity to reward (SR) and sensitivity to punishment (SP), they are underpinned by a theory of personality which is essentially neuropsychological and is explained in terms of

systems of behavioural activation and inhibition. The reinforcement sensitivity theory (RST) of personality was proposed by Gray (1970, 1982, cited in Corr, 2008) and incorporated three neuropsychological systems which are fundamental in the nature of an individual's personality. Two of these systems relevant to young novice driver risky behaviour because they help regulate the behaviour of the individual are the behavioural activation system (BAS) and the behavioural inhibition system (BIS). The BIS and BAS are orthogonal to each other (Torrubia, Avila, Molto & Caseras, 2001). The BAS regulates behaviour in rewarding circumstances and is related to trait extraversion, impulsivity and sensation seeking. The BIS regulates behaviour in punishing circumstances and is related to trait neuroticism and anxiety. The BIS and the BAS regulate behaviour through their operation as feedback systems, with the BIS sensitive to be punishments and consequently 'inhibiting' behaviour in aversive circumstances, whilst the BAS was thought to be sensitive to rewards, therefore 'activating' behaviour in rewarding circumstances (see Smillie, Pickering, & Jackson, 2006 for a review). It can be considered that RST, as a neuropsychological theory using the BAS and the BIS (as measured by sensitivity to rewards and punishments respectively) to explain the risky behaviour of young people, is consistent with the evidence for the role of brain maturation in this behaviour (Steinberg, 2008).

A number of tools have been developed in recent years to measure the operation of the BIS and the BAS, mostly via self-report (see Torrubia et al., 2001 for a review). The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) is a self-report questionnaire with two subscales that were designed to explore the operation of the BIS as sensitivity to punishment (SPQ) and the BAS via sensitivity to reward (SRQ). It is a refinement of earlier scales including the Susceptibility to Punishment Scale (Torrubia & Tobena, 1984, cited in Torrubia et al., 2001) and Susceptibility to Reward Scale (Muntaner & Torrubia, 1985, cited in

Torrubia et al., 2001). SP and SR scores derived from the new SPSRQ have been found to be associated as expected with other instruments that measure BIS- and BAS-related personality traits such as neuroticism, impulsive sensation seeking (Zuckerman & Kuhlman, 2000), and anxiety (Torrubia et al., 2001). Interestingly, Torrubia et al. (2001) reported no gender differences in SP, with males reporting greater SR than females.

The SPSRQ has been used to explain risky behaviours such as dysfunctional eating and hazardous drinking (Loxton & Dawe, 2006). Individuals with greater SR and less SP have also been found to be more likely to use marijuana (Simons & Arens, 2007) and methamphetamines (Simons, Dvorak, & Batién, 2008). Marijuana use and expectancies regarding use were also found to be moderated by the individual's SP and SR (Simons & Arens, 2007). The current research will examine the role of SP and SR in self-reported risky driving behaviour, including the potential differential influences for each gender, in addition to exploring the relationships between SP and SR and sensation seeking propensity, anxiety and depression.

Propensity for sensation seeking and the young novice driver

Importantly, as noted earlier, risky driving behaviour is associated with a range of potential rewards which can impact upon road safety (Cavallo et al., 1997). Of particular concern for the young novice driver is experiencing strong desirable emotions (see Jonah, 1997, for a review). These feelings include excitement and power (Arnett, Offer, & Fine, 1997; Sullman, 2006) and they have consistently been found to be associated with risky driving, offences and crashes (Rimmo & Aberg, 1999). The Impulsive Sensation Seeking scale (ISSS) (Zuckerman, 1994) has been used in adolescent populations to explore this experience of excitement that is presumed to be demonstrative of a personal propensity for sensation seeking (PPSS) (e.g., in Spain, Goma-i-Freixanet, Valero, Punit, & Zuckerman, 2004). The ISSS has been found to be

predictive of risky behaviour (e.g., Zuckerman & Kuhlman, 2000) including risky driving (Oltedal & Rundmo, 2006). PPSS has also been found to be predictive of self-reported risky driving behaviour over and above other personality traits such as low conscientiousness and anger; however, it is noteworthy that it did not predict risky behaviour in a virtual environment driving task (Schwebel, Severson, Ball, & Rizzo, 2006).

As noted earlier, Gray aligned the individual's SR to the personality trait of impulsivity, and due to this conceptual similarity measures of SR appear also to measure PPSS (Smillie et al., 2006). Torrubia et al. (2001) reported a significant relationship between PPSS as measured by Zuckerman's ISSS and the SRQ ($r = .36-.43$ for females; $r = .41-.45$ for males). In addition, there was no relationship between SPQ scores and PPSS (e.g., $r = .02-.08$ for females; $r = .04-.08$ for males). Whilst there appears to be shared variance amongst the constructs of SR and PPSS, the nature of this relationship has not been elucidated for the young novice driver, particularly in relation to their self-reported risky driving behaviour. It may be that PPSS and SR overlap, are encapsulated within each other, or are in fact the same psychological constructs. The ISSS (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993) will be utilised in the current study to measure PPSS. Understanding the relationship between SR and PPSS may reveal additional avenues for intervention in road safety. Furthermore, the cognitive, physiological, behavioural and social maturation of the young novice driver can have implications for their risky behaviour (Dahl, 2008) beyond their SR, SP and PPSS.

Depression, anxiety and the young novice driver

Adolescents experience a high incidence of psychological distress, evidenced as anxiety and depression, and a corresponding association with risky behaviour has been found. American research reports the prevalence of depression during adolescence at 24% (Avenevoli, Knight,

Kessler, & Merikangas, 2008), and 1 in 10 adolescents are likely to be depressed at any given time (Strine et al., 2008). Research also reveals that adolescents who experience depression are more likely to become adults who experience depression (Mulye, Pak, Nelson, Adams, Irwin, & Brindis, 2009). There are differences in the experience of psychological distress for each gender and over the developmental period of adolescence, irrespective of ethnicity (Huang, Xia, Sun, Zhang, & Wu, 2009), with greater prevalence of depression in females (Boticello, 2009) who tend to experience symptoms earlier (Crawford, Cohen, Midlarsky, & Brook, 2001).

Kessler's Psychological Distress Scale (K10), developed by Kessler and Mroczek (1994, cited in Andrews & Slade, 2001), is a 10-item measure of non-specific psychological distress – that is, for mood or anxiety disorder. The K10 has been found to be more clinically accurate in screening for psychological distress than other popular instruments such as the General Health Questionnaire (Furukawa, Kessler, Slade, & Andrews, 2003) and the Composite International Diagnostic Interview Short-Form (CIDI-SF) scale (Kessler et al., 2003). The K10 items align well with Criterion A of the DSM-IV (TR) diagnoses of major depressive episode (Cairney, Veldhuizen, Wade, Kurdyak, & Streiner, 2007) – higher scores corresponding to greater probability the respondent meets the criteria for a current DSM-IV (TR) or CIDI mental disorder diagnosis (Andrews & Slade, 2001).

Factor analytic studies of the scale have identified the two factors of depression (DEP) and anxiety (ANX) within the K10 (Brooks, Beard, & Steel, 2006). DEP and psychological distress have been found to be associated not only with risky behaviours such as unprotected sex (Swanholm, Vosvick, & Chng, 2009), cigarette smoking and unsafe levels of alcohol consumption (Waller, Hallfors, Halpern, Iritani, Ford, & Guo, 2006), but also with physical inactivity and obesity (Strine et al., 2008), and eating disorders (Darby, Hay, Mond, Rodgers, &

Owen, 2007). Slessareva and Muraven (2004) found that psychological distress, that is DEP and ANX, mediated the relationship between the personality trait of self-control and SP. Torrubia et al. (2001) reported that SP and ANX were highly associated for both males ($r = .68$) and females ($r = .59$), whilst SR and DEP were not related for either males ($r = .03$) or females ($r = .10$).

DEP and ANX have also been found to be predictive of risky driving behaviour in both young and older drivers. DEP was the only psychosocial characteristic that predicted future drink driving amongst Swedish drink-driving offenders (Hubicka, Kallmen, Hiltunen, & Bergman, 2010). ANX has been found to be significantly associated with both risky driving and sensation seeking propensity of young novice drivers (Oltedal & Rundmo, 2006), and young novice drivers with high self-reported ANX were more likely to engage in risky driving behaviour (Ferreira & Guisande, 2009). In contrast, for more experienced drivers, simulator driving tasks have revealed that drivers with higher ANX are more likely to drive more cautiously (Stephens & Groeger, 2009). The full K10 used as the measure of psychological distress has also been found to predict self-reported risky driving behaviour (Scott-Parker et al., in press).

Studies to date have not explored the differential influence of the two subscales of DEP and ANX within the K10 on risky driving behaviour. Whilst prior research, and their inclusion within one psychological instrument, suggests that they are highly correlated, the precise relationship between the constructs – and the role each plays in risky behaviour – requires further examination. Research using other instruments such as the Depression, Anxiety and Stress Scale –Short Form has found that DEP and ANX were highly correlated ($r = .64$). (Wu & Wei, 2008). The current research is designed to explore the relationships between SR and SP, PPSS, and ANX and DEP as separate-yet-related constructs and the self-reported risky behaviour of the young novice drivers. On the basis of the research outlined above, it seems likely that there will

be a relationship between SP and ANX and DEP, and a relationship between ANX and DEP and between PPSS and SR.

Study Aims

It has been found that the risky driving behaviour of the young novice is likely to differ according to their psychological distress as measured by their DEP and ANX, their SP and SR, and their PPSS. In addition, the individual's gender has also been found to be influential (e.g., Li, Huang, Lin, & Sun, 2007), and given the nature of the developmental period of adolescence, it is likely that the age of the novice driver may also be of consequence. The relationships amongst these variables however have not been elucidated in prior research. The research reported in this paper is part of a larger study undertaken in Queensland, Australia that used an online survey designed to explore the psychosocial characteristics of, and influences upon, the risky behaviour of young novice drivers in Queensland. The current study aims to explore the direct and indirect relationships between the variables of SR, SP, PPSS, DEP, and ANX, whilst considering the influence of the novice driver's gender and age. Accordingly a full test of the model incorporating SR, SP, PPSS, DEP, ANX, age and gender will be undertaken, and additional analyses investigating suspected mediation relationships between SR and PPSS and between DEP, ANX and SP, and possible moderating effects of gender, will be conducted.

Method

Participants

Seven hundred and sixty-one drivers (523 women and 238 men) aged 17-25 years ($M = 19.00$, $SD = 1.59$) with a Provisional (intermediate) driver's licence volunteered to complete the 25-minute online survey. The sample size exceeds the 20 participants to each variable ratio for path analysis as recommended by Kline (2011).

Measures

Participants reported their age and gender and completed the binary 48-item SPSRQ (Torrubia et al., 2001) (*yes, no*) and the 19-item ISSS from the Zuckerman-Kuhlman Personality Questionnaire (Zuckerman et al., 1993) (*true, false*). Participants also responded to the 5-point Likert scales of the K10 (Kessler et al., 2003) (1 = *none of the time*, 5 = *all of the time*) which was subsequently divided into DEP and ANX subscales, and the 44 item Behaviour of Young Novice Drivers Scale (The BYNDS; Scott-Parker et al., 2010) (1 = *never*, 5 = *almost always*). All items in all scales were summed and analyses were undertaken using the composite scores for each of the instruments. Higher scores on the SPSRQ, the ISSS, and the K10 indicate greater sensitivity to punishment and reward, propensity for sensation seeking and psychological distress; higher scores in the BYNDS indicate more self-reported risky driving.

Procedure and Design

A cross-sectional survey design was used for the online survey. The hyperlink to the survey was forwarded to the 13 major tertiary education institutions (technical colleges and universities) in the state of Queensland, Australia, and was available online from mid-August to 30 October, 2009. Students aged 17-25 years with a provisional driving licence were eligible to participate. Incentives for participation included the opportunity to win one of four \$350 fuel vouchers or research participation credit for eligible university students.

Statistical Analyses

Measures of internal consistency utilised Cronbach's alpha (α). Prior to path analysis, bivariate correlations were used to explore the strength of association between the study variables. Bivariate correlations between continuous variables utilised Pearson's product moment correlation (r). Bivariate correlations between continuous and dichotomous variables utilised

point biserial correlations (r_{pb}). Factor analysis was also be used to explore the relationship between the variables. The online survey tool was created in KeySurvey Enterprise Online Survey Software. All analyses were conducted using AMOS version 18 and PASW version 18.0.

Results

Descriptive Analyses

All data in KeySurvey was exported to SPSS for analysis. Table 1 reports the means, standard deviation and α for each of the variables in the study. The young novice drivers reported moderate levels of risky driving (BYNDS range = 44-166), propensity for sensation seeking (ISSS range 19-38), sensitivity to punishment (SP range 0-24), sensitivity to reward (SR range 0-24), and psychological distress as indicated by depression (DEP range 6-30), and anxiety (ANX range 4-20). Given the gender differences apparent in the literature review, the means and standard deviations were also calculated separately for each gender. As can also be seen in Table 1, males reported greater SR than females, whilst females reported more DEP than males.

[Insert Table 1 here]

Table 2 contains the correlations between the scales, gender, and age of the young novice drivers. SR was strongly associated with PPSS (higher SR associated with higher PPSS), and both SR and PPSS were strongly associated with more self-reported risky driving behaviour. DEP and ANX were strongly associated (higher DEP associated with higher ANX), and DEP and ANX were strongly associated with greater SP and with more self-reported risky driving behaviour.

[Insert Table 2 here]

Again given the gender differences highlighted in the literature review, additional correlation analyses were undertaken for gender, age, and the six scales. Table 3 summarises these

correlations. As can be seen, for female young novice drivers greater PPSS was associated with less SP and with more DEP. In addition, whilst significant for both males and females, the positive relationship between SR and risky driving behaviour (measured by the BYNDS) is stronger for females than males.

Path Analyses

To explore the extent that gender, age, SP and SR, PPSS, DEP and ANX predict self-reported risky driving behaviour, a path diagram was created. Given the univariate normality of the variables as depicted in Table 1, and the multivariate normality as indicated by a skew less than 2.0 and a kurtosis less than 7.0, path analysis used maximum likelihood estimation to estimate the parameters of the model. Good model fit was determined by a combination of the likelihood ratio chi-square statistic (χ^2 non-significant or less than three times the degrees of freedom), Bentler's Comparative Fit Index ($CFI \geq .95$), the Joreskog-Sorbom Goodness of Fit Index ($GFI \geq .95$), the Steiger-Lind Root Mean Square Error of Approximation ($RMSEA \leq .08$) including 90% confidence intervals (Kline, 2011), and the Tucker-Lewis Index ($TLI \geq .95$). Path coefficients and R^2 were also examined.

The measurement model is depicted in Figure 1A. The model was unable to be fitted to the data, $\chi^2(36) = 0.00$.

[Insert Figure 1A here]

The modification indices recommended that the path from SPQ to BYNDS be removed. The modified model was a good fit to the data, $\chi^2(35) = 5.19$, $p = .023$, $GFI = .99$, $CFI = .99$, $TLI = .91$, $RMSEA = .07$, $[.02-.14]$, and the model and path coefficients are provided in Figure 1B. Paths significant at $p < .05$ were positive and revealed that self-reported risky driving behaviour was predicted by the young novice driver's PPSS, SR, DEP, and ANX. SR and PPSS had the

largest beta weight of the predictors ($\beta = .25$). The revised model explained 27% of the variance in self-reported risky driving behaviour.

[Insert Figure 1B here]

Mediation Analyses

After consideration of the relationships between the variables and their prediction of self-reported risky driving behaviour, the variable of participant *age* was removed from further analyses. Participant *gender* was also removed at this stage. The literature suggests that there is a complicated relationship between SP, ANX, DEP and risky behaviour, and there is an association between risky driving behaviour and ANX, DEP and SP as indicated by the correlation coefficients in the preliminary correlation analyses and the fitting of the measurement model. There also appears to be an association between PPSS and SR as discussed in the literature review, and a relationship between risky driving behaviour, PPSS and SR as indicated by the significant correlation coefficients in the preliminary correlation analyses and by the fitting of the measurement model. An exploratory factor analysis based upon a principal components extraction of factors was followed by an oblique rotation to confirm the correlation relationships amongst the variables. Two factors were confirmed accounting for 59.13% of the variance. Factor 1 contained ISSS and SRQ and accounted for 26.02% of the variance, whilst Factor 2 contained SPQ, ANX, and DEP and accounted for 33.11% of the variance.

Accordingly two mediation relationships will be examined. The first pertains to the mediation relationship between ANX and DEP and the individual's SP. Figure 2 illustrates the six models and the path coefficients obtained from each analysis. The first step involved examining the relationship between ANX, DEP and SP and risky driving behaviour, individually. As can be seen from Figure 2A, the young novice drivers' ANX and DEP

individually significantly influence their risky driving behaviour, with greater ANX and DEP associated with more risky driving behaviour. It is noteworthy that whilst SP did not emerge as a significant predictor of self-reported risky driving behaviour, this does not exclude it from being a mediator (Mallinckrodt, Abraham, Wei & Russell, 2006). Three further models were tested. Figure 2B depicts the mediation of ANX and DEP each by SP. Whilst ANX and DEP were each mediated by SP the overall explanation of risky driving behaviour by the three variables did not change significantly, suggesting that the mediation relationship is not influential in this instance. Figure 2C depicts the mediation of both ANX and DEP by SP, and again the overall explanation of risky driving behaviour by the three variables did not change significantly, similarly suggesting that the mediation relationship is not influential in this instance.

[Insert Figure 2 here]

The second mediation relationship that will be investigated is that between PPSS and SR. To explore the possible mediation, four models were tested. Figure 3 summarises the four models and the path coefficients obtained from each analysis. Figure 3A demonstrates that, as indicated by the revised path model in Figure 1B, both SR and PPSS significantly explain the self-reported risky driving behaviour of the young novice, greater SR and PPSS associated with more risky driving behaviour. However, it appears that whilst correlated (see Table 1), SR and PPSS also have some shared variance rather than a mediational relationship (Figure 3B).

[Insert Figure 3 here]

The revised path model was amended again to reflect the co-varying relationships found in the mediational analyses (specifically, between ANX and DEP, and between SR and PPSS) and the coefficients and model are depicted in Figure 4. The model was a good fit to the data, $\chi^2(4) = 22.87, p < .001$, GFI = .99, CFI = .98, TLI = .95, RMSEA = .07, [.05-.11]. SR, PPSS, and

DEP were significant predictors of the self-reported risky driving behaviour of the young novice, explaining a significant 24% of the variance in risky behaviour. Greater SR, PPSS and DEP were associated with more risky driving behaviour. It is noteworthy too that the influence of ANX was approaching significance ($p = .05$).

[Insert Figure 4 here]

Moderation Analyses

The literature review and the investigation of the association between gender and the study variables as a composite and separately for male and female participants (Table 1) suggests that moderation analyses, based on the *gender* of the young novice driver, is also warranted. Given that gender is a dichotomous variable, the simplest approach is to assess the model fit of the revised model separately for male and female young novice drivers. The separate gender analyses revealed interesting differences in the contribution of the model variables to the self-reported risky behaviour of the young novice driver. The revised path model for males (Figure 5A) had a good fit to the data, $\chi^2(4) = 8.79, p = .07, GFI = .99, CFI = .98, TLI = .96, RMSEA = .07, [.00-.14]$. The revised model explained 21% of the variance in the self-reported risky driving behaviour of the young male novice driver. The significant predictors were PPSS, SR, and DEP, with greater PPSS, SR, and DEP associated with more risky driving behaviour. Figure 5B demonstrates the revised model for the female young novice drivers, which also had an acceptable fit to the data, $\chi^2(4) = 25.32, p < .001, GFI = .98, CFI = .97, TLI = .93, RMSEA = .10, [.07-.14]$. The revised model explained 27% of the variance in the self-reported risky driving behaviour of the young female novice driver. The significant predictors were PPSS, SR, ANX and DEP, with greater PPSS, SR, ANX and DEP associated with more risky driving behaviour.

[Insert Figure 5 here]

Examining the β -weights, PPSS was a significant predictor of the risky behaviour of both male and female novice drivers. SR was a significant predictor, particularly for female novice drivers. Female novice risky driving behaviour is also influenced by their DEP and ANX. The risky driving behaviour of young males, in comparison, is more influenced by their DEP and not influenced by their ANX.

Discussion

SR was strongly associated with PPSS, and each trait was strongly associated with the self-reported risky driving behaviour of the young novice drivers. ANX and DEP were strongly associated with SP and with self-reported risky driving behaviour. The final path model demonstrated that DEP, SR and PPSS predicted 24% of variance in self-reported risky driving behaviour. Gender was found to be a moderating variable. Males reported greater SR and PPSS than females, and the path model for males indicated that PPSS was the strongest predictor of the two, followed by DEP then SRQ, with the model explaining 21% of the variance in self-reported risky driving behaviour. Females and males reported similar ANX and SPQ, however females reported greater DEP, and the path model for females which explained 27% of variance in risky driving indicated that SRQ was the strongest predictor of self-reported risky driving, followed by PPSS. Both ANX and DEP were significant predictors for females.

The results have implications for both mental health practitioners and road safety researchers. Psychological distress has been found to be a significant predictor of self-reported risky driving behaviour by young novice drivers (Scott-Parker et al., in press), and the research has elucidated the separate influence(s) of DEP and ANX on male and female young novice drivers' behaviour. Young novice drivers who are experiencing anxiety are at increased risk of injury from a car crash as their greater self-reported risky driving behaviour places them at more

risk of a road crash. In addition, depression also places the young female novice driver at greater risk. Interventions designed to ameliorate depression and anxiety is likely to have broader benefits, such as improved road safety for young and older road users alike.

SR and PPSS, whilst clearly strongly related, are not subsumed within each other, and each exerts their own influence upon the risky behaviour of male and female young novice drivers. A greater proportion of the influence of the young male driver's SR seems to be captured within their PPSS. This is in contrast to the young female driver for whom SR remains a substantial source of influence separate from the PPSS. The findings suggest that for males the kinds of rewards that impact upon their risky driving may primarily be those which generate feelings of power and control, or excitement. On the contrary, for females it may be that there are other rewards in addition to such sensations which impacts upon their risky driving. This may include pragmatic rewards such as shorter journey times when in a hurry, however further exploration is required.

Interventions designed to counter risky behaviour by young novice drivers – such as the GDL legislation introduced in Queensland in July 2007 – frequently rely upon the threat and administration of punitive measures to curtail such behaviour. However this study suggests that while the young novice driver sample was sensitive to punishment, this is not a significant influence on risky driving behaviour. Therefore an intervention that takes into account young drivers' personal propensity for sensation seeking and sensitivity to *rewards* is likely to be more effective in reducing risky behaviour. In addition, Interventions could consider gender differences in the influence of the psychosocial influences of DEP, ANX, SR and PPSS. Such considerations could inform the design of more effective interventions.

This was the first study to explore the link between ANX, DEP, SP, SR and ISS in relation to the self-reported risky behaviour of young novice drivers. Path models for each gender indicate that the nature of the influence of these psychosocial constructs is not straightforward. This finding suggests that research into the various influences upon young novice driver behaviour should incorporate separate analyses by gender, and interventions similarly may need to consider the gender of the young novice driver. This study was the second application of the SPSRQ to an Australian young driver population. The previous application relied upon psychology undergraduates who may not have been young novice drivers, and did not explore gender differences (Cooper & Gomez, 2008). The SPSRQ has also featured in online surveys (e.g., Simons & Arens, 2007; Simons et al., 2008). In addition, the study divided the nature of psychological distress as measured by the K10 according to the separate subscales of anxiety and depression. This allowed a further delineation of the influence of these mental health variables that have been found to be predictive of risky driving behaviour, thereby facilitating an examination of the influence of these related yet distinct constructs and the relationships between each.

The generalisability of the study findings is limited by the survey procedure and method and the number and type of participants sampled. The survey tool was an online survey that was made available to all enrolled students at the 13 major Queensland tertiary education institutions, and therefore the sample may not be representative of all Queensland young novice drivers. In addition, the response rate for the study could not be calculated as there was no way to determine how many young novice drivers accessed the survey and chose not to participate. More female than male young novice drivers completed the survey (68.7% female), reflecting a greater participation of female young drivers even when the higher female student population is taken

into account (55% of the populations of the two Universities the majority of the participants reported being students at in 2009 were female). Separate analyses by gender were undertaken however. Whilst some variables were highly correlated, for example SR and PPSS, there was no evidence of multicollinearity, and a large sample was obtained for both male and female novices.

Future research should be undertaken exploring self-reported risky driving behaviour, actual driving behaviour as observed in driving simulators or in-car video-recording devices (e.g., Conner et al., 2007), police-reported crashes, and police-detected offences, utilising the SPSRQ, ISSS and K10 in different populations in Australia and around the world. Longitudinal studies would allow an exploration of the stability not only of these states and traits but also the extent of the influence of these states and traits upon the behaviour of the young novice driver as they mature from an adolescent to an adult and from a novice to an experienced driver. Such research could be used to inform intervention development.

Young novice driver road safety research has begun to consider the variety and extent of the psychosocial influences upon the risky behaviour of young drivers. This risky behaviour contributes to their overrepresentation in car crashes and their subsequent injuries and fatalities. In addition, the relationship between SP and SR and the individual's PPSS had not been investigated within the domain of the risky driving behaviour of the young novice nor in relation to their ANX and DEP, both of which have been found to be associated with risky driving behaviour.

As shown in the current study, the young driver's SR explained significant variance in their risky behaviour in addition to their PPSS, indicating that whilst these constructs are related they reflect distinct influences upon the young driver's risky behaviour. Notably, the extent of this influence differed for male and female young drivers, and SR appears to be twice as relevant

for females as for males. Moreover, whilst DEP was influential upon the risky behaviour of males and females alike, DEP also appears to be twice as relevant for males as for females. ANX was also influential for the female novice driver specifically, with the influence upon the risky behaviour of female young novice drivers comparable to the effect of SR for males. Continued reliance upon punishment to curtail risky behaviour is not supported by the study findings, because although young drivers are indeed sensitive to punishment, this does not appear to directly explain their risky behaviour within the context of ANX, DEP, SR and PPSS; notwithstanding that SP was theoretically and empirically related to ANX and DEP. Rather, the results suggest that interventions reducing the rewards and sensation seeking experienced by the young novice driver are also warranted. In addition, interventions that address any psychological distress experienced by the young novice driver merit further consideration. Furthermore, attention to the gender differences in the influence of these psychosocial constructs is likely to result in more effective interventions.

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Table 1

Means and Standard Deviations for all Scales for the all the Young Novice Drivers (N = 761), and separately for the Male (N = 238) and Female (N = 523) Participants

Scale	Cronbach's Alpha	Skew	Kurtosis	Young Novice Drivers					
				N = 761		N = 238		N = 523	
				<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
SPQ	0.82	0.01	-0.80	12.16	5.17	11.46	5.41	12.48	5.04
SRQ	0.75	0.22	-0.20	11.32	4.48	12.53	5.41	10.77	4.37
ISSS	0.82	0.13	-0.86	28.20	4.36	29.02	4.45	27.81	4.27
ANX	0.79	1.12	1.57	7.63	2.69	7.29	2.55	7.79	2.75
DEP	0.90	1.17	1.23	11.84	4.86	10.91	4.47	12.27	4.98
BYNDS	0.94	0.85	0.99	84.67	20.44	85.26	21.50	84.44	19.96

SPQ = Sensitivity to Punishment Questionnaire; SRQ = Sensitivity to Reward Questionnaire; ISSS = Impulsive Sensation Seeking Scale; DEP = Depression subscale of Kessler's Psychological Distress Scale; ANX = Anxiety subscale of Kessler's Psychological Distress Scale; BYNDS = Behaviour of Young Novice Drivers Scale.

Table 2

Correlations between Sensitivity to Punishment and Reward, Sociodemographic Variables, Driving Behaviours, and Propensity for Sensation Seeking

Key Measure	Gender	Age	SP	SR	PPSS	ANX	DEP
Age	-.01	—					
SP	.09**	.06	—				
SR	-.18***	-.03	.08*	—			
PPSS	-.13***	-.02	-.11**	.52***	—		
ANX	.09**	.04	.39***	.16***	.11**	—	
DEP	.13***	.02	.43***	.15***	.11**	.70***	—
BYNDS	-.02	-.06	.03	.41***	.40***	.26***	.27***

*Note: * $p < .05$, ** $p < .01$, *** $p < .001$.*

Bivariate correlations between continuous variables utilised Pearson's product moment correlation (r). Bivariate correlations between continuous and dichotomous variables utilised point biserial correlations (r_{pb}).

DEP = Depression measured by the Depression subscale of Kessler's Psychological Distress Scale; ANX = Anxiety measured by the Anxiety subscale of Kessler's Psychological Distress Scale; SP = Sensitivity to punishment measured by the Sensitivity to Punishment Questionnaire (SPQ); SR = Sensitivity to reward measured by the Sensitivity to Reward Questionnaire (SRQ); PPSS = Personal propensity for sensation seeking measured by the Impulsive Sensation Seeking Scale (ISSS); BYNDS = Behaviour of Young Novice Drivers Scale

Table 3

Correlations between Sensitivity to Punishment and Reward, Sociodemographic Variables, Driving Behaviours, and Propensity for Sensation Seeking for Male¹ and Female² Young Novice Drivers

Key Measure	Age	SP	SR	PPSS	ANX	DEP	BYNDS
Age	–	.02 ¹	-.08	-.01	-.01	.02	.04
SP	.08 ²	–	.12	-.02	.41***	.48***	.03
SR	-.01	.09*	–	.55***	.18**	.14*	.34***
PPSS	-.03	-.14**	.49***	–	.11	.04	.38***
ANX	.06	.38***	.18***	.13**	–	.66***	.22**
DEP	.02	.40***	.19***	.17***	.71***	–	.26***
BYNDS	-.10*	.03	.45***	.42***	.28***	.29***	–

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

¹ The bivariate correlations for male young novice drivers are reported above the diagonal.

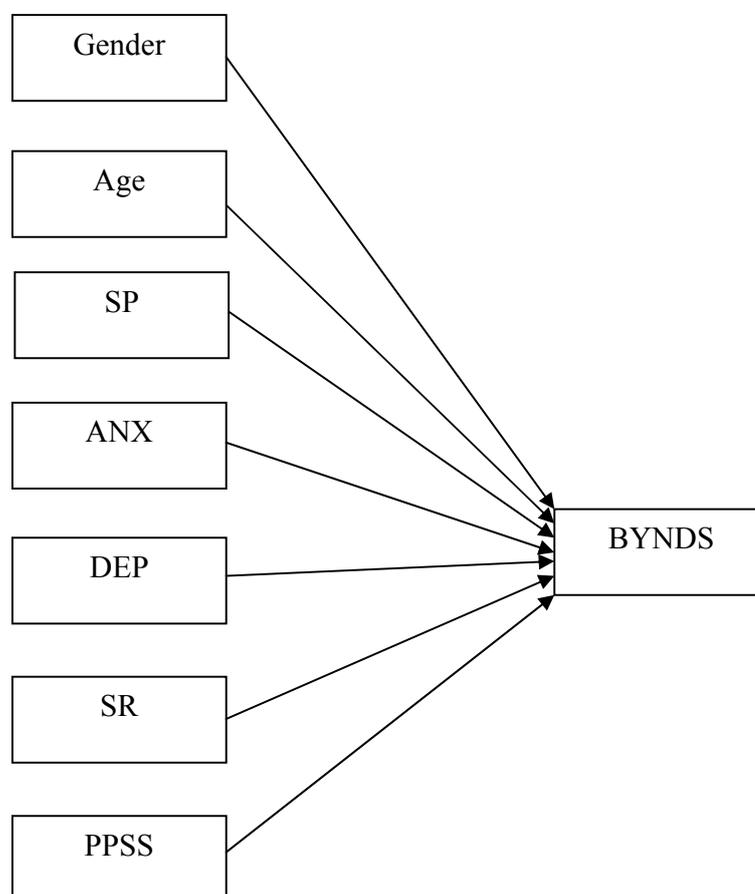
² The bivariate correlations for female young novice drivers are reported below the diagonal.

Bivariate correlations between continuous variables utilised Pearson's product moment correlation (r).

Bivariate correlations between continuous and dichotomous variables utilised point biserial correlations (r_{pb}).

DEP = Depression measured by the Depression subscale of Kessler's Psychological Distress Scale; ANX = Anxiety measured by the Anxiety subscale of Kessler's Psychological Distress Scale; SP = Sensitivity to punishment measured by the Sensitivity to Punishment Questionnaire (SPQ); SR = Sensitivity to reward measured by the Sensitivity to Reward Questionnaire (SRQ); PPSS = Personal propensity for sensation seeking measured by the Impulsive Sensation Seeking Scale (ISSS); BYNDS = Behaviour of Young Novice Drivers Scale

Figure 1A

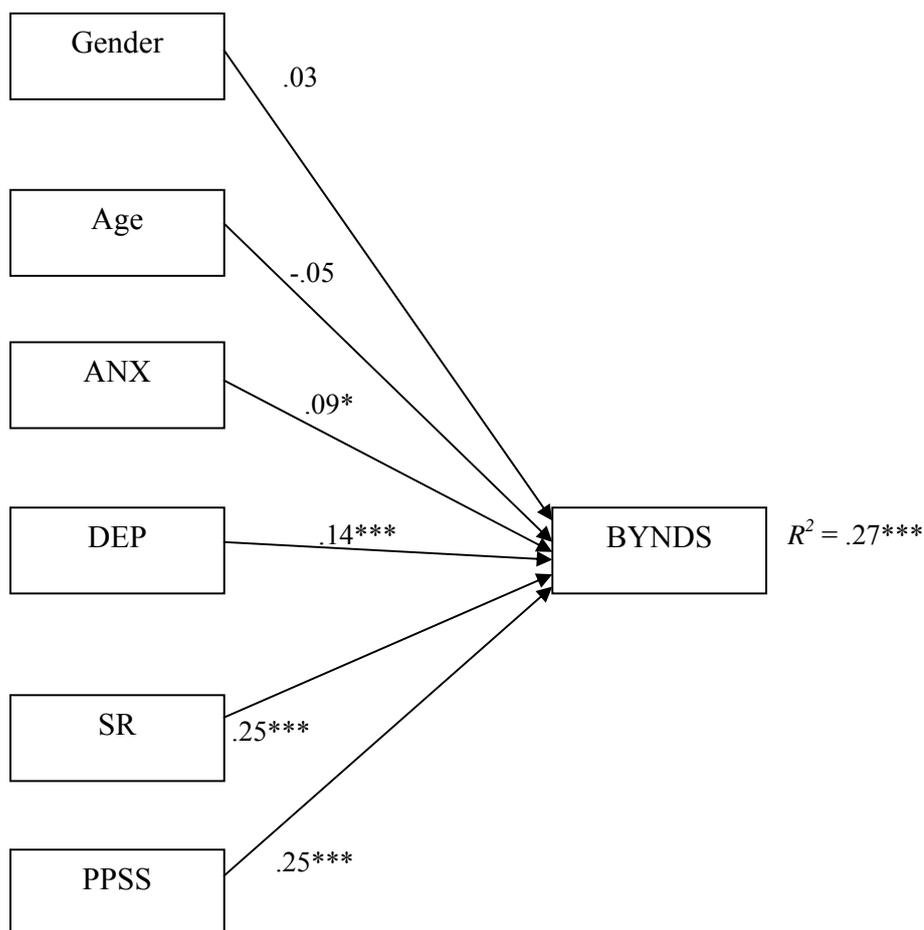
The Measurement Model

(Model unable to be fitted, Goodness of fit: $\chi^2(36, N = 761) = 0.00$).

DEP = Depression measured by the Depression subscale of Kessler's Psychological Distress Scale; ANX = Anxiety measured by the Anxiety subscale of Kessler's Psychological Distress Scale; SP = Sensitivity to punishment measured by the Sensitivity to Punishment Questionnaire (SPQ); SR = Sensitivity to reward measured by the Sensitivity to Reward Questionnaire (SRQ); PPSS = Personal propensity for sensation seeking measured by the Impulsive Sensation Seeking Scale (ISSS); BYNDS = Behaviour of Young Novice Drivers Scale

Figure 1B.

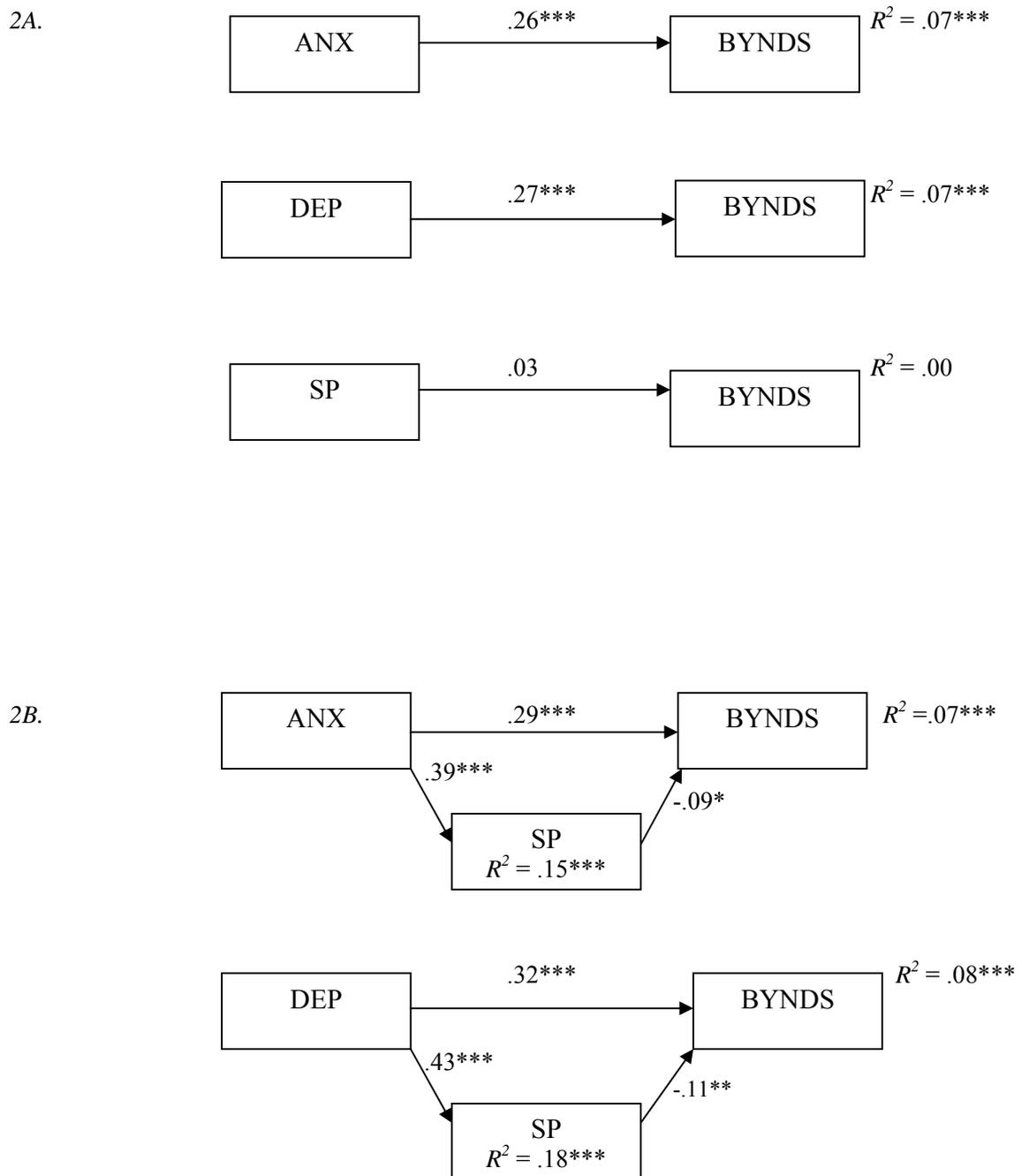
The Revised Path Model for Gender, Age, Sensitivity to Punishment and Reward, Anxiety and Depression, Personal Propensity for Sensation Seeking and Self-Reported Risky Driving Behaviour



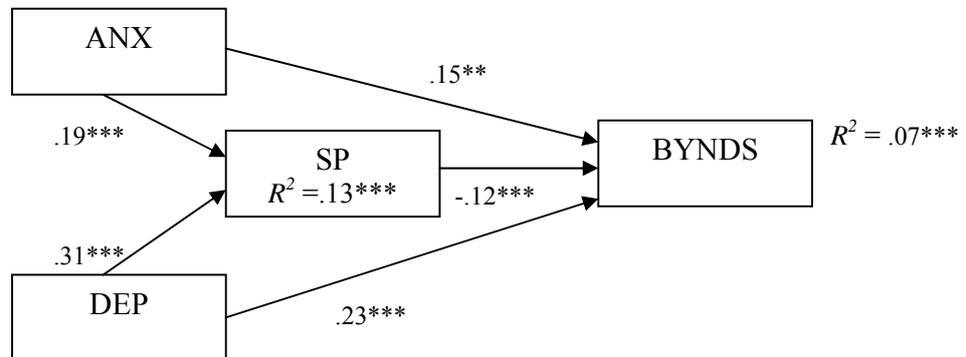
Note: * $p < .05$, *** $p < .001$. (Goodness of fit: $\chi^2 (1, N = 761) = 5.20, p = .02$, GFI = .99, CFI = .99, TLI = .91, RMSEA = .07 [.02- .14]). For ease of interpretation, the covariance arrows with associated correlations are not depicted on the Figure. The reader is referred to Table 2 for the correlations between the variables. DEP = Depression measured by the Depression subscale of Kessler's Psychological Distress Scale; ANX = Anxiety measured by the Anxiety subscale of Kessler's Psychological Distress Scale; SP = Sensitivity to punishment measured by the Sensitivity to Punishment Questionnaire (SPQ); SR = Sensitivity to reward measured by the Sensitivity to Reward Questionnaire (SRQ); PPSS = Personal propensity for sensation seeking measured by the Impulsive Sensation Seeking Scale (ISSS); BYNDS = Behaviour of Young Novice Drivers Scale

Figure 2

Path Models Exploring the Mediation Relationship between Sensitivity to Punishment, Anxiety, Depression and Self-Reported Risky Driving Behaviour



2C.

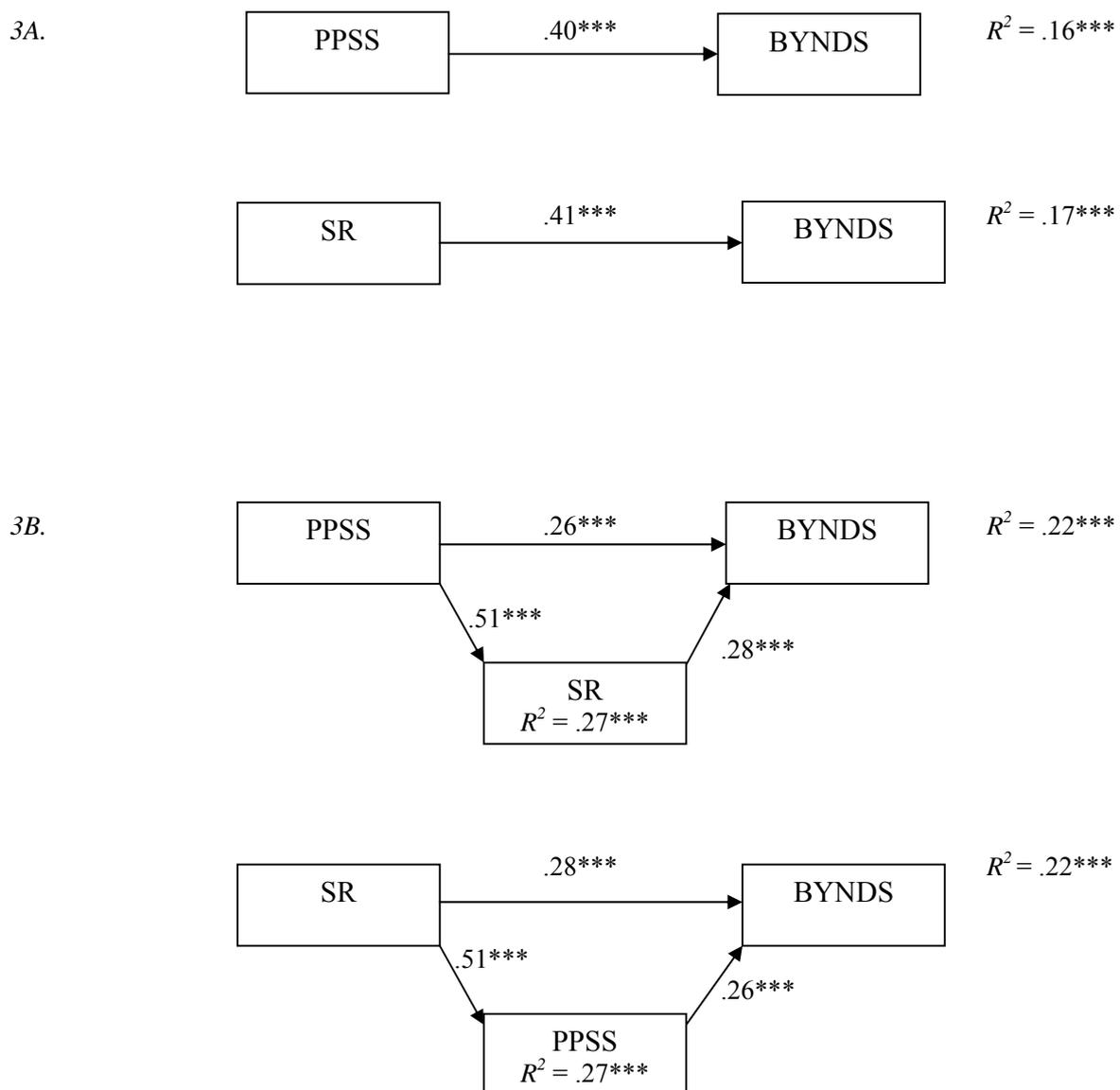


Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

DEP = Depression measured by the Depression subscale of Kessler's Psychological Distress Scale; ANX = Anxiety measured by the Anxiety subscale of Kessler's Psychological Distress Scale; SP = Sensitivity to punishment measured by the Sensitivity to Punishment Questionnaire (SPQ); BYNDS = Behaviour of Young Novice Drivers Scale

Figure 3

Path Models Exploring the Mediation Relationship between Sensitivity to Reward, Personal Propensity for Sensation Seeking and Self-Reported Risky Driving Behaviour

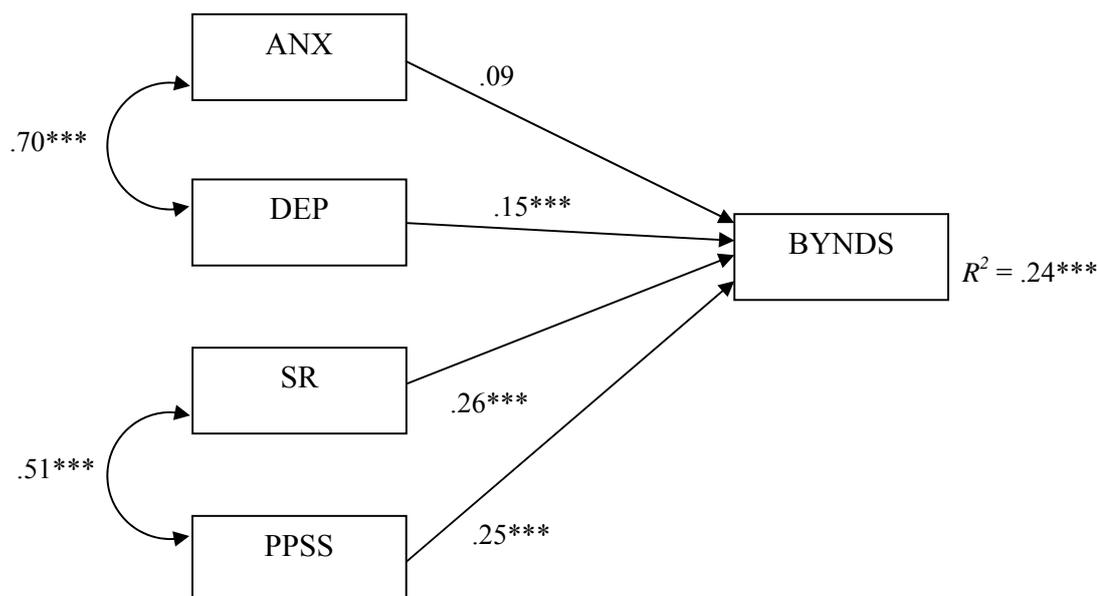


Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

SR = Sensitivity to reward measured by the Sensitivity to Reward Questionnaire (SRQ); PPSS = Personal propensity for sensation seeking measured by the Impulsive Sensation Seeking Scale (ISSS); BYNDS = Behaviour of Young Novice Drivers Scale

Figure 4.

Final Path Model Predicting the Self-Reported Risky Driving Behaviour of Young Novice Drivers According to their Personal Propensity for Sensation Seeking, Sensitivity to Reward, Depression and Anxiety.



Note: *** $p < .001$.

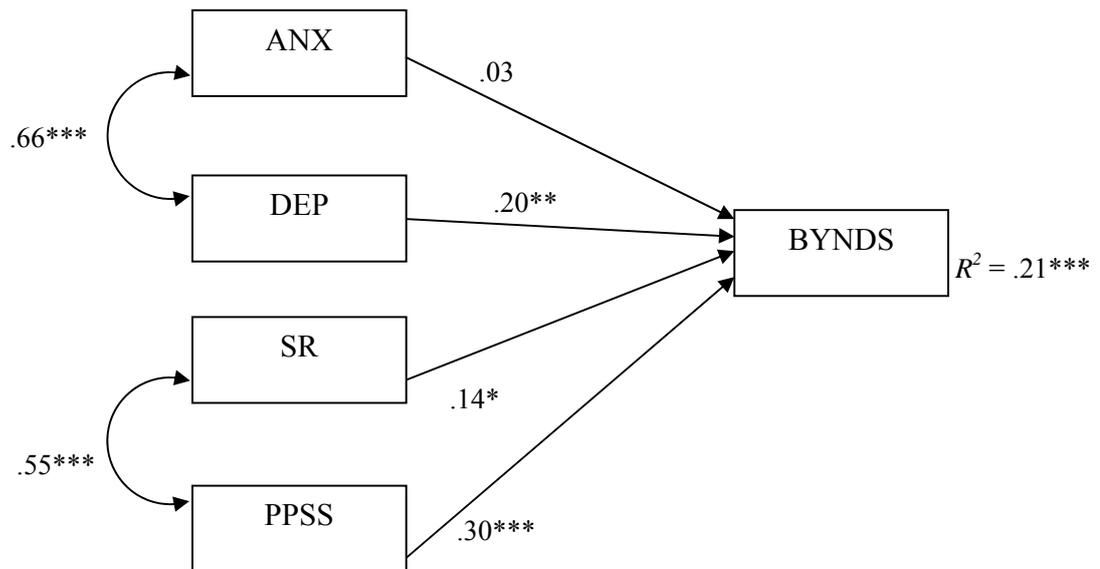
(Goodness of fit: $\chi^2(4, N = 761) = 22.87, p < .001$, GFI = .99, CFI = .98, TLI = .95, RMSEA = .08 [.05- .11]).

DEP = Depression measured by the Depression subscale of Kessler's Psychological Distress Scale; ANX = Anxiety measured by the Anxiety subscale of Kessler's Psychological Distress Scale; SR = Sensitivity to reward measured by the Sensitivity to Reward Questionnaire (SRQ); PPSS = Personal propensity for sensation seeking measured by the Impulsive Sensation Seeking Scale (ISSS); BYNDS = Behaviour of Young Novice Drivers Scale

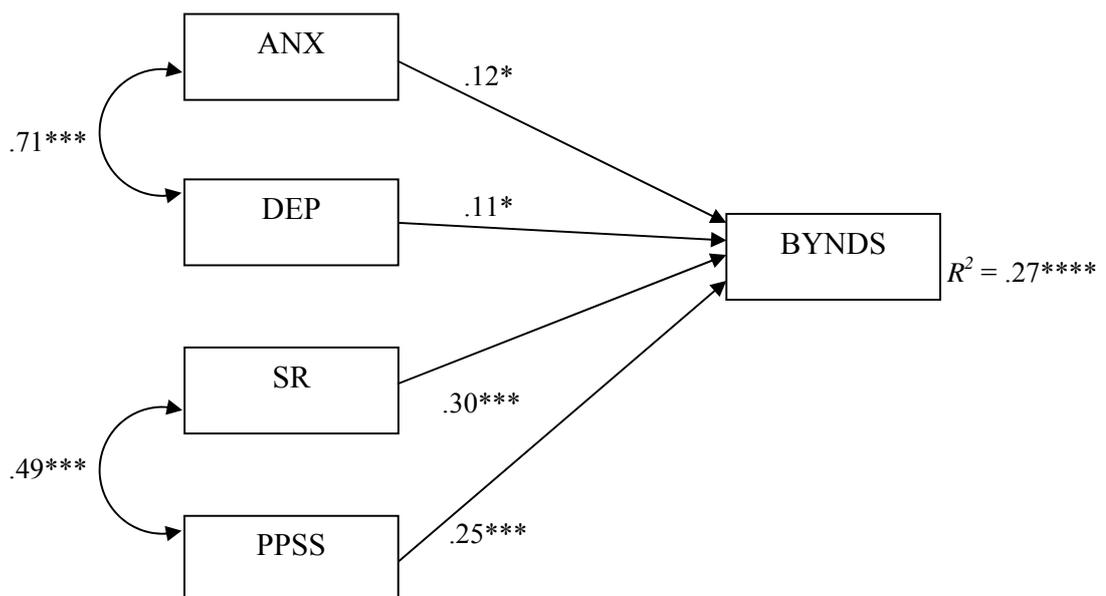
Figure 5.

Final Path Models Illustrating the Moderation by Gender of Self-Reported Risky Driving Behaviour of Young Novice Drivers.

5A. Males ($\chi^2(1, N = 238) = 8.79, p = .07, GFI = .99, CFI = .98, TLI = .96, RMSEA = .07 [.00- .14]$).



5B. Females ($\chi^2(1, N = 563) = 25.32, p < .001, GFI = .98, CFI = .97, TLI = .93, RMSEA = .10 [.07- .14]$).



*Note: * $p < .05$, ** $p < .01$, *** $p < .001$.*

DEP = Depression measured by the Depression subscale of Kessler's Psychological Distress Scale; ANX = Anxiety measured by the Anxiety subscale of Kessler's Psychological Distress Scale; SR = Sensitivity to reward measured by the Sensitivity to Reward Questionnaire (SRQ); PPSS = Personal propensity for sensation seeking measured by the Impulsive Sensation Seeking Scale (ISSS); BYNDS = Behaviour of Young Novice Drivers Scale