Are interactions in Gray's Reinforcement Sensitivity Theory proximal or distal in the prediction of religiosity: a test of the joint subsystems hypothesis

Chris J. Jackson[a,*], Leslie J. Francis[b]

[a]*School of Psychology, University of Queensland, Brisbane, QLD 4072, Australia*
[b]*Welsh National Centre for Religious Education, University of Wales, Bangor, Normal Site, Bangor, Gwynedd LL57 2PX, UK*

Abstract

Gray's Reinforcement Sensitivity Theory (RST) consists of the Behavioural Activation System (BAS) which is the basis of Impulsivity, and Behavioural Inhibition System (BIS) which is the basis of Anxiety. In this study, Impulsivity and Anxiety were used as distal predictors of attitudes to religion in the prediction of three religious dependent variables (Church attendance, Amount of prayer, and Importance of church). We hypothesised that Impulsivity would independently predict a Rewarding attitude to the Church and that Anxiety would independently predict an Anxious attitude to the church, and that these attitudes would be proximal predictors of our dependent variables. Moreover, we predicted that interactions between predictors would be proximal. Using structural equation modelling, data from 400 participants supported the hypotheses. We also tested Eysenck's personality scales of Extraversion and Neuroticism and found a key path of the structural equation model to be non-significant.
© 2003 Elsevier Ltd. All rights reserved.

Keywords: Gray; RST; BIS; BAS; Attitudes; Eysenck; Church; Proximal; Distal; Religiosity

1. Introduction

Gray's (1982, 1987) and Gray and McNaughton's (2000) Reinforcement Sensitivity Theory (RST) of personality is a biological model that also emphasizes animal learning paradigms. According to the model, Impulsivity has a biological basis in the Behavioural Activation System

---

(BAS), and Anxiety has a basis in the Behavioural Inhibition System (BIS). This model is most often thought of as a 45° rotation of Eysenck's model, but recent clarification suggests that Impulsivity is aligned at 30° to Extraversion, and Anxiety is aligned at 30° to Neuroticism (Pickering, Corr, & Gray, 1999). The theory suggests that highly impulsive people learn best from, and are motivated by, reward. On the other hand, people with heightened reactivity to the BIS are sensitive to fear and punishment, and therefore high scorers on anxiety are thought to learn best from, and be motivated by, punishment.

Originally, the BIS and BAS were thought to be sensitive to conditioned and not unconditioned stimuli, and this was thought to be a limitation on the applications of RST. Nevertheless, modern versions of the theory blur the distinction between conditioned and unconditioned stimuli with regard to BAS and BIS (Corr, 2002; Gray & McNaughton, 2000), and in real-life situations such distinctions are unclear anyway. This suggests that the BIS and BAS systems may underlie a more general learning system than originally envisaged by Gray and RST may therefore have wide applications in predicting real world behaviour (Corr, 2001; Jackson, 2001).

A recent review suggests there is little evidence in favour of Gray's RST over Eysenck's (1967, 1997) model of personality and that biological models may have little utility in comparison with cognitive and social models (Matthews & Gilliland, 1999). Corr (2001) replies that much work still has to be done in order to determine the usefulness of RST. In particular, Corr highlights the lack of psychometric work, and the lack of knowledge concerning interactions between the BAS and BIS systems.

The psychometric measurement of BIS and BAS systems remains confused. Some studies use Extraversion and Neuroticism from the EPQ (Eysenck & Eysenck, 1975) and EPS (Eysenck & Eysenck, 1991), while others have used or developed specific measures (e.g. Avila, 2001; Carver & White, 1994). Corr (2002) employs the Impulsivity (IVE) questionnaire from the Eysenck Personality Scales and measures Anxiety using the State-Trait Anxiety Inventory. Jackson (2001, 2002, in press) reports that the Impulsivity and Anxiety scales of the Eysenck Personality Profiler (EPP; Eysenck, Barrett, Wilson, & Jackson, 1992) may also be seen as effective measures of BAS and BIS within the framework of Gray's RST. Jackson shows that these EPP primary scales correlate in expected ways with a goal oriented criterion from the work-place and correlate with components of RST scales derived from the Gray–Wilson Personality Questionnaire (Wilson, Gray, & Barrett, 1990).

Generally, RST studies have assumed separate effects for the BAS and BIS systems (Avila, 2001; Corr, 2001; Pickering et al., 1997). This perspective suggests that the functional capacity of one system is independent of the functional capacity of the other (Pickering, 1997). Gray (1987, p. 180) argues that the behavioural outcome results from whichever system dominates the other. This leads to the belief that just one system is in exclusive control at any one time (the independent systems hypothesis).

A reciprocal inhibition process suggests that behavioural outcome results from an interaction between the BAS and BIS systems (the joint systems hypothesis). Some evidence suggests that the BIS system inhibits the BAS. Evidence comes from several sources: barbiturate drugs, which impair the BIS system, seem to enhance approach behaviour, which is usually associated with the BAS system (Kamano, Martin, & Powell, 1966); lesions in the septo-hippocampal system which impair BIS functioning seem to enhance BAS functioning (Albert & Bignami, 1968; Green, Beatty, & Schwartzbaum, 1967; Isaacson, Douglas, & Moore, 1961; Olton & Isaacson, 1968; Rabe & Haddad,

1969); that it is easier to transform an appetitive conditioned stimulus into an aversive conditioned stimulus than vice versa (Konorski, 1967; Konorksi & Szwejkowska, 1952); by the finding that anxiety moderates appetitive reactions in eyeblink startle responses (Corr, Wilson et al., 1995), induction of positive emotions (Larsen & Katelaar, 1991), instrumental approach behaviour (Corr, Pickering, & Gray, 1995a) and in appetitive classical conditioning (Mangan, 1978; Paisey & Mangan, 1988). From this perspective, we believe that the BIS system is more likely to inhibit the BAS system, than the BAS system to inhibit the BIS or both systems to mutually inhibit each other.

There is also some evidence that the BIS may moderate approach responses in studies using the startle reflex as a reaction to pleasant slides (Corr, Pickering, & Gray, 1995b); induction of positive emotions (Larsen & Katelaar, 1991); instrumental approach behaviour (Corr et al., 1995a) or approach oriented classical conditioning (Paisey & Mangan, 1988). One study found that Impulsivity was not related to reward but found relatively complex BIS and BAS interactions (Zinbarg & Mohlman, 1998).

Corr (2002) compares the separable subsystems hypothesis with the joint subsystems hypothesis using the acoustic startle reflex and a visual information processing task. Results suggested that impulsivity worked in antagonism to anxiety, and low anxiety and high impulsivity were found to produce the most disinhibition. Corr concludes that this is evidence in favour of the joint subsystems hypothesis.

All the above studies are experimental. In fact, little real world data are available for determining possible interaction effects between the BIS and BAS systems. Indeed, there have been few applications of Gray's RST to predicting real world behaviour outside of the clinical domain. One study reports that BAS predicts goal oriented work behaviour, and that it contributes additional variance to more cognitively based models (measured in terms of attributional style and interest in money; Jackson, 2001). Jackson (2002, in press) also reports that Gray's prototypic scales in which BAS and BIS are split into constituent parts are, at best, just moderate predictors of the surface scales of personality, and reports that some of the psychometric relationships between scales do not support the current understanding of RST.

In this study, we extend Jackson's (2001) applied RST study by incorporating proximal attitudes which may be thought of as a cognitive link between distal personality scales and behaviour. This follows the general technique advocated by Chen, Gully, Whiteman, and Kilcullen (2000) who used structural equation modeling to link distal traits to proximal states, which in turn were shown to predict academic performance. Moreover this approach mirrors the general approach of Cloninger (e.g. Cloninger, Svrakic, & Przybeck, 1993), which splits personality into temperament and character. Temperament is analogous to Gray's RST and, character is analogous to the conscious components of personality, which in this study is represented by attitudes. (It should however be noted that Cloninger's character components of personality are trait-like and not attitudinal.)

Given Chen et al.'s distinction between distal and proximal predictors of behaviour, it seems reasonable to suppose that interactions between BAS and BIS pathways may be either distal or proximal or both. However, Gray's original theory suggests relative independence of the biological pathways associated with BAS and BIS systems, so it seems likely that interaction effects may be more likely to occur amongst proximal attitudes than at the distal trait level. Moreover, it seems likely that prototypic scales of temperament will be less complex and therefore independent compared to more advanced character components of personality involving cognitions that are therefore more likely to combine in non-additive ways.

In this study, we are interested in predicting religiosity from distal RST scales and proximal attitude scales. Religious behaviour was measured with two dependent variables, which were Church attendance and Amount of prayer. We also predicted an attitudinal measure of Importance of the church, which we believed would also be predictable from RST.

How might distal scales of Gray's RST predict religiosity via proximal attitudes? First, the BAS represents learning from reward in the form of approaching rewarding stimuli or active avoidance of punishment (Wilson et al., 1990), so we predict that the BAS system will predict a reward oriented attitude to the church, but that this relationship will be *negative*. We propose that people who are high in BAS will find little positive reward in the church in terms of behavioural activation, since the reward is offered to the individual in the form of help (from God, the church, prayer, etc.), as opposed to being actively approached and taken. Our rewarding attitude to the church scale therefore consisted of 'help' items which reflect obtaining rewards with *low* behavioural activation.

We do, however, propose a positive relationship between a rewarding religious attitude and religious behaviour, in which the belief that religion provides help is seen as a positive predictor of Church attendance, Amount of prayer and Importance of the church. This prediction is based on the view that one of the key motivations underlying religious participation and activities is personal reward, either in terms of seeking external social support (extrinsic motivation) or in terms of internal personal development (intrinsic motivation). The research evidence has been documented by Batson, Schoenrade, and Ventis (1993).

Second, the BIS system represents anxiety and thus we propose a positive link between BIS and Anxious attitudes towards religion. This prediction is based on the view that another of the key motivations underlying religious participation and activities is related to anxiety reduction strategies, either in terms of sheltering under the wings of divine protection (Psalm 17:8) or in terms of seeking divine forgiveness (Psalm 51:1). The research evidence has been documented by Jones and Francis (submitted for publication).

Although we predict that mediational effects will be found proximally, our literature review, does not provide much guidance as whether Rewarding or Anxious attitudes are likely to be direct or indirect predictors. We therefore tested the following hypotheses:

1. Impulsivity will independently and negatively predict a Rewarding attitude to religion.
2. Anxiety will independently predict an Anxious attitude to religion.
3. Impulsivity and Anxiety will not directly predict religiosity once the variance from attitudes have been accounted for.
4. Either a Rewarding attitude or an Anxiety attitude will mediate the effect of the other.
5. Gray's RST will better predict religiosity than Eysenck's model.

2. Method

2.1. Sample

A sample of 400 first year undergraduate students participated in the project during their induction into being part of a research active academic community. All students attending the

induction programme agreed to participate in the project. The sample comprised 110 males and 290 females; 260 of the respondents were under the age of 20, 109 were in their twenties, and 31 were aged 30 or over. Nearly half the respondents were pursuing the BEd programme training to be teachers (47%), a further 47% were enrolled on BA programmes in the humanities and the remaining 7% were enrolled on BSc programmes. One in three of the respondents claimed no religious affiliation (33%). The largest denominational groups were Anglicans (27%), Roman Catholics (13%) and Methodists (7%). The remaining 20% identified other Christian denominations or sects. No other world faiths were represented. One in six of the respondents claimed to attend church weekly (17%), 51% claimed to attend church from time to time, and 32% claimed never to attend church.

2.2. Measures

Items from three well-established measures of religiosity, namely the Francis Scale of Attitude toward Christianity (Francis, Lewis, Philipchalk, Brown, & Lester, 1995), the intrinsic and extrinsic measures from the Religious Orientation Scales (Allport & Ross, 1967), and the revised measure of quest (Batson & Schoenrade, 1991a, 1991b), were used to construct scales reflecting attitudes to religion along the desired lines. The three attitudes scales reflected beliefs that religion is:

(a) associated with reward (10 items)
(b) associated with anxiety (10 items)
(c) important (10 items)

The items reflecting each scale are shown in full in the Appendix.

The Eysenck Personality Profiler (EPP; Eysenck et al., 1992; Jackson, Furnham, Forde, & Cotter, 2000) was also administered. It is a 440-item questionnaire designed to produce 22 20-item scales. Of these scales, seven relate to Extraversion, seven relate to Neuroticism and seven relate to Psychoticism. There is also a Lie scale. Each item is assessed on a three point scale: yes, no, and can't decide. The present paper draws on the Impulsivity and Anxiety scales and the overall Extraversion and Neuroticism scales. Impulsivity represented BAS and Anxiety represented BIS, a procedure validated by Jackson (2001, 2002, in press).

We also asked participants to report amount of church attendance and amount of prayer. These are single item objective scales with the following response categories 1 = Never, 2 = Once or twice year, 3 = Sometimes, 4 = Monthly, and 5 = Weekly.

2.3. Data analysis

We report results of structural equation modelling using LISREL 8 (Joreskog & Sorbom, 1993). We set the error variance of the latent variables to be (1−the reliability of the scales) and estimated that a reasonable error variance for the two dependent single item variables (Church attendance and Amount of prayer) could be set to 0.1 (Hayduk, 1987). We took the following measures of goodness of fit: chi-squared, comparative fit index (CFI), goodness of fit index (GFI), adjusted goodness of fit index (AGFI) and the root mean square error of approximation (RMSEA). Researchers generally agree that a score of 0.90 or higher for GFI, AGFI and CFI

and a score of 0.05 or lower for RMSEA together with non-significance of chi-squared indicate a good model fit.

3. Results

Means, standard deviations, reliabilities (coefficient alphas) and intercorrelations are presented in Table 1. We note that Impulsivity is significantly correlated with Extraversion ($r = 0.39**$) and Anxiety is positively correlated with Neuroticism ($r = 0.88**$) in much the way that BAS and BIS scales respectively could be predicted to have relationships with Extraversion and Neuroticism. In general, the pattern of correlations was generally as expected, except that Extraversion did not significantly predict a Rewarding attitude to the church. Key to this study is evidence that BAS negatively predicted Reward, BIS predicted Anxiety, and that Reward and Anxiety attitudes predict Church attendance, Personal Prayer and Importance of Church. In general, Impulsivity, Anxiety, Extraversion and Neuroticism do not, or only weakly, directly predict our dependent variables.

We tested our hypotheses by structural equation modelling (Fig. 1). Six models are reported. Three models use Impulsivity and Anxiety scales to predict Church attendance, Amount of prayer and Importance of church separately; and three models use Extraversion and Neuroticism to predict Church attendance, Amount of prayer and Importance of church separately. For each model the personality scales were used as distal predictors of the proximal reward and anxious attitudes, which in turn were used to predict each of the three dependent variables. All paths in the model in Fig. 1 are significant ($P < 0.05$).

We found evidence that trait Anxiety independently predicts an Anxious attitude about the church, and that Impulsivity independently and negatively predicts a Rewarding attitude. We

Table 1
Means, Standard deviations, alphas and correlations ($N = 400$)

|	M	S.D.	Alpha	CA	PP	I	A	R	BIS	BAS	E
Dependent variables											
Church attendance (CA)	2.53	1.41	–								
Personal prayer (PP)	2.60	1.38	–	0.66**							
Importance (I)	35.38	13.03	0.85	0.66**	0.70**						
Proximal predictors (attitudes)											
Anxious (A)	40.73	13.26	0.77	0.33**	0.39**	0.58**					
Reward (R)	29.57	10.87	0.97	0.66**	0.79**	0.84**	0.47**				
Distal predictors (biological basis)											
Anxiety (BIS)	21.30	9.15	0.82	0.05	0.03	0.12*	0.26**	0.06			
Impulsivity (BAS)	20.96	7.38	0.77	−0.13**	−0.10*	−0.08	−0.02	−0.14**	−0.03		
E	103.12	30.06	0.89	−0.05	−0.01	−0.01	0.01	−0.01	−0.15**	0.39**	
N	114.37	45.57	0.95	0.01	0.02	0.10*	0.28**	0.03	0.88**	0.06	−0.11*

 * $P < 0.05$.
 ** $P < 0.01$.
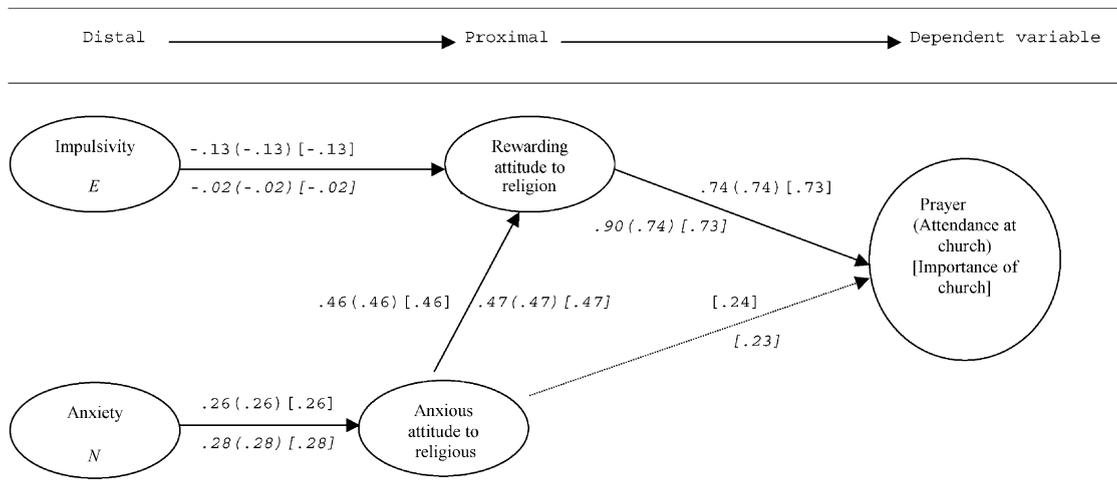
Fig. 1. Standardized path coefficients for the prediction of prayer, (attendance at church) and [importance of church] from religious attitudes and Gray's Reinforcement Sensitivity Theory. Coefficients above the arrows are from the RST model and lower coefficients (in italics) are from Eysenck's model. All values are significant ($P < 0.05$), except for the Extraversion link with a rewarding attitude towards religion. The dotted arrow represents an extra path between Anxious attitude to religion and Importance of church which was required to achieve high goodness of fit.

found that Rewarding attitudes mediated Anxious attitudes in the prediction of religiosity. In the case of predicting Importance of the church, an Anxious attitude to the church was also a direct predictor. An Anxious attitude to the church did not directly predict the two other dependent variables.

Each of the three models assessing BAS and BIS as distal predictors of religiosity had excellent goodness of fit as indicated by our measures of χ^2, CFI, AGFI and GFI and RMSEA (Table 2).

We then tested various alternative models to determine if alternative solutions might be of interest. We found that paths between Impulsivity and Anxious attitudes, and Anxiety and Rewarding attitudes were not significant. Results of extra exploratory paths directly between Anxiety and Impulsivity to the religiosity dependent variables, and predicting the religiosity from Rewarding attitudes mediated by Anxious attitudes are shown in Table 3. In summary, we found

Table 2
Goodness of fit summary for the structural equation models

DV	Chi^2	df	P	RMSEA	GFI	CFI	AGFI
Imp/Anx							
Prayer	4.88	5	0.43	0.00	1.00	1.00	0.99
Attendance	5.55	5	0.35	0.02	0.99	1.00	0.98
Importance	4.13	4	0.38	0.01	1.00	1.00	0.98
E/N							
Prayer	8.54	5	0.12	0.04	0.99	0.99	0.97
Attendance	8.87	5	0.11	0.11	0.99	0.99	0.97
Importance	6.45	4	0.17	0.04	0.99	1.00	0.98

Table 3
Significance of paths that modify the RST structural models

Path	DV	Beta	P	Comment on goodness of fit
Impulsivity directly predicts dependent variable[a]	Prayer	0.01	ns	All very good
	Church	0.02	ns	All very good
	Importance	0.00	ns	All very good
Anxiety directly predicts dependent variable[a]	Prayer	−0.01	ns	All very good
	Church	−0.05	ns	All very good
	Importance	−0.01	ns	All very good
Anxious attitude directly predicts dependent variable[a]	Prayer	0.05	ns	All very good
	Church	0.05	ns	All very good
	Importance	0.24	<0.05	As reported in Table 2
Reward attitude predicts Anxious attitude and Anxious attitude predicts dependent variable[b]	Prayer	0.45, 0.45	<0.05, <0.05	All below acceptable limits
	Church	0.45, 0.38	<0.05, <0.05	All below acceptable limits
	Importance	0.48, 0.57	<0.05, <0.05	All below acceptable limits

[a] Extra path to those shown in Fig. 1.
[b] After deleting the Anxious attitude→Rewarding attitude and Rewarding attitude→Dependent variable paths.

that the distal BAS and BIS scales did not directly predict religiosity in addition to the specified model. We also found that the role of Anxious attitudes as a mediator between Rewarding attitudes and religiosity was significant. However, the general goodness of fit of the models was unacceptably low in each of the three models.

We also tested three models in which Extraversion is substituted for Impulsivity and Neuroticism for Anxiety. However, whilst excellent goodness of fit models could be achieved (see Table 2), we could not find a significant link between Extraversion and a Rewarding religious attitude.

4. Conclusion

Our a priori model of the relationship between distal RST scales and proximal attitudinal scales was a robust predictor of religious behaviour (measured as Church attendance and Amount of prayer). We know this because our goodness of fit indices were all high and all hypothesised paths are significant. The model was also a good predictor of Church importance, except that a further path between Anxious attitude to the church and Church importance had to be specified in order to achieve high goodness of fit.

In line with our hypotheses, we found that Impulsivity negatively predicted a Rewarding attitude to the church, and Anxiety positively predicted an Anxious attitude. When modifying our hypothesised model, we did *not* find that Impulsivity predicts an Anxious attitude and trait Anxiety predicts a Rewarding attitude. The suggestion here is that RST scales of BAS (measured as Impulsivity) and BIS (measured as Anxiety) independently predict proximal attitudes. This

finding supports Gray's original view that RST scales do not distally interact together. As such, we did not find evidence in favour of a joint subsystem hypothesis in Gray's distal reward and punishment systems.

Whilst, Rewarding attitudes directly predicted religiosity, we found that an Anxious attitude was mediated by Rewarding attitudes. This supports our general hypothesis that interactions in the reward and punishment systems are proximal and therefore that the joint subsystem is proximally located. In this study we find that Anxious attitudes inhibit Rewarding attitudes in the prediction of religious behaviour. Since we think that this is the first study of this type, it is unknown if such results generalize to other fields outside of religiosity.

We were not surprised that an extra path was necessary to predict Church importance attitudes from Anxious attitudes, because (a) they are both attitudes and we are suggesting relationships between attitudes are relatively complex and (b) because of the possibility of common error variance such as halo effects between these attitude measures that would increase the correlation between the variables.

To support the notion that Anxious attitudes only indirectly predict religiosity, we modified the model so that Anxious attitudes mediated the relationship between Rewarding attitudes and the dependent variables. Although the paths were significant, the overall model was rejected due to unacceptably low goodness of fit on all measured indices. As such, there is no evidence that Anxious attitudes mediate the relationship between Rewarding attitudes and religiosity.

This study adds to the body of knowledge concerning interactions between the BAS and BIS systems. Most studies are experimental and do not draw on a distinction between distal and proximal predictors. Results of this study, which is one of the few to utilise real world measures of behaviour, suggest that this inhibition does take place, but that it takes place at the attitudinal (which Matthews and Gilliland, 1999, would probably term the cognitive level and Cloninger would term the character level) as opposed to Gray's distal or biological model. We urge that further studies of possible interaction effects measure both distal and proximal predictors to determine the generality of the proposed model. Results of this study certainly shed light on the location of interactions between these two important pathways, such that evidence in favour of the joint subsystems hypothesis can only be found proximally.

We also tested the possibility that the RST scales of Impulsivity and Anxiety may directly predict behaviour in addition to the mediational effects of the proximal attitudes. Paths linking Impulsivity and Anxiety scales to the dependent variables were all non-significant, which suggests that RST does not directly predict outcomes. Our finding that the biological basis of RST scales is mediated by attitudes, or cognitions in the form of attitudes, supports the view of Matthews and Gilliland (1999) that the cognitive basis of behaviour has more of a direct and stronger predictive basis than that provided by biological models. However, it is also important to recognise that the more general BAS and BIS systems also predict specific attitudes towards religion, so it may be that many other attitudes also have a basis in these systems. However, this is yet to be tested.

We also determined if Eysenck's scales of Extraversion and Neuroticism could be substituted for Impulsivity and Anxiety respectively. Although, our goodness of fit indices were more than satisfactory, no significant path between Extraversion and a Rewarding attitude could be identified. This finding suggests that Eysenck's model has little applicability to the

prediction of our dependent variables when mediated by Rewarding and Anxious attitudes. The suggestion here is that Gray's model has more applicability to the prediction of religiosity than Eysenck's.

Finally, it is interesting to note that this study provides one definition of what low behavioural activation might reflect. Clearly, it is not to do with punishment since this would reflect the independent BIS scale as opposed to low BAS. Instead, low BAS seems to be related to obtaining help (i.e. rewards) passively as a result of, for example, prayer as opposed to actively going out to get rewards.

In summary, this study provides evidence in favour of Gray's RST being mediated by attitudes in the prediction of religiosity. We find that Anxious attitudes tend to inhibit Rewarding attitudes, and that Gray's RST has only an indirect effect in the prediction of the dependent variables.

Appendix

Importance of church attitude

1. The church is very important to me
2. I think going to church is a waste of my time
3. Jesus doesn't mean anything to me
4. The idea of God means much to me
5. God wasn't very important until I began to ask questions
6. I believe religious feelings are one of the more important things in life
7. It is important to spend time in private religious thought and meditation
8. Religion is very important to me
9. Religion is important because it answers many questions about life
10. I was not interested in religion until I asked questions about the meaning of life

Rewarding attitude to religion items

1. Saying my prayers helps me a lot
2. God helps me to lead a better life
3. I like to learn about God very much
4. God means a lot to me
5. Prayer helps me a lot
6. I know that Jesus is very close to me
7. I think praying is a good thing
8. I believe that God listens to prayers
9. I believe that Jesus still helps people
10. I know that God helps me

Anxious attitude to the church

1. It might be said I value my religious doubts and uncertainties
2. The primary purpose of prayer is to gain relief and protection
3. I pray chiefly because I have been taught to pray
4. I am driven to ask religious questions out of an awareness of world tensions
5. My life experiences have led me to rethink my religious convictions
6. Doubting is an important part of what it means to be religious
7. I find religious doubts upsetting
8. I am constantly questioning my religious beliefs
9. Religion develops from a growing sense of personal identity
10. The purpose of prayer is to secure a happy and peaceful life

References

Albert, M., & Bignami, G. (1968). Effects of frontal medial cortical and caudate lesions on two-way avoidance learning by rats. *Physiology and Behaviour*, *3*, 141–147.

Allport, G. W., & Ross, J. M. (1967). Personal religious orientation and prejudice. *Journal of Personality and Social Psychology*, *5*, 432–443.

Avila, C. (2001). Distinguishing BIS-mediated and BAS-mediated disinhibition mechanisms: a comparison of disinhibition models of Gray (1981, 1987) and of Patterson and Newman (1993). *Journal of Personality and Social Psychology*, *80*, 311–324.

Batson, C. D., & Schoenrade, P. A. (1991a). Measuring religion as quest: validity concerns. *Journal for the Scientific Study of Religion*, *30*, 416–429.

Batson, C. D., & Schoenrade, P. A. (1991b). Measuring religion as quest: Reliability concerns. *Journal for the Scientific Study of Religion*, *30*, 430–447.

Batson, C. D., Schoenrade, P., & Ventis, W. K. (1993). *Religion and the individual: a social-psychological perspective*. Oxford: Oxford University Press.

Carver, C. S., & White, T. (1994). Behavioral inhibition, behavioural activation, and affective responses to impending reward and punishment: the BIS/BAS scales. *Journal of Personality and Social Psychology*, *67*, 319–333.

Chen, G., Gully, S. M., Whiteman, J. A., & Kilcullen, R. N. (2000). Examination of relationships among trait-like individual differences, state-like individual differences and learning performance. *Journal of Applied Psychology*, *85*, 835–847.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry*, *50*, 975–990.

Corr, P. J. (2001). Testing problems in J. A. Gray's Personality Theory: a commentary on Matthews, G. and Gilliland, K. (1999). The personality theories of H. J. Eysenck and J. A. Gray: a comparative review. *Personality and Individual Differences*, *30*, 333–352.

Corr, P. J. (2002). J. A. Gray's reinforcement sensitivity theory: tests of the joint subsystems hypothesis of anxiety and impulsivity. *Personality and Individual Differences*, *33*, 511–532.

Corr, P. J., Pickering, A. D., & Gray, J. A. (1995a). Personality and reinforcement in associative and instrumental learning. *Personality and Individual Differences*, *19*, 47–71.

Corr, P. J., Pickering, A. D., & Gray, J. A. (1995b). Personality, punishment and procedural learning: a test of J. A. Gray anxiety theory. *Journal of Personality and Social Psychology*, *73*, 337–344.

Corr, P. J., Wilson, G. D., Fotiadou, M., Kumari, V., Gray, N. S., Checkley, S., & Gray, J. A. (1995). Personality and affective modulation of the startle reflex. *Personality and Individual Differences*, *19*, 543–553.

Eysenck, H. J. (1967). *The biological basis of personality*. Springfield, IL: Charles C. Thomas.

Eysenck, H. J. (1997). Personality and experimental psychology: the unification of psychology and the possibility of a paradigm. *Journal of Personality and Social Psychology*, *73*, 1224–1237.

Eysenck, H. J., Barrett, P., Wilson, G., & Jackson, C. J. (1992). Primary trait measurement of the 21 components of the P-E-N system. *European Journal of Psychological Assessment*, *8*, 109–117.

Eysenck, H. J., & Eysenck, S. B. G. (1975). *The Eysenck Personality Questionnaire*. London: Hodder & Stoughton.

Eysenck, H. J., & Eysenck, S. B. G. (1991). *The Eysenck Personality Scales*. London: Hodder & Stoughton.

Francis, L. J., Lewis, J. M., Philipchalk, R., Brown, L. B., & Lester, D. (1995). The internal consistency reliability and construct validity of the Francis scale of attitude toward Christianity (adult) among undergraduate students in the UK, USA, Australia and Canada. *Personality and Individual Differences*, *19*, 949–953.

Gray, J. A. (1982). *The neuropsychology of anxiety: an enquiry into the functions of the septo-hippocampal system*. Oxford: Oxford University Press.

Gray, J. A. (1987). *The psychology of fear and stress*. Cambridge: Cambridge University Press.

Gray, J. A., & McNaughton, N. (2000). *The neuropsychology of anxiety* (2nd ed.). Oxford: Oxford University Press.

Green, R. H., Beatty, W. W., & Schwartzbaum, J. S. (1967). Comparative effects of septo-hippocampal and caudate lesions on avoidance behaviour in rats. *Journal of Comparative Neurology and Psychology*, *64*, 444–452.

Hayduk, L. A. (1987). *Structural equation modeling with LISREL: essentials and advances*. Baltimore, USA: Johns Hopkins University Press.

Isaacson, R. L., Douglas, R. J., & Moore, R. Y. (1961). The effect of radical hippocampal ablation on acquisition of avoidance response. *Journal of Comparative and Physiological Psychology*, *54*, 625–628.

Jackson, C. J. (2001). Comparison between Eysenck & Gray's models of personality in the prediction of motivational work criteria. *Personality and Individual Differences*, *31*, 129–144.

Jackson, C. J. (2002). Mapping Gray's model of personality onto the Eysenck Personality Profiler (EPP). *Personality and Individual Differences*, *32*, 495–507.

Jackson, C. J. (2003). Gray's Reinforcement Sensitivity Theory: a psychometric critique. *Personality and Individual Differences*, *34*, 533–544.

Jackson, C. J., Furnham, A. F., Forde, L. D., & Cotter, T. (2000). The dimensional structure of the Eysenck Personality profiler. *British Journal of Psychology*, *91*, 223–239.

Jones, S. H., & Francis, L. J. The relationship between religion and anxiety: a study among Anglican clergymen and women. *Journal of Psychology and Theology* (in press).

Joreskog, K. G., & Sorbom, D. (1993). *LISREL 8: Structural Equation Modeling with the SIMPLIS Command Language*. Mooresville, 111: Scientific Software.

Kamano, D. K., Martin, L. K., & Powell, B. J. (1966). Avoidance response acquisition and amobarbital dosage levels. *Psychopharmacologia*, *8*, 319–323.

Konorski, J. (1967). *Integrative activity of the brain*. Chicago: University of Chicago Press.

Konorski, J., & Szwejkowska, G. (1952). Chronic extinction and restoration of conditioned reflexes: IV. The dependence of the course of extinction and restoration of conditioned reflexes on the 'history' of the conditioned stimulus (the principle of the primary of first training). *Acta Biologiae Experimentalis*, *17*, 141–165.

Larsen, R. J., & Katelaar, T. (1991). Personality and susceptibility to positive and negative emotional states. *Journal of Personality and Social Psychology*, *61*, 132–140.

Mangan, G. L. (1978). Factors of conditionability and their relationship to personality types. *Pavlovian Journal of Biological Science*, *13*, 226–235.

Matthews, G., & Gilliland, K. (1999). The personality theories of H. J. Eysenck and J. A. Gray: a comparative review. *Personality and Individual Differences*, *26*, 583–626.

Olton, D. S., & Isaacson, R. L. (1968). Hippocampal lesions and active avoidance. *Physiology and Behaviour*, *3*, 719–724.

Paisey, T. J. H., & Mangan, G. L. (1988). Personality and conditioning with appetitive and aversive stimuli. *Personality and Individual Differences*, *9*, 69–78.

Pickering, A. D. (1997). The conceptual nervous system and personality: from Pavlov to neural networks. *European Psychogist*, *2*, 139–163.

Pickering, A. D., Corr, P. J., & Gray, J. A. (1999). Interactions and reinforcement sensitivity theory: a theoretical analysis of Rusting and Larsen (1997). *Personality and Individual Differences*, *26*, 357–365.

Pickering, A. D., Corr, P. J., Powell, J. H., Kumari, V., Thornton, J. C., & Gray, J. A. (1997). Individual differences in reactions to reinforcing stimuli are neither black nor white: to what extent are they gray? In H. Nyborg (Ed.), *The scientific study of human nature: tribute to Hans J. Eysenck at eighty* (pp. 36–67). London: Elsevier Sciences.

Rabe, A., & Haddad, A. K. (1969). Acquisition of two-way shuttle-box avoidance after selective hippocampal lesions. *Physiology and Behaviour*, *4*, 319–323.

Wilson, G., Gray, J., & Barrett, P. (1990). A factor analysis of the Gray–Wilson personality questionnaire. *Personality and Individual Differences*, *11*, 1037–1045.

Zinbarg, R. R., & Mohlman, J. (1998). Individual difierences in acquisition of affectively valenced associations. *Journal of Personality and Social Psychology*, *74*, 1024–1040.