



**Origins and structure of social and political attitudes:  
Insights from personality system theory and behavioural genetics**

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## Declaration

I hereby declare that this thesis is of my own composition, and that it contains no material previously submitted for the award of any other degree. The work reported in this thesis has been executed by myself, except where due acknowledgement is made in the text.

.....

Gary J. Lewis

## For Billy

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## Abstract

People differ, often strikingly, in their views on desired social structures and processes. For example, while some value ethnic diversity in their society, others believe non-indigenous individuals (whatever that might mean) should be repatriated to their land of origin. Similarly, whereas some believe religion should play no role in determining social policy, others strongly advocate the importance of living according to religious scripture, including at a social level. This variation in attitudes, and its implication for societal cohesion, has made research on the origins of social and political attitudes of enduring interest to psychologists, sociologists, political scientists, among many others.

The goal of the current thesis was to extend work in this literature in two key ways: Firstly, I examined whether political attitudes can be understood within a personality system model. This work addresses previous mixed results on the links of basic personality traits to political conservatism. In Chapter 3, I test predictions from this model; namely, that direct influences on political behaviour flow from moral values, with personality mostly acting indirectly via these moral values, rather than directly affecting political attitudes. Findings from two studies (published as Lewis & Bates, 2011a) supported these predictions suggesting that the new model helps explain inconsistencies in previous research attempting to link personality to political orientation that have not included the intermediary level of values.

Secondly, I examined the genetic architecture of social attitudes constructs in three separate studies. Chapter 4 addressed whether in-group favouritism reflects heritable effects, and, secondly, whether race-favouritism was accounted for broad or specific genetic effects. Results indicated that a common biological mechanism exists facilitating generalised favouritism, with evidence for additional genetic effects specific to each form of group favouritism. These findings

(published as Lewis & Bates, 2010) suggest that (at least) at the genetic level, race favouritism is multiply determined.

In Chapter 5, I examined whether prosocial obligations across the domains of welfare, work, and civic obligation share a common genetic basis, or reflect specific heritable components (published as Lewis & Bates, 2011b). In females, results indicated the existence of a common heritable factor underlying each of these prosocial obligations. In males, a prosocial factor was also observed; familial effects (genetic and shared-environment effects were indistinguishable) influenced this general mechanism. At the domain-specific level, modest genetic effects were observed in females for civic and work obligations, with shared-environment effects influencing welfare obligations. In males, genetic influences were observed for welfare obligation, with unique-environments affecting work and civic duty.

Finally, in Chapter 6, I present work examining the genetic architecture of religious belief. Although genetic factors are known to influence strength of religious belief, the psychological mechanism(s) through which this biological influence is manifest are presently unknown. Two non-theological constructs – 1) need for community integration and 2) need for existential certainty – were hypothesised to account for the genetic effects on religiosity. The results supported this hypothesis, with genetic influences on these traits wholly accounting for the heritable basis of religiosity, suggesting that religion “re-uses” systems involved in meeting both social and existential needs.

### **A Note on Personal Pronouns**

This thesis is based on published work to a large extent. In order to maintain consistency with the published literature, and to acknowledge the collaborative nature of the work, “we” rather than “I” is used throughout all empirical chapters.

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## **Chapter One - Individual Differences in Social and Political Attitudes: An Overview**

*I often think it's comical; Nature always does contrive!*

*That every boy and every gal that's born into the world alive*

*Is either a little Liberal, Or else a little Conservative! Fal, lal, la!*

W.S. Gilbert and A. Sullivan

### 1.1 Homo Politicus: An Introduction

Considerable individual differences exist in social and political attitudes. For example, data from the US General Social Survey 2010 indicates that around 25% of Americans would prefer homosexual books removed from public libraries, and around 20% want gays to be banned from teaching in schools (Smith, Marsden, Hout, & Kim, 2011). In the same survey almost 60% felt unrestricted access to abortion treatments was wrong (with, interestingly, little difference by gender), and more than 50% believed that anti-American Muslim clergymen should not be allowed to speak in public.

In Europe, similar variability in socio-political attitudes is apparent. For example, while religious belief is less prevalent (as compared to the US), a recent survey still suggests that around a third of Britons feel that religious leaders should play a more prominent role in social issues (YouGov, 2010). 24% feel that academic freedom should not extend to potentially offensive or racist conclusions (vs. 44% who felt academics should be free irrespective of their conclusions: 32% entered 'neither' or 'not sure'; YouGov, 2011a), and 49% oppose gay marriage (vs. 42% who are in support: 9% entered 'don't know'; YouGov, 2011b).

With this variability in mind, and the implications of such differences in opinion for societal cohesion, the goal of this thesis is to further current understandings of the origins of

social and political attitudes, with a particular focus on political conservatism, in-group favouritism, prosociality, and religious belief. Specifically, I present work from two research traditions: firstly, I examine the role of personality system theory (McCrae & Costa, 1999) as a model framework for understanding the aetiology of political conservatism (Chapter 3); secondly, in three studies I examine the genetic architecture of 1) in-group favouritism, 2) prosocial obligations, and 3) religious belief (Chapters 4-6). Before the bases of this work are detailed in full, however, it is necessary to provide an overview of work in the field to date. This overview is provided next (Section 1.2), followed by detail concerning the specific questions addressed in this thesis (Section 1.3).

## 1.2 Origins of Social and Political Attitudes: An Overview

Confronted with variation across many spheres of social and political attitudes, a natural and important question arises concerning the origins of these individual differences: *why* do people vary in their views on issues such as immigrants, the importance of religion in their lives, and welfare economics? In the coming sections I review research conducted since the Second World War on the antecedents of social and political attitudes. This review is necessarily selective (the relevant literature is simply too vast to satisfactorily summarise at this time), although broadly representative of major perspectives in the field. Additionally, while major works are detailed, these bodies of research do not form a single, cohesive explanation of human social and political attitudes; rather they remain a disparate set of ideas concerning the origins of socio-political attitudes such as prejudice, political conservatism, and religiosity. Indeed, one of the core aims of this thesis is to examine an aetiological model of political attitudes which integrates personality, values, and political sentiment (see Chapter 3).

I begin this review section with the highly-influential work of Frenkel-Brunswik and colleagues (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950). Building on Freudian psychoanalytic models of the mind, these researchers endeavoured to account for fascism in terms of the so-called “authoritarian personality”. I then detail classical and operant conditioning (Pavlov, 1927; Watson 1924/1931) and social imitation models (e.g. Bandura, Ross, & Ross, 1961) of human social and political behaviour, before moving toward work initiated in the 1950s and 60s examining situational determinants of social attitudes and behaviour, such as the role of resource conflict in generating prejudice (e.g. Sherif, 1966). More recent developments (from the 1980s to present day) are then addressed, incorporating trait-based approaches, such as the Big Five model of personality (Costa & McCrae, 1992), as explanations of social and political attitudes. Finally, the emergence over the last decade of biological models of attitudes drawing from work in evolutionary psychology (e.g. Schaller & Duncan, 2007) and behavioural genetics (e.g. Alford, Funk, & Hibbing, 2005) are described.

### 1.2.1 The Authoritarian Personality

Following the Nazi atrocities prior to and during World War Two, intense interest developed in understanding the origins of prejudice and discrimination (Duckitt, 1992). It was from this backdrop that the highly-influential publication, *The Authoritarian Personality* (Adorno et al., 1950) emerged. The authoritarian personality was characterised as a clustering of traits (conventionalism, authoritarian submission, authoritarian aggression, anti-intraception (a general opposition to subjective or imaginative tendencies), superstition and stereotypy, power and “toughness”, destructiveness and cynicism, projectivity (projecting the anxiety producing id impulse onto “inferior” or minority groups), and exaggerated concerns with sex; p. 228) with the

fundamental origins of the authoritarian personality couched within Freudian (1923/1962) psychoanalytic theory, and emphasising the importance of early childhood experiences as the driving influence on attitudes (Adorno et al., 1950).

This psychoanalytic interpretation argued that rearing by a strict, authoritarian father would facilitate the development of a strong super-ego (conscience, or socially acceptable component of mind, and derived from identification with the father; Freud, 1923/1962). A strong super-ego, in turn, leads to the repression of unconscious desires. These repressed drives are then able to be expressed or satisfied only when the individual projects them onto other people. These “others” must be people whom it is acceptable to aggress against, thus minorities are typically targeted, particularly if social sanctions are weaker for such aggression. Authoritarians will thus often utilise socially accepted prejudices as an outlet for the sublimated needs of their id (according to this theory). As Adorno et al. (1950) conclude, “*A basically hierarchical, authoritarian, exploitative parent-child relationship is apt to carry over into a power-oriented, exploitively dependent attitude towards one's sex partner and one's God and may well culminate in a political philosophy and social outlook which has no room for anything but a desperate clinging to what appears to be strong and a disdainful rejection of whatever is relegated to the bottom...[and] the formation of stereotypes and of ingroup-outgroup cleavages. Conventionality, rigidity, repressive denial, and the ensuing break-through of one's weakness, fear and dependence are but other aspects of the same fundamental personality pattern, and they can be observed in personal life as well as in attitudes toward religion and social issues*” (p. 971).



### 1.2.1.1 Challenges to the Authoritarian Personality

Although *The Authoritarian Personality* was highly-influential (Duckitt, 1992), a number of challenges to its arguments have appeared in the literature. For example, psychoanalytic interpretations are commonly argued to be unfalsifiable and thus to be intrinsically of no use as accounts of behaviour (e.g. Crews, 1996). Moreover, the theory has been criticised as a source of insight into the origins of authoritarianism. McCourt, Bouchard, Lykken, Tellegen, and Keyes (1999), for instance, reported that right-wing authoritarianism (RWA: Altemeyer, 1981), a measure inspired by the work of Adorno et al. (1950), does not show a significant effect of shared-environment (which is commonly conceived to reflect rearing conditions), falsifying the claim that parental upbringing is a substantive source of the authoritarian personality syndrome. As such, while the work of Adorno et al. (1950) generated enormous interest in the prejudice and conservatism literature (Duckitt, 1992), it may ultimately be remembered more for its misgivings than for its putative insights into prejudice and discrimination (Martin, 2001).

### 1.2.2 Conditioning and Modelling

Alongside the psychoanalytic approach, psychology in the 1950s and 60s saw the development of conditioning (e.g. Watson, 1924/1931; Skinner, 1971) and social-learning and modelling (e.g. Bandura, 1973) frameworks of human behaviour. These perspectives, too, came to bear directly on thinking related to the origins of social and political sensibilities. The Jesuit maxim "*Give me the child until he is seven, and I will show you the man*" is among the most well-known suggestions that conditioning is a significant influence on lasting attitudes and beliefs. Two prominent models of conditioning (classical and operant) are now briefly



introduced, followed by an introduction to social-learning theory and imitation models of attitude formation and behaviour.

#### 1.2.2.1 Classical Conditioning

Classical conditioning was pioneered by Ivan Pavlov (1927). Pavlov distinguished between unconditioned stimuli (US) and their unconditional responses (UR): for instance, food (US) and salivation (UR), and the possibility of creating responses to arbitrary “conditioned stimuli” – so-called conditioned responses (CR). The conditioned stimulus (CS) is any neutral stimulus that does not initially generate the UR, such as the ringing of a bell. Conversely, the US evokes an innate, reflexive, response (as inhaling noxious fumes would likely provoke a coughing reflex). When the CS is repeatedly presented prior to the appearance of the US, the organism develops a response to the CS as if it was the US: for instance, salivating to a bell (Pavlov, 1927).

It was clear to Pavlov and others that this form of conditioning might have important implications for understandings concerning the origins of human behaviour, including political behaviour. For example, Razran (1940) exposed participants to a variety of slogans, such as “*Workers of the world, unite!*” under one of three conditions: 1) sitting in a neutral setting, 2) eating a free lunch, or 3) inhaling noxious odours. Participants subsequently showed increased agreement with the slogans paired with a free lunch, and a decrease in agreement with slogans paired with noxious smells. Similarly, Stuart, Shimp, and Engle (1987) demonstrated that pairing an unknown brand of toothpaste with a positive stimulus (e.g. a pleasant landscape image), significantly increased the desirability of the product when compared to a control group.

### 1.2.2.2 Operant Conditioning

Operant conditioning differs from classical conditioning in that the former does not depend on simply linking a pre-existing unconditional response to a conditioned stimulus, but rather seeks to generate new responses in the organism, requiring the organism to “operate” on the environment in order to receive reinforcement or avoid punishment. Operant conditioning became associated with a blank-slate model of human behaviour (Pinker, 2002), suggesting that most, if not all, behaviours could be elicited and maintained in any individual with suitable conditioning (Skinner, 1971). This idea was perhaps most famously described by John B. Watson, who famously stated, “*Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I’ll guarantee to take anyone at random and train him to become any type of specialist I might select – doctor, lawyer, artist, merchant-chief, and yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors*” (Watson 1924/1931, p. 104)<sup>1</sup>.

Empirical studies of the efficacy of operant conditioning of attitudes commonly involved an experimenter interviewing a participant on his or her attitudes. Throughout the interview the experimenter would signal approval (e.g. smiling) or disapproval (e.g. frowning). The participant is subsequently re-interviewed after a delay, the prediction being that conditioning (reward and punishment) will have led to attitude change. In support of this theory, Insko (1965) reported that responses of 70 individuals to an attitude survey were significantly influenced by a telephone conversation one week earlier, in which specific opinions had been “rewarded” by the confederate interviewer with the verbal reinforcer “good”.

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<sup>1</sup> Interestingly, the next line of this passage, frequently omitted when cited in the literature, indicates Watson was somewhat less confident of his position than commonly conceived: “*I am going beyond my facts and I admit it, but so have the advocates of the contrary and they have been doing it for many thousands of years*”

Perhaps the most notorious example of the use of operant conditioning to shape social and political beliefs is the attempt of the Chinese to indoctrinate United Nations prisoners (c. 20,000 men) towards their own political beliefs, during the Korean War in the 1950s: “*The prisoners were surprised that they were expected to think of themselves as students of politics under the tutelage of their guards. They soon learned, however, that their treatment, and therefore their survival, depended on how far their political convictions please their captors*” (Brown, 1996, p. 54). This attempt at indoctrination was noted to have had short-term effects, as captives were swayed by social isolation and continued harassment (Lifton, 1961); however, long-term effects were not observed, particularly once these individuals had been returned to their homelands (Lifton, 1961), suggesting that the extent to which reinforcement schedules exert an influence are perhaps limited in scope, an issue discussed in more detail below.

### 1.2.2.3 Challenges to the Conditioning Perspective

Conditioning has demonstrable capabilities to shape both attitudes and behaviour (e.g. Insko, 1965; Razran, 1940). Important questions remain, however, over the extent to which this form of influence can account for the variance observed in social and political attitudes. Certainly, the radical behaviourist notion that any outcome can be achieved given the appropriate reinforcement schedule (Watson, 1924/1931) is likely to be flawed. As Pinker (2002) notes: “*this theory [leaves us] without a good answer to the question “Why are people smarter than rats?”*” (p. 21). Cacioppo, Marshall-Goodell, Tassinari, and Petty (1992) observed that conditioning effects are stronger for non-words (made-up phrases and neologisms) than for existing real words, suggesting that prior knowledge can dilute the influence of conditioning. And recently, Olsson, Ebert, Banaji, and Phelps (2005) reported that extinction to fear conditioning is retarded

to racial out-group faces (as compared to racial in-group faces), which the authors interpret as evidence for a prepared fear response to a specific target i.e. out-group individuals. This pair of findings suggests that while conditioning can shape the content of attitudes, this influence is not unlimited and, at least in the case of out-group evaluation, is likely applied within an evolved socio-cognitive framework for understanding intergroup relations: that is, if out-group individuals posed a threat to fitness (Manson & Wrangham, 1991), a mechanism overly sensitive to such sources of threat (i.e. weighting false positives over false negatives) would likely have been adaptive.

Additionally, differential sensitivities to conditioning (e.g. Eysenck, 1983) suggest that not all individuals will respond identically to a given input, in turn suggesting that attitude formation may vary as a function of conditionability. In line with this view, Livingston & Drwecki (2007) report that individuals who score lower in implicit and explicit measures of prejudice are also less likely to develop negative affective associations to neutral stimuli in a classical conditioning paradigm (although they were more likely to acquire positive affective associations to neutral stimuli). As such, while conditioning models present useful frameworks within which to understand aspects of the origins of social and political attitudes and behaviour, these models alone cannot explain individual differences in social and political attitudes.

#### 1.2.2.4 Social Learning and Modelling

Attitude formation has also been theorised as a social learning process, whereby formal reinforcement is unnecessary in order for behaviour to be shaped. Prominent in this field, Bandura (1973) argued that modelling, or “observational learning”, is an important component to the generation of attitudes and behaviour. Bandura’s own 1961 study on the antecedents of

aggression in children is a landmark study in the field. In this study, children were first exposed to either an adult aggressively playing with a toy “Bobo doll” (e.g. hitting the doll in the face), to an adult playing non-aggressively with the doll, or to a control condition where the doll, but no adult was present. Following this exposure the children were encouraged to play with a selection of desirable toys. Next, the experimenter informed the children that they were no longer allowed to play with the toys (an intervention designed to cause frustration). The children were then given a group of undesirable toys and the Bobo doll. Bandura and colleagues noted that children in the model condition were more likely to play aggressively with the Bobo doll than children in either of the control conditions. These findings were taken as evidence that aggressive behaviour in children results from the observation (and modelling) of aggressive adult behaviour.

These studies have subsequently been replicated and extended. For instance, Grusec and Skubinski (1970) observed that children were more likely to donate their prizes from a game to help a needy child when having been exposed to similar adult behaviour than when exposed to adults simply verbalising the desirability of this action. In a later study, Coates, Pusser, and Goodman (1976) demonstrated that children who viewed prosocial behaviour on television (e.g. Sesame Street) showed a subsequent increase in prosocial behaviour when compared to a control group.

Right-wing authoritarianism<sup>2</sup>, with links to political conservatism and prejudice (Altemeyer, 1988), has been posited to emerge via social learning/modelling. Altemeyer (1988) argues that *“parents...serve as powerful models...for their children, so that even if they do not intentionally teach certain attitudes, their offspring can still acquire them by observing the parents’ behaviour, from conversation around the dinner table, and so forth”* (p. 55). Altemeyer extends the scope of social learning’s influence for the acquisition of authoritarian attitudes to

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<sup>2</sup> Right-wing authoritarianism is addressed in greater detail in Section 1.2.4

teachers, siblings, TV personalities, comic-book heroes, and peers, as well as asserting that development of authoritarianism is not age-limited. Both the breadth of possible influences on the development of authoritarian attitudes and the malleability across the lifespan contrast this view of authoritarianism from the account of Adorno et al. (1950), who emphasised early life experiences within the family as fundamental shapers of the authoritarian personality.

Similarly, Jennings, Stoker, and Bowes (2009) report that political attitudes on issues such as political knowledge, vote choice, and economic liberalism are significantly associated with parental views and moderated by the degree of parental political involvement. The authors suggest that this result is in line with a social learning account of political attitude origins: “As expected on the basis of social learning theory, children are more likely to adopt their parents’ political orientations if the family is highly politicized and if the parents provide consistent cues over time” (p. 782).

#### 1.2.2.5 Challenges to Social Learning and Modelling

The field of modelling has not, however, been without dispute, especially about causality. For instance, Rosenkoetter (1999) reported that time spent watching prosocial sitcoms (e.g. The Cosby Show) correlated with mother’s reports of the frequency of prosocial behaviour in the children. Rosenkoetter, however, raises the important issue of direction of causality, suggesting that genetic factors may account for this association, such that “*children with a genetic predisposition toward empathy and nurturance may select programs, friends, and a host of other experiences which are compatible with a prosocial personality*” (Rosenkoetter, 1999, p. 990). This approach anticipates research detailed in later sections of this chapter and so is not covered in further detail here except to say that several studies have recently argued that this familial



transmission of political attitudes may reflect genetic inheritance rather than parental modelling (e.g. Alford, Funk, & Hibbing, 2005). Questions over the strength of such effects have also been raised (e.g. Ferguson, 2010; Gauntlett, 1995), at least within the sphere of media violence. As Ferguson (2010) argues, “*far from being a powerful lasting influence, modelling effects witnessed appear to be small and evaporate quickly*” (p. 71).

### 1.2.3 The Role of the Situation

Although psychoanalytic and conditioning/modelling research continued to influence psychological thinking, in the 1960s increasing interest was directed towards understanding social and political attitudes and behaviour as a function of the situation. Situationism was perhaps best articulated, at least with respect to trait psychology, by Walter Mischel (1968) who, in his influential monograph, argued that behaviours across settings often correlated only weakly ( $< .30$ ). This observation led Mischel (among others) to conclude that underlying traits were only marginal determinants of behaviour, with situational influences providing more powerful effects.

Situationist thought concerning the origins of prosocial attitudes and behaviour was widespread in the 60s and 70s. For instance, Krebs (1978) noted that, “*just about everyone will help in some situations; just about nobody will help in other contexts; and the same people who help in some situations will not help in others*” (p. 142). Gergen, Gergen, and Meter (1972), reflecting situationist thinking concerning (the putative absence of) traits, argued that research on prosociality was little more than a “*quagmire of evanescent relations among variables, conflicting findings, and low order correlation coefficients*” (p. 113). Finally, Latane and Darley (1970) claimed “[*t*]here are reasons why personality should be rather unimportant in

*determining people's reactions to the emergency. For one thing, the situational forces affecting a person's decision are so strong” (p. 115).*

Work on the antecedents of prejudice are perhaps the best known examples of situationist accounts of the origins of social and political attitudes. “Realistic group conflict” theory (Sherif, 1966) proposes that conflict arises between groups as a necessary consequence of competition over finite resources (Sherif, 1966; Sherif & Sherif, 1956). In the influential Robbers’ Cave study, Sherif and colleagues investigated intergroup dynamics in a summer-camp for boys. The boys were divided into two groups – the self-named “Rattlers” and “Eagles” – and once in-group relations were formed were subsequently exposed to intergroup competition. The results were striking: hostilities were observed within days such that the experiment was necessarily halted and an integration phase was introduced. The results were taken as evidence that specific situations can invoke behaviours that might not otherwise be observed. Importantly, the researchers noted the results were observed in psychologically-normal individuals, and thus not simply the consequence of the experimenters having inadvertently selected for aggressive-types who perhaps would have been generally more prone to hostile behaviour.

The “frustration-aggression” hypothesis is an alternative situationist model with which to understand the antecedents of prejudice and discrimination. Dollard, Doob, Miller, Mowrer, and Sears (1939) argued that aggression always results from frustration (e.g. following goal achievement being impeded), as a mechanism for returning to psychological equilibrium. While the target of aggression may be the perceived source of the frustration, enmity can be directed towards more abstract (e.g. the prevailing political system), unavailable (e.g. specific political figures), or indeterminate (e.g. the economy) entities (c.f. Hogg & Vaughan, 2011). Miller and Bugelski (1948) provide support for the frustration-aggression hypothesis showing that



adolescent males at a summer camp who had anticipated an evening away from the camp but were frustrated in this goal became more aggressive towards minority groups. Additionally, a recent meta-analysis of 122 studies concerning displaced frustration and aggression towards arbitrary others indicated that “*that those who are provoked and unable to retaliate reliably respond more aggressively toward an innocent other than those not previously provoked*” (Marcus-Newhall, Pederson, Carlson, & Miller, 2000, p. 682).

Last, but certainly not least, a seminal series of studies illuminating the power of situations were conducted by Milgram (1974) in light of questions concerning the culpability of individuals who were complicit in Nazi atrocities during the Second World War. Milgram’s goal was to investigate the extent to which the presence of authority figures can lead otherwise ordinary individuals to commit acts of violence on other (unknown) individuals. In Milgram’s initial experiments participants were informed that they were taking part in a study of learning where the learner would receive electric shocks for incorrect answers, with these shocks administered by the participant. Although the design of the experiment was such that no electric shocks were actually delivered (the “learner” was in fact a confederate), the participants were led to believe that the shocks were real (the learner was in a separate room with communication possible only through an intercom). The results of the studies were striking: the majority of participants continued to shock the learner even when the force of the shock increased to levels apparently capable of inflicting severe pain. This was in spite of the fact that there were no physical constraints placed on the participants: any sign of dissent was merely rebutted with the phrases (in order, as appropriate): “Please *continue*”; “The experiment requires that you *continue*”; “It is absolutely essential that you *continue*”; “You have no other choice, you *must* go on”. Further independent work has established the robustness of the initial findings

(Blass, 1999; Burger, 2009) and while ethical concerns have constrained further studies of this kind, it is broadly accepted that deference to authority can induce disturbing behaviours in (at least some) otherwise normal individuals (Burger, 2009).

#### 1.2.3.1 Challenges to the Situationist Perspective

While powerful insights into human behaviour have been made within the situationist paradigm (e.g. Milgram, 1974; Sherif, 1966), important challenges to this framework have been voiced. Most prominently, and explored in greater detail below (see Section 1.2.4), trait psychologists have argued that while behaviour can certainly vary as a function of circumstance, this perspective understates (or wholly neglects) the fact that stable individual differences exist (Bowers, 1973; Jost, 2008). As such, while situations influence behaviour, and may play a large role in influencing population level rates of behaviour (e.g. scarcity of resources provoking intergroup conflict), individual differences exist that influence how individuals respond to these situational factors (Bowers, 1973). As such, situationism, while undoubtedly generating critical understandings into human social behaviour, cannot form a complete explanation of the origins of social and political attitudes.

#### 1.2.4 The Return of Individual Differences

The impact of work in the 1960s and 70s emphasising the situational determinants of social and political attitudes resulted in a situation where, as Jost (2006) notes, “*once thriving research programs on individual differences in political orientation...lay dormant for almost two decades*” (p. 652). Recently, however, research has begun to re-affirm the stability of attitudes across time, and between individuals, as well as the coherent organisation of attitudes around a

limited number of underlying themes or values constructs. While not necessarily denying the role of reinforcement or other social influences, this move towards what could ultimately be described as an individual differences approach to socio-political psychology has flourished in recent years with considerable work conducted into the underlying individual differences generating stable variation in political and social attitudes (e.g. Jost, 2006).

#### 1.2.4.1 Personality

The re-emergence of the interest in individual differences as predictors of attitudes coincided with the broad consensus being reached concerning the validity of a five-factor model of personality traits (i.e. agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience; Costa & McCrae, 1992), a taxonomy that has been widely used in recent years as a framework for explaining social and political beliefs. Of these major dimensions of personality, openness has demonstrated robust associations with political orientation, with high levels of openness correlating around .30 with liberalism (Carney et al., 2008; McCrae, 1996; Trapnell, 1994; Van Hiel & Mervielde, 2004). Traits other than openness have shown mixed results. For example, modest associations have been reported between conscientiousness and political orientation (Gosling, Rentfrow, & Swann, 2003; Mondak & Halperin, 2008); however, other studies have found no evidence for association (e.g. Alford & Hibbing, 2007). And while some authors have reported modest effects of agreeableness, extraversion, and neuroticism on political orientation (e.g. Barbaranelli, Caprara, Vecchione, & Fraley, 2007), other studies have failed to find significant associations between these traits and political orientation (Alford & Hibbing, 2007; Carney et al., 2008; Mehrabian, 1996; Trapnell, 1994). These mixed results are notable in line with common assumptions that personality is a core influence on political

attitudes and behaviour (Sniderman, 1975; Winter, 2003). Indeed, this issue is the focus of work reported in Chapter 3 that attempts to provide a novel explanation for these mixed results and integrate personality and political attitudes into a single model.

#### 1.2.4.2 Attitudes and Values

In addition to the five-factor model, a range of attitudinal and values constructs have been proposed as predictors of social and political beliefs, notably social dominance orientation, right-wing authoritarianism, and, more recently, moral foundations theory: each of these frameworks, along with links to social and political attitudes, are detailed below.

Social dominance orientation (SDO; Pratto, Sidanius, Stallworth, & Malle, 1994) is conceptualised as a measure of individual differences in levels of group-based discrimination and domination and emerged from social dominance theory (Sidanius & Pratto, 1999). Initial work on SDO demonstrated reliable associations with a wide range of social and political attitudes: individuals with higher SDO scores were more prejudiced, conservative, and patriotic (Pratto et al., 1994). Conversely, those individuals scoring low in SDO were more favourable towards womens' and gay rights. These results have been replicated and extended in many subsequent studies linking SDO to, for instance, prejudice (Altemeyer, 1998; Esses, Jackson, & Armstrong, 1998; McFarland, 1999) and extreme right-wing political views (Dambrun, Maisonneuve, Duarte, & Guimond, 2002).

Right-wing authoritarianism (RWA; Altemeyer, 1981; 1996) is conceptualised as a cluster of correlated traits: 1) Authoritarian submission - submissiveness to authorities who are perceived to be legitimate in one's society; 2) Authoritarian aggression - directed against deviants and out-groups, perceived to be targets according to established authorities; 3)

Conventionalism - adherence to the norms endorsed by society and belief that others should also adhere. RWA has shown robust associations to prejudice (e.g. Altemeyer, 1998; Lambert & Chasteen, 1997; Lippa & Arad, 1999; McFarland et al., 1993) and conservatism (Altemeyer, 1996). Importantly, RWA appears to influence social and political attitudes independently of SDO (Duckitt & Sibley, 2010a): controlling for SDO, RWA predicted dislike for out-groups described as deviant/socially threatening, whereas SDO independently (of RWA) predicted dislike for out-groups described as socio-economically disadvantaged.

More recently, Haidt and colleagues have proposed “moral foundations” theory as a model framework for understanding social and political attitudes (e.g. Haidt & Graham, 2007). According to these authors, moral behaviour is organised around five core foundations: harm (minimising harm to others), fairness (maximising fairness to all), in-group loyalty (the importance of the in-group), authority (respect for status and hierarchy), and purity (avoiding impure or disgusting acts/entities). These five facets of morality, in turn, correlate to form two higher-order moral factors of “individualizing” (the combination of harm and fairness) and “binding” (the combination of authority, in-group loyalty, and purity; Graham et al., 2009). Importantly, both individualizing and binding have been shown to account for significant variance in liberalism-conservatism in both the United States and UK (Graham et al., 2009) and in The Netherlands (van Leeuwen & Park, 2009), with more liberal individuals tending to report lower scores on binding and higher scores on individualizing.

#### 1.2.4.3 Challenges to the Individual Differences Perspective

Although the individual differences approach to social and political attitudes has yielded a number of robust findings (e.g. SDO and RWA as predictors of prejudice; Sibley & Duckitt,

2008), this perspective has rarely integrated traits and environmental moderators into a single model. Some recent attempts to incorporate interactive components within an individual differences framework have begun to yield fruitful results (Duckitt & Sibley, 2010b); however, more work of this kind will be needed to generate fine-grained understandings of the origins of social and political attitudes. Additionally, the role of basic traits of personality as an influence on social and political attitudes is presently unclear (e.g. Alford & Hibbing, 2007), a fact that may reflect more complex and/or indirect effects of personality on social and political attitudes (Gerber, Huber, Doherty, Dowling, & Ha, 2010; Mondak, Hibbing, Canache, Seligson, & Anderson, 2010), an issue that is explored in detail in Chapter 3.

#### 1.2.5 The Evolutionary Psychology of Social and Political Attitudes

Alongside the “re-discovery” of individual differences, in the last two decades, evolutionary theory has become an increasingly powerful framework in psychology (Barkow, Cosmides, & Tooby, 1992; Pinker, 2002) and this mode of thought has inspired evolutionary accounts of socio-political behaviour arguing that selective pressures operating on humans equipped our minds with a specific repertoire of behaviour, some components of which are relevant to social and political attitudes. For example, Schaller and Duncan (2007) have argued that humans are equipped with a “behavioural immune system” designed to minimise pathogen threats of which the implications for social and political attitudes include biases of attention and memory toward individuals with physical deformities (Ackerman et al., 2009; Kurzban & Leary, 2001; Park, Faulkner, & Schaller, 2003), cross-cultural variation in food preferences and taboos (Fessler & Navarrete, 2003), religious diversity (i.e. diversity is greatest in regions of high pathogen load; Fincher & Thornhill, 2008), and aversions toward out-group individuals on



grounds they may transmit disease (Faulkner, Schaller, Park, & Duncan, 2004; Hodson & Costello, 2007).

The “tribal instinct” hypothesis (Van Vugt & Park, 2008) is an evolutionary model of intergroup relations positing that adaptations for group life have been sculpted by natural selection. Intergroup conflict is understood to have been reasonably common in ancestral environments (Alexander, 1987; Tooby & Cosmides, 1988), and it is estimated that intergroup conflict claimed the lives of up to 30% of ancestral men (Keeley, 1996), which would have plausibly led to selection for traits able to enhance fitness in such hostile environments, such as in-group favouritism (e.g. the ability to affiliate enhances capability in war and hunting) and out-group derogation (e.g. “get them before they get us!”). Kurzban and Leary (2001) note that *“membership in a potentially cooperative group should activate a psychology of conflict and exploitation of out-group members - a feature that distinguishes adaptations for coalitional psychology from other cognitive systems”* (p. 195). Support for the tribal instinct hypothesis includes the observation that people preferentially provide resources to in-group over out-group members, even when group membership is designated based on an arbitrary criterion, such as painting preferences (Brewer, 1979; Tajfel & Turner, 1979).

While the above examples of evolutionary thinking concerning social attitudes have focused on intergroup behaviour, a sophisticated model concerning the evolution of normative and prosocial behaviour has recently been posited by Chudek and Henrich (2011). These authors argue that gene-culture co-evolution is responsible for both the emergence of norm mechanisms and, subsequently, prosocial attitudes and behaviour. The proposed model suggests the following: firstly, fitness advantages would have been bestowed on those who were able to use others as exemplars in order to overcome the obstacle of having to rediscover important

technological or behavioural strategies. This early form of conformity coupled with the emergence of cultural rules likely creates a selective pressure for the emergence of more advanced norm detection and adoption mechanisms. Finally, between-group competition extends and spreads prosocial norms as groups best able to instantiate such social codes out-compete those who do not and in doing so transmit the successful cultural strategies. While this model is largely untested to date, it provides an attractive and sophisticated framework for understanding the origins of human prosociality.

#### 1.2.5.1 Challenges to the Evolutionary Psychology Perspective

While some intriguing lines of enquiry have emerged from an evolutionary psychology perspective of social and political attitudes, it is currently unclear how and why these adaptations create variance in social and political attitudes. In line with standard evolutionary thinking (e.g. Tooby & Cosmides, 2005), psychological adaptations are postulated to be species-typical mechanisms. The question arises, then, of how individual differences in social and political attitudes might be generated from these adaptations. The response to this criticism has been that it misrepresents the fundamental tenets of evolutionary psychology. As noted by Tooby and Cosmides (2005), "*genes are regulatory elements that use environments to construct organisms. Thus, every single component of an organism is codetermined by the interaction of genes with environments. Moreover, some of those components are computational mechanisms, designed to produce behavior on the basis of information from the environment. Seen in this way, it is senseless to ask whether kin detection or language acquisition or snake phobias are caused by the genes or the environment: These phenomena are caused by evolved mechanisms that operate on information from the environment in particular ways, and these evolved mechanisms were*



*themselves constructed by the interaction of genes with the environment*" (p. 34). Accordingly, variance in attitudes towards foreigners might be generated via the interaction between a coalitional/group member encoding adaptation (e.g. Kurzban, Tooby, & Cosmides, 2001) and environmental input, such as resource shortages (Sherif, 1966). However, while this solution is plausible, work specifying the precise architecture of this system is still required to fully (or at least better) account for the origins of variation in social and political attitudes.

### 1.2.6 Genetic Bases of Social and Political Attitudes

As previous sections will have shown (with the exception of evolutionarily inspired work), the bulk of research concerning the origins of social and political attitudes has implicitly assumed or explicitly asserted that environmental factors drive social and political attitudes: even the broadly consensus view that social attitudes are largely stable (Jost, 2006; although challenged by some, e.g. Converse, 1964) has not removed the implicit assumption that this stability is of environmental origins. As Alford, Funk, and Hibbing (2005) note, "*political science debates concerning the source of political attitudes and behaviors have been over timing, over whether attitudes and behaviors are primarily shaped early in life or by more proximate occurrences. Conspicuously absent is consideration of the possibility that certain attitudes and behaviors may be at least partially attributable to genetic factors*" (p. 154). This view is echoed outside of political science and within the attitudes literature more broadly: in a review of the attitudes literature, Tesser and Shaffer (1990) reported no references to genetic explanations of attitude responses<sup>3</sup>. Recently, however, the contention that genetic factors may underpin a significant proportion of variance in social and political attitudes has been tested empirically,

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<sup>3</sup> However, Tesser and Shaffer (1990) overlook important work including Eaves & Eysenck (1974) and Martin et al. (1986)

with early evidence suggesting that a range of attitudes with relevance to political life contain a genetic substrate.

#### 1.2.6.1 Genetics of Political Attitudes and Behaviour

Perhaps the earliest genetically informative study of socio-political attitudes was conducted by Eaves and Eysenck (1974) who, in pioneering work published in *Nature* and using a classical twin design<sup>4</sup>, showed that self-reported radicalism (vs. conservatism) and tough-mindedness (vs. tender-mindedness) were both substantially influenced by genetic factors: heritability estimates for these traits were .65 and .54, respectively. However, the heterodox findings of Eaves and Eysenck (1974) were largely suppressed in the literature, in large part because of extended criticisms of genetic explanations of social behaviour and attitudes (e.g. Schwartz & Schwartz, 1974): biological explanations at this time were simply not en vogue (McGuire, 1968; Segerstrale, 2000).

Some 12 years later a second high-impact article appeared (PNAS; Martin et al., 1986) supporting the original findings of Eaves and Eysenck (1974), and extending the scope of heritable influences on social and political attitudes to include the Wilson-Patterson scale (Wilson & Patterson, 1968), a catch-phrase measurement instrument tapping a range of social and political issues. A modest trickle of results followed this finding including work demonstrating genetic influences underlying religious beliefs and prosociality (both detailed in later sections); however, mainstream consideration of these results was delayed until Alford, Funk, and Hibbing (2005) revisited the earlier Martin et al. (1986) findings, presenting re-analyses of these data to a social and political science audience.

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<sup>4</sup> See Chapter 2 for a full description of these methods

A steady body of work has emerged into the literature in recent years replicating and extending these initial findings of genetic influence on social and political attitudes. Hatemi et al. (2007) reported that vote choice is heritable, but that the majority of this genetic influence on vote choice is accountable through the heritability of political attitudes. Fowler, Baker, and Dawes (2008) observed that actual voter turnout is also under significant genetic control. Strength of affiliation, or partisanship, to a party (irrespective of the particular party) is substantially heritable, although these genetic effects on political attitudes do not appear to emerge until young adulthood ( $> 20$  years; Hatemi et al., 2009). Finally, Hatemi et al. (2010), utilising an extended twin design and so accounting for standard concerns over limitations in the CTD (see Chapter 2 for more detail), report findings that closely mirror those from CTD studies, and note that *“for most political and social attitudes, genetic influences account for an even greater proportion of individual differences than reported by studies using more limited data and more elementary estimation techniques”* (Hatemi et al., 2010, p. 798).

At the time of writing, few molecular genetic studies of political attitudes and behaviour have been reported. Of these early studies, two genes (monoamine oxidase and serotonin polymorphisms) have been linked to voting participation (Fowler & Dawes, 2008), and dopamine receptor gene variation for partisan attachment (Dawes & Fowler, 2009). And a recent study addressing gene-environment interaction (GxE) reported a moderating effect of friendship on the influence of dopamine polymorphisms on political attitudes (Settle, Dawes, Christakis, & Fowler, 2010). Finally, while candidate gene studies allow tests of specific loci with putative links to politically-relevant traits, genome-wide studies allow a far greater number of loci to be examined for association with a given trait in an exploratory (hypothesis-free) manner (Wang, Barratt, Clayton, & Todd, 2005). Hatemi and colleagues recently conducted the first such study

for political attitudes (Hatemi et al., 2011), performing a genome-wide linkage study on political conservatism. Their results revealed three peaks reaching genomewide significance ( $LOD > 3$ ), with a further peak 'suggestive' of linkage ( $LOD > 2.5$ ). These four loci independently accounted for between 9.4% and 12.9% of the total phenotypic variation in political conservatism (measured as the first principle component emerging from Wilson-Patterson items), although the authors suggest these figures are likely to be biased upward on account of capitalizing on chance deviations.

#### 1.2.6.2 Genetics of Prosociality

A growing body of research has also demonstrated that prosociality possesses a heritable component. Rushton et al. (1986) reported that 50% of the variance in altruism measured by the Self-Report Altruism Scale (SRAS; Rushton, Chrisjohn, & Fekken, 1981) was accounted for by additive genetic influences. This study was significant also for its demonstration that the shared-environment (which includes familial effects) exerts no influence on prosocial behaviour. A subsequent study in an independent sample of 322 twin pairs broadly replicated this initial finding, reporting similar genetic effects on prosociality (Rushton, 2004). Similar findings have been found in children: Knafo and Plomin (2006) found that genetic effects influencing prosocial behaviour in infants/children at 2 years and 7 years accounted for 32% and 61% of phenotypic variance, respectively: over the same time-span shared-environment effects were seen to decrease from 47 to 3%. Furthermore, cross-cultural validation of these findings in pre-adolescents has also been reported in Korean twins (Hur & Rushton, 2007). However, not all studies have reported genetic effects on prosocial attitudes. For instance, Krueger, Hicks, and

McGue (2001) observed that heritable effects on a modified version of the SRAS were non-significant in males (female data was not analysed in this study).

Recent work has also begun to address the genetic and environmental contributions to social preferences in games drawn from the experimental economics literature. Wallace, Cesarini, Lichtenstein, and Johannesson (2007) report that 40% of variation in ultimatum game (UG) responding is explained by additive genetic effects. (In the UG, the Player 1 proposes how to divide the sum between the two players, with Player 2 able to either accept or reject this offer. If Player 2 rejects, neither player receives anything. If Player 2 accepts, the money is split according to the proposal). Similar results have been reported for behaviour in the trust game (Cesarini et al., 2008), where participants are bestowed with an initial endowment of which to send a chosen proportion to another participant (the trustee). The sent amount is then multiplied by some factor and the trustee decides how much of the received sum to return to the investor.

Building on genetically informative findings from twin studies, molecular genetic work has sought to identify loci implicated in traits such as empathy and cooperation. Much of this work has focused on two specific candidates – oxytocin and vasopressin – largely due to robust findings linking these neuromodulator peptide hormones to vertebrate social behaviour, including pair bonding, aggression, and social memory (Lee, Macbeth, Pagani, & Young, 2009). Rodrigues, Saslow, Garcia, John, and Keltner (2009) reported a significant association between a single oxytocin receptor (OXTR) single nucleotide polymorphism (SNP; rs53576) and behavioural (Reading the Mind in the Eyes task; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) and self-report dispositional empathy: individuals homozygous for the G allele (GG) were more empathic than those individuals with one or two copies of the A allele (AG/AA). Tost et al. (2010) supported these findings reporting that individuals homozygous for

the G allele for the rs53576 SNP have significantly higher scores than heterozygotes or individuals homozygous for the A allele on the reward-dependence sub-scale of the Tridimensional Personality Questionnaire (Cloninger, 1987), which taps degree of sociability, reliance on social approval, and sensitivity to interpersonal feedback. Furthermore, Tost et al. (2010) report that A allele individuals possessed significantly decreased hypothalamic gray matter and increased right amygdala volume (in males only), with a significant negative correlation between local amygdala volume and individual reward-dependency scores in the total sample ( $r = -.19$ ). A further set of OXTR SNPs (although rs53576 was not included) were significantly associated with prosocial behaviour (Israel et al., 2009), as measured by the dictator game and the social values orientation task.

Variation in the arginine vasopressin receptor gene has also shown links to behaviour in experimental games. Knafo et al. (2008) reported that the proportion of money offered in a dictator game was predicted by the length of AVPR1a RS3 microsatellite repeat element: individuals with longer RS3 alleles allocated more money than individuals with shorter alleles, although no replication of this finding has been reported to date.

Polymorphisms in genes influencing dopamine have also been linked to prosocial behaviour. Bachner-Melman et al. (2005) found that self-report prosociality is significantly associated with the dopamine receptor D4 (DRD4) gene: relative to the 7-repeat allele, individuals with the 4-repeat allele of DRD4 48 bp VNTR reported a higher score of prosociality. Zhong et al. (2010) support these findings showing that variation in DRD4 is significantly associated with social preferences in Chinese individuals measured using the Ultimatum Game paradigm. In this study the 2-repeat allele was shown to predict significantly lower levels of minimum acceptable offers than the 4-repeat allele: the 7-repeat is rare in the



Chinese population (Ding et al., 2002) and the 2-repeat is considered intermediate to the 4-repeat and the 7-repeat allele (Asghari et al., 1995).

Finally, recent work has linked the COMT Val158Met polymorphism to prosocial behaviour. Individuals with at least one Val allele donated approximately twice as much money to a developing country's children's charity when compared with those participants without a Val allele (Reuter, Frenzel, Walter, Markett, & Montag, 2010).

### 1.2.6.3 Genetics of Religiosity

Perhaps most surprising among genetic research into social and political attitudes has been the finding of heritable variation underlying religious beliefs. In an early study, Martin et al. (1986) reported significant genetic effects on attitudes such as observance of the Sabbath, authority of the church, and truthfulness of the Bible, although significant shared-environment effects were also observed. In a sample of reared-apart MZ twins and reared-together MZ and DZ twins, Waller, Kojetin, Bouchard, Lykken, and Tellegen (1990) supported these earlier findings showing that religious attitudes, importance, and interests are significantly genetically influenced. Provocative even twenty years later (e.g. Charney, 2008), the authors further argued that it is time to “*discard the a priori assumption that individual differences in religious and other social attitudes are solely influenced by environmental factors*” (p. 141). Not all studies have shown significant genetic effects on religious beliefs. For instance, Kendler, Gardner, and Prescott (1997) observed in a sample of females that additive genetic factors were modest in determining personal devotion (items including the “*Importance of religious beliefs*”) and at zero for personal conservatism (items including “*Literal belief in [the] Bible*”). However, subsequent work has largely corroborated these earlier positive findings indicating that religious beliefs and



practices are indeed heritable (Bouchard, McGue, Lykken, & Tellegen, 1999; Bradshaw & Ellison, 2008; D'Onofrio, Eaves, Murrelle, Maes, & Spilka, 1999; Koenig, McGue, Krueger, & Bouchard, 2005; Vance, Maes, & Kendler, 2010), but that shared-environment factors are also present, and of particular importance in determining affiliation (D'Onofrio et al., 1999).

#### 1.2.6.4 Challenges to the Genetic Perspective

Intense criticism of the reported associations between genetic factors and political attitudes has been received from some quarters within social science (e.g. Beckwith & Morris, 2008; Charney 2008a; Charney 2008b). Indeed, it has been suggested (somewhat dismissively) that if the results of twin research were true “*it would require nothing less than a revision of our understanding of all of human history, much, if not most of political science, sociology, anthropology, and psychology, as well as, perhaps, our understanding of what it means to be human*” (Charney, 2008a, p. 300). Challenges to the underlying assumptions of the classical twin design (CTD) are not new to the literature (e.g. Lewontin, Rose, & Kamin, 1984); as such, this issue is revisited in Chapter 2 where a more detailed discussion of the methodological strengths and shortcomings of the CTD are outlined in anticipation of further socio-genetic work reported in later chapters of this thesis. However, it is noteworthy at this stage that robust responses to challenges from both Charney (2008a) and Beckwith and Morris (2008), among others, have been presented in the literature (e.g. Medland & Hatemi, 2009).

### 1.3 The Current Thesis: Outstanding Questions

With this review of the literature in mind, where do we find ourselves with regards to the origins of social and political attitudes? While the literature is vast, it is apparent, as noted above,

that previous work, while offering predictive power (to greater or lesser extents) of social and political attitudes, cannot (at least singularly) fully account for the bases of such attitudes. Clearly, then, important avenues have not yet been explored in the field, and pivotal questions remain. In the sections below, I briefly outline a series of inter-related issues in the social and political attitudes literature that have either been neglected thus far, or have presented equivocal conclusions where work has been conducted: attempts to provide additional insight into these issues form the basis for the current thesis. Specifically, I address two broad issues: firstly, the role of personality as an influence on political conservatism (Aim 1); Secondly, the influence and structure of genetic factors on social attitudes, including in-group favouritism, prosocial obligations, and religious belief (Aims 2-4).

### 1.3.1 Aim 1: Testing a Personality System Model of Political Conservatism

In recent years, personality has been a major candidate for understanding individual differences in political and social attitudes. While some findings have been robust in the literature, such as the role of openness in explaining prejudice (Sibley & Duckitt, 2008) and conservatism (McCrae & Sutin, 2009), work in this domain has produced mixed results (e.g. Alford & Hibbing, 2007) despite the mostly unchallenged view in the field that personality is a core influence on political attitudes and behaviour (Sniderman, 1975; Winter, 2003). One possible resolution to these mixed results may be found in considering personality's role in determining social and political attitudes within a personality systems framework (introduced in detail in Chapter 3; McCrae and Costa, 1999), whereby personality affects an intermediary layer of values (or characteristic adaptations), which in turn influence political attitudes and behaviour. Work reported in Chapter 3 utilises this personality systems approach and tests the theory that

personality exerts significant effects on political conservatism, but that an intermediary layer of values are required for this influence to be observed.

### 1.3.2 Aim 2: Determining the Genetic Architecture of In-group Favouritism

As previous sections have described, the origins of prejudice have been a major target of research for at least the last 70 years (e.g. Adorno et al., 1950); however, to date no study has yet addressed a number of critical questions concerning the genetic architecture of ethnocentrism, or in-group favouritism, particularly in light of work showing that related social attitudes contain a genetic basis (e.g. Alford et al., 2005). Thus, important outstanding questions include the following: 1) Is in-group favouritism heritable?; 2) If so, are there multiple heritable components to in-group favouritism, such as towards one's race and one's chosen in-groups (e.g. religion)? 3) And if race favouritism is heritable, does a common affiliative mechanism account for this genetic basis, or do distinct heritable factors to race favouritism exist over and above any common mechanism? Chapter 4 addresses each of these questions.

### 1.3.3 Aim 3: Determining the Magnitude of Genetic Effects and Comorbidities

#### Underlying Prosocial Obligations

As noted above, several genetically informative studies of prosocial attitudes and behaviour exist in the literature; however, important questions, too, remain in this domain. Firstly, while a number of studies have reported heritable effects underlying prosocial attitudes (e.g. Rushton, 2004), these results have not been reported by all (e.g. Krueger et al., 2001). As such, there is a need to further examine the relative genetic and environmental contributions to prosocial attitudes in order to robustly establish the aetiology of these traits. Secondly, while studies to date have addressed the heritable basis of prosociality in the domain of welfare

concern for others, little is known of the role of genes in determining prosocial obligations in broader domains, such as towards work and civic duties: is variation in these domains under genetic control? Thirdly, does prosocial sentiment generalise across distinct domains of social life, such as at work, in civic-life, and with respect to the general welfare of others, and if so does this common prosocial obligation factor have a genetic basis? Chapter 5 addresses each of these questions.

#### 1.3.4 Aim 4: Explaining the Heritable Bases of Religiosity: Can Religiosity Genes be Reduced to Community and Existential Needs?

Finally, while genetic influences have been shown to underpin religious beliefs (e.g. Koenig et al., 2005), the nature of the psychological mechanism(s) through which these biological factors are manifest is presently unknown. As such, critical information concerning the reducibility of religiosity to more fundamental (and non-theological) socio-cognitive traits and motivations (e.g. Boyer, 2003; Graham & Haidt, 2010), such as 1) needs for community integration and 2) needs for existential certainty, are currently absent in the literature. Chapter 6 addresses the question of whether heritable variance underlying these non-theological variables can account for the genetic bases underlying religious belief.

## **Chapter 2 - Behaviour Genetic Methodology: A Brief Introduction**

The goal of this chapter is to provide a concise introduction to behaviour genetic methodology, with a specific focus on the capabilities and limitations of the classical twin design to elucidate genetic and environmental contributions on psychological traits. This background provides important methodological information underpinning the genetically informative studies conducted for this thesis and described in Chapters 4-6. In the sections that follow I outline 1) basic principles of genetic theory, 2) the classical twin design method, 3) the key assumptions and limitations of the classical twin design, and 4) extensions of the classical twin design to the multivariate case, and the advantages of this advanced design. (Note: information on the specific models and analytical strategies used in this thesis is presented, as appropriate, in Chapters 4-6).

### 2.1 Basic Principles of Genetic Theory

#### 2.1.1 Mendel and the Laws of Heredity

Although his research went largely unrecognised in his lifetime, Gregor Mendel's (1866) work, rediscovered by de Vries, Correns, and Von Tschermak at the turn of the 20<sup>th</sup> century (cf. Bowler, 2003), underpins the field of genetics. Mendel's great contribution emerged from his meticulous cross-breeding experiments with plants of different species. He observed that when crossing two qualitatively distinct plants, such as those yielding smooth vs. wrinkled peas, the resulting offspring was not a blend, as consensus would have predicted at the time. Rather, the progeny all yielded smooth peas (Mendel, 1866). This finding falsified the then accepted wisdom of blended inheritance (cf. Charlesworth & Charlesworth, 2009; Plomin, Defries, McClearn, & McGuffin, 2001). Mendel, however, had the crucial foresight to allow the offspring of the cross-

breeding experiment to self-fertilise in order to study their progeny. What he observed was that three quarters of this generation's peas had smooth seeds, with the remaining quarter possessing wrinkled skins: the "factor" underlying wrinkled seeds had not disappeared following the first generation of breeding, but instead had been, in some manner, "hidden".

To explain this finding, Mendel argued that each individual possessed two "elements" (what geneticists now term "alleles"), one from each parent, which typically co-exist in pairs but crucially are segregated in sex cells. One of these alleles was reasoned to be dominant, that is to say expressed irrespective of the status of the other allele. This would mean that each of the progeny of Mendel's cross-breeding experiment would have possessed the dominant allele coding for smooth skins and the recessive allele coding for wrinkled skins. Following self-fertilisation, and bearing in mind that each parent provides just one of its two alleles to its progeny, the subsequent generation should yield a population with three quarters smooth-skinned peas and one quarter wrinkled-skinned peas. These observations helped to explain the observed data and inspired what became known as Mendel's Law of Segregation.

Mendel took this work further showing that cross-breeding two traits (at least those traits with a dominance expression) produced 9:3:3:1 ratios in subsequent generations. This ratio is consistent with the conclusion that alleles of different genes are independently inherited (although this is only true for genes that are not in linkage disequilibrium with each other; Falconer & MacKay, 1996). As such, this discovery became known as Mendel's Law of Independent Assortment.



### 2.1.2 Quantitative Traits

While Mendelian traits provided an elegant account of many traits, most traits of interest to social and behavioural scientists (e.g. personality, intelligence, social and political attitudes) are quantitative in nature: that is to say, continuously distributed and influenced by the combined action of multiple genetic loci, a fact intimated by the lack of Mendelian patterns of inheritance for such traits (Plomin et al., 2001). In addition, environmental influences are likely to contribute to observed variation in traits, further blurring the pattern of inheritance.

This distinction between Mendelian or single-allele traits and continuous variance led to disputes in the literature which were not resolved until the seminal work of Fisher (1918) in combining both the mechanical simplicity of Mendelian transmission of alleles with the statistical implications of phenotypes which involved the addition of the effects of two or more such genes. In modern work, quantitative traits, are handled behaviourally by examining the pattern of covariance among groups differing in their genetic and environmental similarity; for instance, siblings and cousins, adopted siblings and twins, or most commonly, monozygotic, or identical, and dizygotic, or fraternal, twin-pairs; the classical twin design (Neale & Cardon, 1992). Given such groups, it is possible to estimate more or less complex patterns of transmission and the relative proportions of phenotypic variance resulting from genetic and environmental influences (e.g. Falconer & MacKay, 1996; Fisher, 1918; Mather & Jinks, 1982; Plomin et al., 2001).

### 2.2 Why Twins? The Variance Components Approach

As mentioned above, estimation of the respective contributions of genetic and environmental influences for a given trait is typically performed using twin or pedigree data and



the variance components approach (Neale, Boker, Xie, & Maes, 1999; Neale & Cardon, 1992). In the classic twin design, observed variance in a given trait/measure is partitioned into three of the following four components: additive genetic effects (A), non-additive genetic effects (D) or shared-environment effects (C), and unique-environment effects (E): if data is limited to twins reared together, shared-environment and dominant genetic effects are confounded and cannot be estimated within the same model. Additive genetic effects simply refer to the effect exerted by the sum of the individual effects of all the genes involved (Falconer & MacKay, 1996), with non-additive genetic effects referring to the situation where the total gene effect differs from the sum of the individual effects of these genes. These non-additive effects stem either from interactions within a gene (dominance) or between genes (epistasis; Falconer & MacKay, 1996). Shared-environment effects are those common to individuals of a twin pair (or family). Shared-environment effects include (but are not limited to) variables such as socioeconomic status and parental style; they serve to increase the similarity of both dizygotic (DZ) twins and monozygotic (MZ) twins. Unique-environment effects are those influences that serve to make members of twin pairs less similar to each other. These effects are in principle wide-reaching and might include both differential exposures to teachers, employment, romantic partners, and health, as well as differential perceptions of events to which both members of a twin pair were exposed. Measurement error is also subsumed within this component of variance, unless multiple measures are conducted to remove this bias.

Estimates for the A, C, and E variance components are derived using the following logic: MZ twins raised in the same family share both 100% of the variance in their genetic matter and all of the effects of the shared-environment. As such, any differences arising between them are thus effects of the unique environment. Accordingly, the correlation observed between MZ twins

is an estimate of  $A + C$ . DZ twins have a common shared-environment; however these individuals only share (on average) 50% of the variance in their genetic matter. As such, the correlation between DZ twins is an estimate of  $\frac{1}{2}A + C$ . From this information, the following formulas can be derived (where  $r_{mz}$  and  $r_{dz}$  are the correlations of the trait in MZ and DZ twins, respectively):

$$r_{mz} = A + C$$

$$r_{dz} = \frac{1}{2}A + C$$

Because the difference between the MZ and DZ correlations occurs entirely because of a halving of the genetic similarity (assuming no asymmetry in environmental similarities for either zygosity class, or no non-additive genetic effects),  $A$  is simply twice the difference between the MZ and DZ correlations:

$$A = 2(r_{mz} - r_{dz})$$

As the MZ correlation reflects the full effect of  $A$  and  $C$ , an estimate of  $E$  can be derived by subtracting the magnitude of this correlation from 1:

$$E = 1 - r_{mz}$$

Finally, an estimate of  $C$  is derived as follows:

$$C = r_{mz} - A = 2r_{dz} - r_{mz}$$

Although the above derivation of the  $A$ ,  $C$ , and  $E$  variance components is valuable as an illustration of the underlying logic of such analyses, it is noteworthy that modern computing technology allows sophisticated analytical tools, such as maximum likelihood estimation (Neale

& Cardon, 1992), to provide parameter estimates for variance components. This approach has the considerable advantage of allowing researchers to test competing nested models (such as by using the likelihood ratio test), as well as to model parameters for multiple variables simultaneously (see below: Section 2.3).

## 2.3 Extensions to the Multivariate Case

While Section 2.2 detailed the basis for decomposing the respective genetic and environmental influences on a given trait, as noted above, analytical tools are now available to model multiple variables simultaneously. These methodological developments provide fundamental advantages for researchers seeking to understand the genetic architecture of complex traits. For example, it becomes possible to demonstrate that heritable bases underpinning anti-social behaviour are also associated with general cognitive ability (Koenen, Caspi, Moffitt, Rijdsdijk, & Taylor, 2006), or whether genetic effects increasing one's sense of civic and work obligation also serve to increase one's concern for the welfare of anonymous others (see Chapter 5 for more detail on this specific issue). The same logic can be applied to environmental effects: for example, do common environmental influences underpin different aspects of religious belief and behaviour (Vance, Maes, & Kendler, 2010)?<sup>5</sup>

## 2.4 Challenges to and Limitations of the Classical Twin Design

### 2.4.1 Equal-Environment Assumption

As with almost all behavioural methodology, the classical twin design (CTD) rests upon a set of core assumptions that require careful consideration. Perhaps the most well-known of these, largely through sustained criticism of the CTD method for perceived violations (Beckwith &

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<sup>5</sup> Accordingly to Vance et al (2010), this question can be answered in the affirmative.

Morris, 2008; Lewontin, Rose, & Kamin, 1984), is the equal-environments assumption (EEA). The EEA assumes that the contribution of shared-environmental influences does not differ between siblings for the trait under investigation. The main concern here is that if shared-environment influences were larger for one class of zygosity than another, for example MZ pairs vs. DZ pairs, and these differences were not accounted for in the model, the estimated genetic and environmental influences would be biased: in such a case, the size of genetic effects on the trait would be overestimated while the shared-environment effects would be underestimated.

It is well-acknowledged that MZ twins are treated more similarly than fraternal siblings in a variety of ways. For example, as children MZ twins are more likely to share a bedroom and to be dressed alike. And as adults they tend to stay in closer contact with each other than do DZ twins (Kendler, Neale, Kessler, Heath, & Eaves, 1993; Loehlin & Nichols, 1976). Despite these unquestioned similarities in specific aspects of the environment, the critical issue concerning the EEA is whether these differences influence the trait under investigation, i.e. does sharing the same bedroom lead one to become more similar, for instance, in tendencies towards depression or on political attitudes? In short, evidence for increased environmental similarity in MZ pairs does not in and of itself invalidate the CTD.

A number of methods have been used to test the EEA. For example, utilising the perceived zygosity design (Scarr, 1968), studies have shown that children whose parents believed them to be dizygotic when in fact they were monozygotic remain as concordant as MZ twins raised by parents who believed they were monozygotic (Kendler et al., 1993). More recently, Visscher et al. (2006) reported an assumption-free method of estimating heritability using molecular data to obtain precise measures of genetic relatedness of sibling pairs (although siblings on average share 50% of their segregating genes, this varies over a small range for

individual siblings just as a gambler's outcomes deviate from the average expectation on any short-run trial). This variation in genetic similarity between siblings allows a direct estimate of heritability. For height this estimate closely followed that obtained from the CTD (Visscher et al., 2006), thus validating the method, at least with respect to work on height: future work utilising this method in psychological traits will be important.

#### 2.4.2 Generalisability: Twin/Singleton Differences

The CTD has also been challenged with regards to the validity of generalising to the wider population from findings obtained in a twin population. The fundamental test of whether this assumption has been violated is to compare the trait scores of twins to their non-twin siblings who are matched for social background and family influences (while controlling for age and sex effects). Twins are known to differ from singletons on some traits (notably those relating to prenatal growth); however, systematic differences in personality and other social science phenotypes have not been reported (Evans, Gillespie, & Martin 2002), suggesting findings in twins can be informative outside of this population.

#### 2.4.3 C and D are confounded in the CTD

If data is limited to twins reared together, shared-environment and dominant genetic effects are confounded and cannot be estimated within the same model: it is not possible to model A, C, D, and E with just the information available from MZ and DZ pairs reared together. The decision to fit an ACE or an ADE model typically adheres to the following heuristic. If  $r_{DZ} > .5r_{MZ}$ , an ACE model will usually fit better than an ADE model, on grounds that shared environments serve to make DZ pairs more similar (relative to MZ pairs) thus reflecting the DZ

correlation being greater than half of the MZ correlation, which would not be expected if only A and E were present. Conversely, if  $r_{DZ} < .5r_{MZ}$ , an ADE model will usually fit better than an ACE model, on grounds that if MZ twins are more than twice as similar than DZ pairs this is evidence for the presence of non-additive genetic effects: recall that non-additive effects require all of the relevant alleles to produce the effect, and this will occur on average in only 25% of DZ pairs (vs. 50% for additive effects), thus decreasing the DZ pair similarity.

Removing the confounding of C and D in the CTD is possible using an extended twin and family design. In such a design, the additional information afforded by the use of data, for example, on parents of twins (Eaves, Last, Young, & Martin, 1978; Neale & Fulker, 1984) and offspring of twins (Nance & Corey, 1976), allows for formal estimation of both shared-environment and non-additive genetic effects.

## 2.5 Summary

In summary, powerful analytical frameworks exist that allow researchers to understand the respective genetic and environmental contributions to variance in observed complex traits, such as personality, intelligence, or social and political attitudes, which include (but are certainly not limited to) the classical twin design. Modern methods have allowed this decomposition of genetic and environmental influences to be extended to take into account multiple variables with the important outcome that it is now possible to understand the common genetic and environment effects that may underpin two apparently distinct traits. As has been noted, numerous challenges to the methods of behavioural genetics have been voiced in the literature; however, most of these criticisms have been rebutted; for example, assumption free estimates of heritability are now possible (e.g. Visscher et al., 2006), tests of violations of the equal

environment assumption have not revealed systematic violations (e.g. Kendler et al., 1993), and extended twin and family designs allow shared-environment and dominance genetic effects to be estimated (Eaves et al., 1978), thus removing a confound of the CTD.



## **Chapter 3: Political Conservatism within the Personality System Model**

### 3.1 Introduction

The role of individual differences underlying stable variation in political orientation has a long history (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950; Eysenck, 1954). This line of research has grown in recent years, partly because of the finding that political attitudes contain a substantial heritable component (Alford, Funk, & Hibbing, 2005; Martin et al., 1986) and the hypothesis that some or all of this genetic effect may reflect differences in personality (Verhulst, Hatemi, & Martin, 2010). However, while personality has intuitive links to political orientation (Sniderman, 1975), research has largely failed to support such associations (Alford & Hibbing, 2007; Carney, Jost, Gosling, & Potter, 2008; Mehrabian, 1996; Trapnell, 1994). Here we use the “personality system” model (McCrae & Costa, 1999) in two studies designed to examine the possibility that personality affects political orientation via mediating characteristic adaptations – in this case moral values. We first briefly summarise previous research relating personality to political orientation. We then describe how this three-level personality system model links personality to political behaviour via moral values, before presenting two studies testing predictions from this model.

#### 3.1.1 Personality and Political Orientation: A Brief Overview

Of the major dimensions of personality, openness has been most reliably associated with political orientation, with high levels of openness correlating around .3 with liberal political attitudes (Carney et al., 2008; McCrae, 1996; Trapnell, 1994; Van Hiel & Mervielde, 2004). Results for traits other than openness have been mixed. For instance, modest relationships have

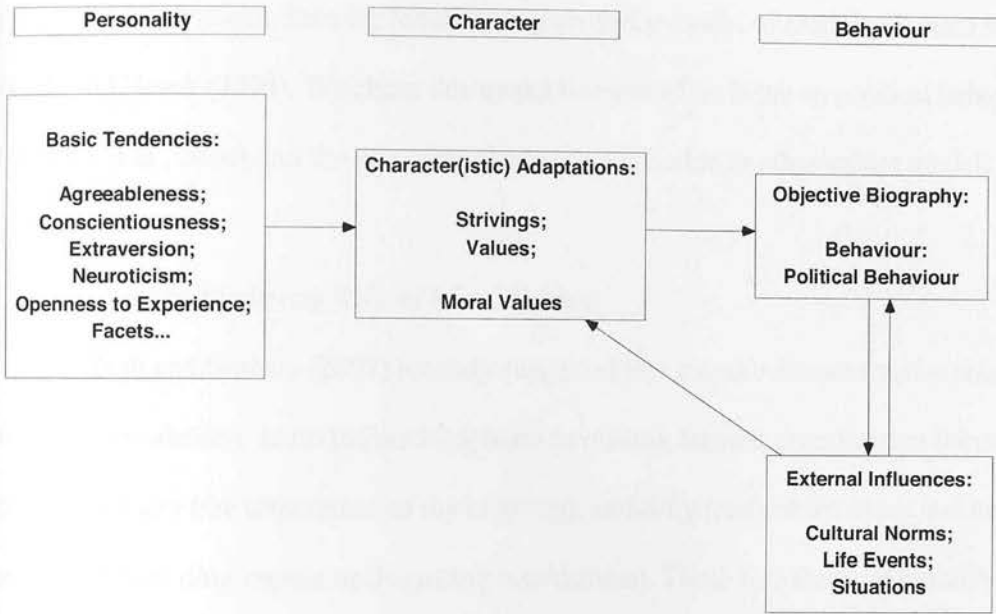
been reported between conscientiousness and political orientation (Gosling, Rentfrow, & Swann, 2003; Mondak & Halperin, 2008), but other studies have found no association (e.g. Alford & Hibbing, 2007). Likewise, while some studies have reported modest effects of agreeableness, extraversion, and neuroticism on political orientation (e.g. Barbaranelli, Caprara, Vecchione, & Fraley, 2007), more studies have failed to find associations from these traits to political orientation (Alford & Hibbing, 2007; Carney et al., 2008; Mehrabian, 1996; Trapnell, 1994). This led some authors to argue that, with the exception of openness, personality is unrelated to political orientation (Alford & Hibbing, 2007; McCrae, 1996).

### 3.1.2 Politics Within the Personality System Model

Large individual differences are apparent in political behaviour even after controlling for factors such as social status, gender, and cognitive ability (Schoon, Cheng, Gale, Batty, & Deary, 2010). As such, while individual differences in traits such as personality may have significant effects on political behaviour, these may be complex or indirect in nature (Gerber, Huber, Doherty, Dowling, & Ha, 2010; Mondak, Hibbing, Canache, Seligson, & Anderson, 2010). A model accounting for such complex or mediated effects linking personality to behaviour has been termed a “personality system framework” (McCrae & Costa, 1999). The personality system framework (see Figure 3.1) consists of three linked domains. At the most basic level (Level 1), lie largely biologically driven “basic tendencies” including personality. Level 2 consists of “characteristic adaptations” such as values. Constructs at this level are argued to be formed under the joint influence of basic tendencies and external factors such as life-events and cultural norms. Finally, at the third level of organization lies “objective biography” – behaviours emitted in interplay with external stimuli and characteristic adaptations. Importantly, this model implies

that the influence of basic tendencies (including personality traits) is often mediated by characteristic adaptations with no direct link from personality to behaviour.

Figure 3.1 The personality system model (adapted from McCrae & Costa, 1999).



While McCrae and Costa (1999) focused on the development and structure of personality, the model provides a coherent framework for translating personality traits into behaviours such as political orientation. For example, a person high on the basic tendency of empathy may come to value fairness (a characteristic adaptation). In translating this value into behaviour, contextual factors will play a role. This suggests that the behaviours under analysis should be specific to a particular context rather than aggregating across contexts. To give a concrete example, a single value such as fairness may be reflected in support for increased taxation of high earners in one context, and in support for merit-based pay in the context of

deciding individual compensation. We next turn to specifying and testing a set of characteristic adaptations that may mediate the effect of basic tendencies on political orientation.

In developing a mediated model, a measurement model must be chosen for the mediating layer. While several powerful measures of values have been proposed, in particular the Schwartz (1992) model of values, here we focus on the two-factor model of morality posited by Graham, Haidt, and Nosek (2009). We chose this model because of its focus on political behaviours (Graham et al., 2009), but the reasoning should be applicable to other values models.

### 3.1.3 The Mediating Role of Moral Values

Haidt and Graham (2007) recently suggested that moral behaviour varies according to five core foundations: harm (minimising harm to others), fairness (maximising fairness to all), in-group loyalty (the importance of the in-group), authority (respect for status and hierarchy), and purity (avoiding impure or disgusting acts/entities). These five facets of morality, in turn, correlate to form two higher-order moral factors of “individualizing” (the aggregate score on harm and fairness) and “binding” – the aggregate score on authority, in-group loyalty, and purity (Graham et al., 2009). Both individualizing and binding have been shown to account for significant variance in liberalism-conservatism in both the United States and UK (Graham et al., 2009) and in The Netherlands (van Leeuwen & Park, 2009).

Several face valid links exist from personality to these moral values. Neuroticism, characterised by anxiety and threat-sensitivity (Costa & McCrae, 1992), has face-valid associations with both binding (to secure the group from threat) and individualizing (to protect individuals from coercion). Research supports the suggestion that enhanced response to threat predicts greater support for policies that protect social norms (Oxley et al., 2008). Agreeableness,

which indexes empathy and pro-social tendencies (Jensen-Campbell & Graziano, 2001), is conceptually linked to a preference for reduction of suffering and injustice, features that underpin individualizing. Openness has been consistently found to predict unconventionality (McCrae, 1996). Thus we predicted a negative association between openness and binding (which reflects a preference for group conformity), as well as a positive association with individualizing reflecting the desire for maximum freedom of expression. Conscientiousness reflects responsible and dutiful behaviour and is associated with Protestant work ethic values (Christopher, Zabel, & Jones, 2008; Costa & McCrae, 1992) and as such is conceptually linked to binding, via the emphasis on group order. Finally, extraversion has shown links with right-wing authoritarianism (Ekehammer, Akrami, Gylje, & Zakrisson, 2004), which indexes submissiveness, conformity, and aggressiveness to legitimised out-groups (Altemeyer, 1996), perhaps as a reflection of extraversion enhancing fitness by increasing social dominance (Nettle, 2005). As such, we predicted extraversion would associate positively with binding, which in turn taps authoritative, parochial values.

#### 3.1.4 Overview

In summary, we hypothesised that previous links of political orientation to moral values reported recently in US, UK, and Dutch samples would be replicable in independent UK and US samples. Our critical predictions specified that each of the five personality domains would show significant effects on political orientation, mediated by moral values within a personality system framework. Next we use structural equation modelling in two independent studies to test hypotheses linking the five-factor model to binding and individualizing and politics.

## 3.2 Method – Study 1

### 3.2.1 Participants

Four hundred and forty-seven participants took part in Study 1 (315 female; mean age (female) = 19.27, SD = 2.65; mean age (male) = 20.12, SD = 3.94). Participants were undergraduate students who received partial course credit for their time.

### 3.2.2 Procedure and Measures

Moral values were assessed using the 32-item Moral Foundations Questionnaire (MFQ) measure of harm, fairness, in-group loyalty, authority, purity, with 2 validity-check items (Graham et al., 2011). Personality was assessed using the full 240-item NEO-PI-R providing measures of the five major domains of personality: agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience (Costa & McCrae, 1992). Political orientation was assessed on a 7-point Likert-scale measure asking “*How would you describe your political orientation?*” and anchored at 0 with the label “*Very liberal*” through to 6 “*Very conservative*”. This single-item measure has been used widely in political psychology research and shown good reliability and predictive validity (Carney et al., 2008; Fuchs & Klingemann, 1990; Jost, 2006). All measures were administered on-line via a web browser to facilitate data storage and scoring.

## 3.3 Results – Study 1

Descriptive statistics and reliability for the scales are shown in Table 3.1 and correlations between the scales in Table 3.2.

Table 3.1 Descriptive statistics for personality, moral values, and political orientation in Study 1 and Study 2.

| Measure                      | Study 1 |      | Study 2 |      |
|------------------------------|---------|------|---------|------|
|                              | M       | SD   | M       | SD   |
| <b>Moral Values</b>          |         |      |         |      |
| Harm                         | 3.52    | 0.72 | 5.05    | 0.85 |
| Fairness                     | 3.68    | 0.65 | 4.64    | 0.97 |
| In-group                     | 2.78    | 0.76 | 3.75    | 1.19 |
| Authority                    | 2.84    | 0.80 | 3.73    | 1.06 |
| Purity                       | 2.13    | 0.85 | 3.78    | 1.26 |
| <b>Personality</b>           |         |      |         |      |
| Agreeableness                | 47.59   | 8.33 | 9.93    | 2.18 |
| Conscientiousness            | 40.87   | 8.79 | 10.89   | 2.26 |
| Extraversion                 | 53.72   | 7.61 | 7.65    | 3.23 |
| Neuroticism                  | 57.97   | 8.91 | 6.74    | 2.70 |
| Openness                     | 55.86   | 7.12 | 10.47   | 2.23 |
| <b>Political Orientation</b> |         |      |         |      |
|                              | 2.40    | 1.33 | 3.43    | 1.02 |

Table 3.2 Correlations among personality domains, moral values, and political orientation in Study 1.

| Measure   | Har<br>m    | Fa.          | In.          | Au.          | Pu.          | A            | C            | E            | N    | O            |
|-----------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------|--------------|
| Fairness  | <b>.64*</b> |              |              |              |              |              |              |              |      |              |
| In-group  | <b>.31*</b> | <b>.26*</b>  |              |              |              |              |              |              |      |              |
| Authority | <b>.22*</b> | <b>.17*</b>  | <b>.65*</b>  |              |              |              |              |              |      |              |
| Purity    | <b>.29*</b> | <b>.15*</b>  | <b>.52*</b>  | <b>.55*</b>  |              |              |              |              |      |              |
| A         | <b>.38*</b> | <b>.25*</b>  | .00          | -.02         | .08          |              |              |              |      |              |
| C         | .08         | .03          | .00          | .00          | .04          | <b>.16</b>   |              |              |      |              |
| E         | <b>.15*</b> | .03          | <b>.15*</b>  | <b>.12</b>   | .07          | <b>.18*</b>  | <b>.13*</b>  |              |      |              |
| N         | <b>.14*</b> | .09          | -.03         | -.02         | .07          | -.07         | <b>-.44*</b> | <b>-.30*</b> |      |              |
| O         | <b>.16*</b> | <b>.16*</b>  | <b>-.22*</b> | <b>-.24*</b> | <b>-.27*</b> | <b>.13*</b>  | .00          | <b>.31*</b>  | .05  |              |
| Pol.      | <b>-.11</b> | <b>-.25*</b> | <b>.26*</b>  | <b>.26*</b>  | <b>.32*</b>  | <b>-.15*</b> | .08          | .00          | -.06 | <b>-.30*</b> |

Note: Bolded correlations are significant at  $< .05$ , Asterisk (\*) signifies significance at the .01

level (2-tailed). A = Agreeableness; C = Conscientiousness; E = Extraversion; N = Neuroticism;

O = Openness; Pol. = Political Orientation.



Structural models were built using AMOS 17.0 for Windows. Multiple fit indices were used; namely, the  $\chi^2$  test, the comparative fit index (CFI), and the root-mean square error of approximation (RMSEA). We handled measurement error in personality and moral values by treating each variable as a latent factor: personality was defined by a single indicator, the mean score of the relevant dimension, with the measurement error variance fixed as the difference between 1 and the reliability of the scale (calculated using Cronbach's alpha) times the scale variance (Hayduk, 1987). Moral values were defined by multiple indicators: the scales of in-group, authority, and purity, and the scales of harm and fairness, were utilised as indicators for binding and individualizing, respectively. Personality traits and moral values were allowed to correlate in each model.

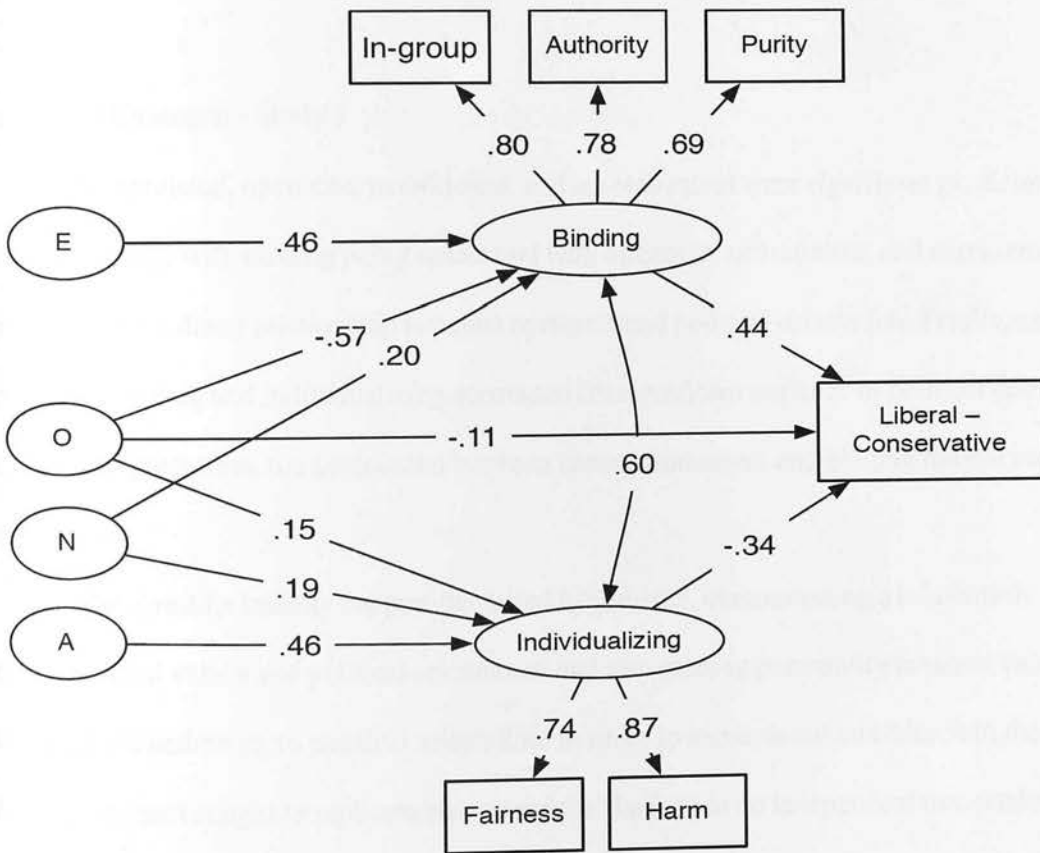
Three models were tested (although we acknowledge further theoretical models may be plausible as well): Model 1 (our predicted model) specified that personality influences moral values, which in turn influence political orientation. Model 2 reversed the roles of moral values and personality, specifying that moral values influence personality, which in turn influences political orientation. Finally, we tested a model in which personality influences political orientation, which in turn influences moral values (Model 3).

Model 1, our theoretical model, described the data well without modification (RMSEA = .07,  $\chi^2 = 99.17$  ( $df = 30$ ,  $p < .001$ ), CFI = .95). By comparison with Model 1, Models 2 and 3 provided poorer fits to the data as judged by all of the fit indices: RMSEA = .10,  $\chi^2 = 107.80$  ( $df = 31$ ,  $p < .001$ ), CFI = .91 and RMSEA = .12,  $\chi^2 = 226.48$  ( $df = 32$ ,  $p < .01$ ), CFI = .85, respectively.

We subsequently examined model 1 for potential improvements. The path from conscientiousness to binding was non-significant, and so was removed. Furthermore,

modification indices suggested that openness had a direct association with political orientation, and so this path was added. This final version described the data well (RMSEA = .07,  $\chi^2 = 80.20$  ( $df = 24, p < .001$ ), CFI = .95; see Figure 3.2).

Figure 3.2 Path diagram illustrating the relationships between personality, moral values, and political orientation in Study 1.



As neuroticism loaded positively on both binding and individualizing, this effect was further analysed. To test whether different facets of neuroticism might be having different, perhaps even opposing effects on moral values, we built a model containing all of the neuroticism facets and then reduced the model down to only those facets that showed significant pathways to binding and/or individualizing. The final model fit the data well (RMSEA = .07,  $\chi^2 = 17.53$  ( $df = 6, p < .01$ ), CFI = .99) and included three facets: the facets anxiety and self-consciousness loaded positively on individualizing ( $\beta = .14$  and  $.17$ , respectively), while depression loaded negatively on individualizing ( $\beta = -.16$ ).

### 3.4 Brief Discussion - Study 1

As predicted, openness, neuroticism, and agreeableness were significant predictors of individualizing, with binding being associated with openness, neuroticism, and extraversion. We also observed a direct relationship between openness and political orientation. Finally, as predicted, binding and individualizing accounted for significant variance in political orientation. Contrary to prediction, the association between conscientiousness and binding did not reach significance.

These results broadly support the initial hypotheses, demonstrating a relationship between moral values and political orientation, and also relating personality to moral values, and via mediated pathways, to political orientation. In order to increase our confidence in the findings we next sought to replicate and extend the findings in an independent non-student sample utilising a broader measure of political orientation. This study is presented below.

## 3.5 Method - Study 2

### 3.5.1 Participants

Four hundred and seventy-six participants took part in Study 2 (307 female; mean age (female) = 33.69, SD = 12.33; mean age (male) = 31.65, SD = 10.95). Participants in this sample were recruited from a web-based recruitment site, Amazon's 'Mechanical Turk', or Mturk, a website that allows people (aged 18 or over) to perform short tasks for small sums of money: data from this sample has been reported elsewhere (Kurzban, Dukes, & Weeden, 2010). The survey was restricted to residents of the United States. This site has generated results comparable to other samples (e.g. DeScioli & Kurzban, 2009). The sample contained 81% European Americans, 5% African Americans, 5% Asian Americans, 4% Latino Americans, and 5% other.

### 3.5.2 Procedure and Measures

Each participant rated their support/opposition on a 7-point Likert scale to 14 items addressing current political issues. These items included restrictions against Internet pornography, comprehensive sex education in public schools, banning abortion and legalised gay marriage, allowing undocumented immigrants to stay in the United States, higher taxes for the wealthy, aggressive military response to dangerous foreign groups, unemployment payments, gun control laws, offshore drilling, and subsidised healthcare for the poor. These items summed had a Cronbach's alpha of .82 and were subsequently utilised as a single scale indexing political orientation (higher scores represented greater conservatism).

Participants also completed the moral relevance items from Graham et al. (2009), which are similar to the MFQ scales used in Study 1 and are designed to measure the same five moral dimensions of harm, fairness, in-group loyalty, authority, and purity. Personality was measured

with a short Big Five personality inventory (Rammstedt & John, 2007), with each of the Big Five dimensions indexed by two items.

### 3.6 Results – Study 2

Descriptive statistics and reliability for the scales are shown in Table 3.1 and correlations between the scales in Table 3.3.

Table 3.3 Correlations among personality domains, moral values, and political orientation in Study 2.

| Measure   | Har<br>m    | Fa.         | In.         | Au.         | Pu.         | A            | C            | E            | N            | O            |
|-----------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|
| Fairness  | <b>.62*</b> |             |             |             |             |              |              |              |              |              |
| In-group  | <b>.33*</b> | <b>.47*</b> |             |             |             |              |              |              |              |              |
| Authority | <b>.38*</b> | <b>.47*</b> | <b>.68*</b> |             |             |              |              |              |              |              |
| Purity    | <b>.33*</b> | <b>.38*</b> | <b>.52*</b> | <b>.54*</b> |             |              |              |              |              |              |
| A         | <b>.17*</b> | <b>.15*</b> | .01         | .03         | <b>.17*</b> |              |              |              |              |              |
| C         | -.01        | .04         | .09         | <b>.11</b>  | <b>.15*</b> | <b>.18*</b>  |              |              |              |              |
| E         | .04         | .08         | <b>.10</b>  | .09         | .04         | <b>.04</b>   | <b>.10</b>   |              |              |              |
| N         | .09         | .09         | <b>.10</b>  | .04         | .06         | <b>-.26*</b> | <b>-.20*</b> | <b>-.21*</b> |              |              |
| O         | .08         | <b>.15*</b> | .01         | .05         | -.08        | <b>.18*</b>  | <b>.10</b>   | <b>.30*</b>  | <b>-.21*</b> |              |
| Pol.      | .07         | <b>-.12</b> | <b>.17*</b> | <b>.21*</b> | <b>.34*</b> | -.06         | <b>.18*</b>  | <b>.12</b>   | .08          | <b>-.15*</b> |

Note: Bolded correlations are significant at  $< .05$ , Asterisk (\*) signifies significance at the .01

level (2-tailed). A = Agreeableness; C = Conscientiousness; E = Extraversion; N = Neuroticism;

O = Openness; Pol. = Political Orientation.

We next attempted to confirm the final model of Study 1. Moral values were modelled as latent factors and were defined by multiple indicators. The scales of in-group, authority, and purity, and the scales of harm and fairness, were utilized as indicators for binding and individualizing, respectively. Personality traits and political orientation were modelled as

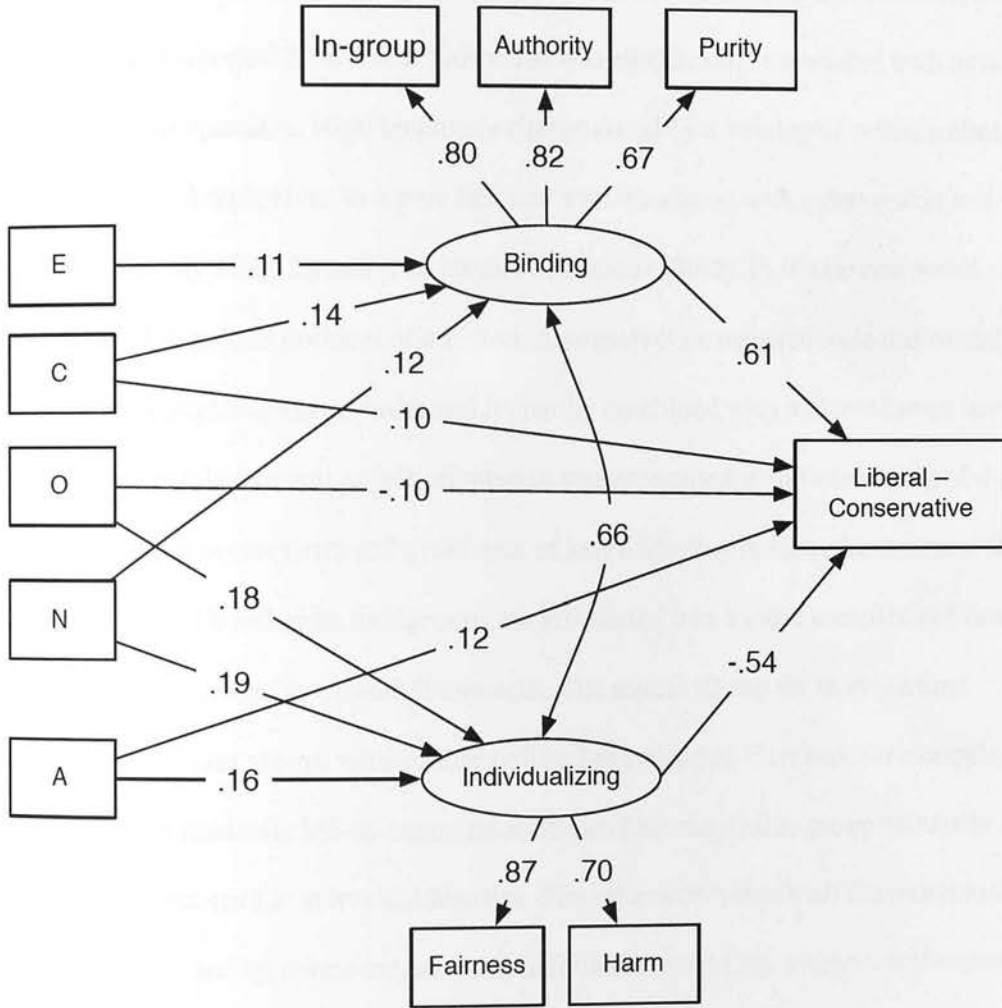
manifest variables. Personality traits were allowed to correlate in line with significant covariance observed in the correlation matrix. Model 1 again provided an adequate description of the data (RMSEA = .07,  $\chi^2 = 98.06$  ( $df = 30, p < .001$ ), CFI = .94). Models 2 and 3 provided poorer fits to the data as judged by all of the fit indices: RMSEA = .10,  $\chi^2 = 131.49$  ( $df = 24, p < .001$ ), CFI = .91 and RMSEA = .07,  $\chi^2 = 110.65$  ( $df = 32, p < .01$ ), CFI = .93, respectively.

We subsequently examined model 1 for potential improvements. Observations of the path coefficients suggested that in this sample openness did not affect binding. Additionally, we observed that openness, conscientiousness, and agreeableness contained a significant direct path to political orientation. In a second step we adjusted for these paths, which led to a model demonstrating a good fit to the data (RMSEA = .06,  $\chi^2 = 81.87$  ( $df = 28, p < .001$ ), CFI = .95; see Figure 3.3).

### 3.7 Brief Discussion - Study 2

Confirming the findings of Study 1, openness, neuroticism, and agreeableness were significant predictors of individualizing, with binding being associated with conscientiousness, neuroticism, and extraversion: conscientiousness was not a significant predictor of binding in Study 1, but was predicted to show links with this moral value. As in Study 1, openness directly influenced political orientation; however, in contrast to Study 1, here we observed additional direct paths from agreeableness and conscientiousness to political orientation. Finally, binding and individualizing, as in Study 1, accounted for significant variance in political orientation. These results broadly support the initial hypotheses and the results of Study 1, demonstrating a relationship between moral values and political orientation, and illuminating links from personality to moral values and, via mediated pathways, to political orientation.

Figure 3.3 Path diagram illustrating the relationships between personality, moral values, and political orientation in Study 2.



### 3.8 General Discussion

The central aim of these two studies was to test a personality system model of the relationship between personality, moral values, and political orientation. The core hypothesis was that interposing an appropriate measure of characteristic adaptations in the form of moral



values would reveal links of personality to political orientation. This hypothesis was confirmed in two independent studies, supporting a personality system model (McCrae & Costa, 1999) of political orientation.

High individualizing is characterised by a concern for fairness and ensuring that individuals are protected from harm. This value was significantly associated with agreeableness, neuroticism, and openness. High binding is characterised by a valuing of order, authority, in-group loyalty, and aspirations to a pure life, and was associated with extraversion and low openness (in Study 1 and 2), and with conscientiousness (Study 2). These two moral values in turn combined to predict political orientation. A conservative orientation in this model was associated with high valuing of order and hierarchy combined with a low value on the treatment of individuals, while a liberal or left-orientation was associated with low valuing of the group and strong emphasis on equity and avoidance of harm. Moving in from the extremes the model revealed how simple left-right distinctions are articulated into a more complex political landscape in the personality system framework. The model allows for quite distinct characteristics among groups with similar political orientations. Contrast, for example, two individuals with moderate left-of-centre orientations. One may value group solidarity strongly, but have little concern for individual liberties. The other may value both the individual and the group to an equal but moderate extent. Such individuals would, we suggest, self-report an identical orientation on the liberal-conservative dimension, but would disagree strongly over particular policies: for instance, immigration and free trade (where those high on group loyalty might favour trade barriers and protection) and civil liberties (where concerns for the treatment of individuals would be relevant). Thus the model allows far more sophisticated and precise political behavioural predictions than can be made from a simple unitary left-right spectrum.

A further important observation from the results concerns the significant influence of neuroticism upon both individualizing and binding. Higher levels of neuroticism predict higher levels of both these values, but individualizing and binding influence political orientation in opposite directions. As such, it is likely that failures to associate neuroticism with political orientation in previous research may be due to these influences effectively cancelling out at the level of political orientation. We observed additional countervailing effects at the facet-level: scores on anxiety and self-consciousness both increase individualizing, while depression scores relate negatively to this value. This latter finding suggests that future work attempting to link neuroticism with political attitudes would be wise to consider facet-level associations alongside the more common domain-level relations.

Although our predictions were broadly validated across studies, some differences were observed between Study 1 and Study 2. In Study 1 links from conscientiousness were non-significant while in Study 2 conscientiousness showed significant links to binding and a direct link to political orientation. Possible explanations may include a lack of power, but also possible increasing effects of conscientiousness with age and accompanying changes in responsibilities and life-roles (mean age in Study 2 was 32 years vs. 20 years in Study 1). Additionally, while the association of openness to both individualizing and political orientation were robust, we failed to replicate the association between openness and binding in Study 2. This may reflect a loss of bandwidth (coverage of the breadth of behaviours) in the ten-item inventory (two items per Big Five dimension) used in Study 2. This interpretation seems plausible given that low openness has shown robust links to traits with prima facie links to binding, such as right-wing authoritarianism (Sibley & Duckitt, 2008). Future work is nevertheless recommended to confirm the stability of this association between openness and binding. Finally, the strength of the relationships between

personality traits and moral values was notably lower in Study 2 (specifically, the links from openness and extraversion to binding, and from agreeableness to individualizing). Again, this may have arisen because of limitations in coverage of the short-measure personality instrument and further work is recommended to clarify the magnitude of these associations.

A number of opportunities for future research emerge from these findings. Firstly, exploration of additional intermediary constructs by which personality exerts effects on political behaviours may be valuable. Candidates include values constructs such as those proposed by Schwartz (1992) and cultural-ideological measures explored by Ashton and colleagues (Ashton et al., 2005). In addition, traits with links both to personality and to political orientation (Sibley & Duckitt, 2008), such as social dominance orientation (Pratto, Sidanius, Stallworth, & Malle, 1994) and right-wing authoritarianism (Altemeyer, 1996), may also help to further articulate the relationship between personality and political attitudes.

Secondly, further insight into the origins of political attitudes may flow from examination of the dynamic components of the personality systems model. For example, while emotionality is posited as exerting a chronic influence on binding, this value is likely to increase in importance when the individual feels threatened (e.g. Cohrs & Asbrock, 2009; Duckitt & Sibley, 2010a). Accordingly, experimental manipulations that address these putative dynamic or acute effects may increase understanding of influences on political behaviour.

In summary, the studies reported here suggest that the personality system model is a useful framework for understanding the complex relationship between personality and political orientation. The data suggest that personality traits play a significant role in shaping political orientation, but do so largely indirectly, via an intermediary layer of characteristic adaptations.

This model may be productive for further understanding individual differences in political behaviour.

## **Chapter 4 - Genetic Bases of In-group Favouritism:**

### **Evidence for Common and Specific Biological Mechanisms**

#### 4.1 Introduction

In-group favouritism is ubiquitous in human societies (Bernhard, Fischbacher, & Fehr, 2006; LeVine & Campbell, 1972; Sumner, 1907). As Fiske (2002) notes, “*people typically seek other people who are similar to themselves, being comfortable with others they perceive as members of their own in-group. From comfort follows, at best, neglect of people from out-groups and, at worst, murderous hostility toward out-groups perceived as threatening the in-group*” (p. 123). Competition for resources exacerbates in-group favouritism (Sherif, 1966; Sherif & Sherif, 1956). Indeed, in the classic Robbers’ Cave study, Sherif and colleagues (Sherif, 1966) exposed boys assigned to one of two groups at a summer camp to intergroup competition: hostilities were observed within days such that the experiment was necessarily halted. However, favouritism continues to exist even in the absence of such competition (Billig & Tajfel, 1973; Tajfel, 1982; Tajfel, Billig, Bundy, & Flament, 1971; Yamagishi & Mifune, 2008) and extends to arbitrary affiliations (Locksley, Ortiz, & Hepburn, 1980; Yamagishi & Mifune, 2008); individuals who are assigned to a group on grounds as trivial as preferences within a set of paintings are more likely to distribute financial resources to other in-group members than to out-group individuals (e.g. Tajfel et al., 1971). Such observations, coupled with the survival and reproductive benefits of group membership (Baumeister & Leary, 1995) – groups are better equipped to repel outside attacks, can hunt more efficiently, and provide greater mating opportunities – suggest that mechanisms fostering alignment with the in-group are likely to have been subject to positive selection in humans (Hammond & Axelrod, 2006).

If the selective benefits of in-group favouritism have been high while the cues for affiliation have been arbitrary (rather than limited to a small set of essentialist types), selection could have favoured the development of a flexible central affiliation mechanism (CAM) that has access to the full range of perceptual information signifying group membership (Kurzban, Tooby, & Cosmides, 2001; Rand et al., 2009). If such a central mechanism underlies human in-group favouritism, then the drive to prefer own-group members may be high, and the chosen in-group will be relatively arbitrarily assembled on the basis of context and will be updatable over time. By contrast, a strong-specificity hypothesis suggesting that affiliation is based on a set of essentialist features, such as kinship, ethnicity, or shared beliefs, predicts that favouritism will be uncorrelated across domains, relatively hard to form from arbitrary cues, and relatively invariant to context (Gil-White, 2001; Hirschfeld, 1996).

Although previous research has tended to favour either a CAM or an essentialist model of favouritism, it is also plausible that both a flexible CAM system and a set of essentialist mechanisms have evolved in humans. Research suggests that group affiliation is relatively flexible for at least some features: Rand et al. (2009), observed that while in-group favouritism was present in voters during the 2008 Democratic primary season (Hillary Clinton vs. Barack Obama), this bias against Obama was absent in Clinton supporters once she had conceded, suggesting that (at least) this form of in-group identity may be flexible. However, certain types of groupings appear to robustly retain special salience: Gil-White (2001; see also Hirschfeld, 1996) notes from research with Mongol semi-nomadic pastoralists that humans understand ethnic groups as if they were “species”, with essential, immutable properties. Therefore, we predicted that a mixed model containing both a flexible CAM mechanism and specialized essentialist mechanisms would best explain human in-group favouritism.

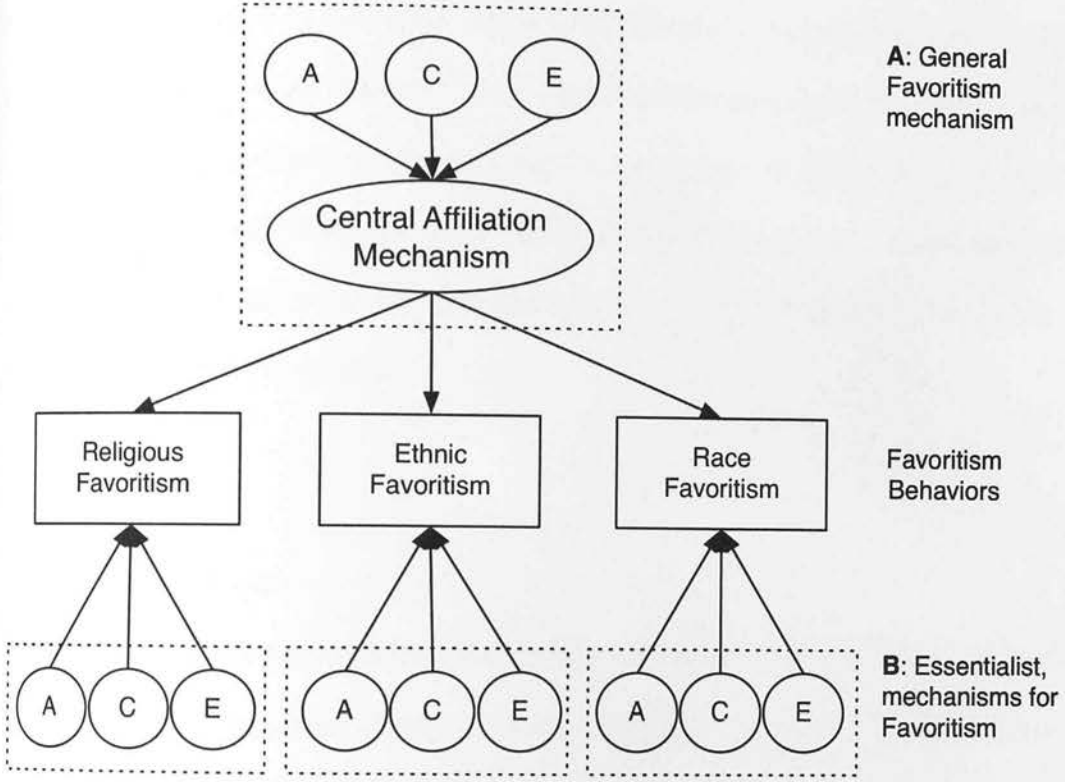


We tested these contrasting mechanisms using measures of in-group favouritism across three important social groupings—religion, ethnicity, and race. Favouritism according to these groupings was assessed in a large, genetically informative, and population-representative twin sample and analysed using multiple-group multivariate structural modelling. The three theoretical models make clear predictions about behaviour and, in particular, about the patterns of correlation that should be observed between different types of favouritism. Multivariate behaviour genetics research designs allowed us to discriminate among these theories through the predicted patterns of genetic and environmental influences on in-group favouritism. In particular, the common-pathway model was developed by Kendler, Heath, Martin, and Eaves (1987) as a powerful statistical tool precisely to distinguish among these types of competing theories (i.e., those with a common underlying mechanism for a given set of traits vs. those with a unique mechanism specific to each trait); in the research reported here, we applied the common-pathway model to in-group favouritism.

If a common brain or mental system underlies multiple behaviours (as is predicted by the CAM model of in-group favouritism), then environmental and genetic effects on these diverse behaviours must be mediated by this central (or common) pathway, as shown in the upper portion of Figure 3.1. However, if each behavioural domain reflects the operation of distinct, essentialist brain or mental systems, then each of these behaviours will result from its own unique genetic (*A*), shared-environment (or familial-environment; *C*), and unique environment (*E*) effects (see the lower portion of Fig. 1). Finally, if the brain or mental systems underlying favouritism involve both a common flexible system and additional distinct, essentialist mechanisms, then a mixed model (i.e., one encompassing both parts of Fig. 1) would be required to explain the observed pattern of behaviour.



Figure 4.1 Predictions from the central affiliation mechanism (CAM) and essentialist theories of in-group favouritism.



Note: As illustrated in the upper portion of the figure, if there is a single neural or mental mechanism for affiliation across multiple behavioural domains, this would constrain genetic (*A*) and environmental (*C*, shared environment, and *E*, unique environment) influences on favouritism to be mediated through the CAM factor. However, as illustrated in the lower portion of the figure, if there are distinct, essentialist mechanisms (i.e., if each essential group-formation domain has its own evolved mechanism), different kinds of favouritism would have different sets of genetic and environmental influences.

We tested these competing theories of in-group favouritism by comparing three models: Model 1, the CAM model; Model 2, the essentialist model; and Model 3, the mixed Central

Affiliation Mechanism model. Model 1 assumes that favouritism is not based on essentialist systems and allowed us to test the prediction that genetic and environmental effects operating solely via a single common favouritism factor fit the data well. Model 2 allowed us to test the prediction that only specific influences operating on each favouritism trait are required for the model to achieve a good fit to the data, and that there is no need for a common favouritism factor. Model 3, the full common-pathway model, allowed us to test the prediction that both a general favouritism mechanism and additional specific (essentialist) effects are required to provide an adequate fit to the data.

## 4.2 Method

### 4.2.1 Participants

Phenotypic data were available for 957 pairs of twins contacted by the MacArthur Foundation Survey of Midlife Development (MIDUS) in the United States (Kendler, Thornton, Gilman, & Kessler, 2000; Kessler, Gilman, Thornton, & Kendler, 2004). These data were collected on working-age (25-74) adults to examine the factors pertaining to midlife development in the domains of mental and physical health, and psycho-social wellbeing, among others. Twin pairs were recruited through telephone calls and asking respondents whether they, or any of their immediate family, were members of an intact twin pair. A representative sample of the United States of approximately 50,000 households was screened in this manner. If respondents reported the presence of a twin in the family (c. 15%), permission was requested to contact them again for further participation in the survey. Sixty percent of applicable respondents agreed and were thus referred to the MIDUS recruitment process. Further information on the sample is available in Brim et al. (1995-1996).

The pairs of twins were assessed for religious, ethnic, and racial in-group favouritism, among other behaviours. Of the monozygotic (MZ) pairs, 167 were male (mean age = 44.6 years, SD = 11.4) and 194 were female (mean age = 43.7 years, SD = 12.2). Of the dizygotic (DZ) pairs, 136 were male (mean age = 44.6 years, SD = 12.4), 210 were female (mean age = 45.8 years, SD = 12.6), and 250 were opposite-sex pairs (mean age = 45.9 years, SD = 11.8). The excess of females over males is comparable to previous twin research (Lykken, McGue, & Tellegen, 1987).

#### 4.2.2 Measures of In-group Favouritism

For each group type, we assessed three distinct elements of in-group favouritism: (a) strength of identification with the group, (b) preference for affiliating with in-group members, and (c) the importance placed on marrying within the group. For instance, religious in-group favouritism was assessed with the following items: "How closely do you identify with being a member of your religious group?"; "How much do you prefer to be with other people who are the same religion as you?"; and "How important do you think it is for people of your religion to marry other people who are the same religion?". The items for ethnic and racial in-group favouritism had the same wording as the items for religious in-group favouritism, except that the appropriate group type was substituted (e.g., "How closely do you identify with being a member of your racial group?"; also see Appendix A). All responses were made on 4-point Likert scales (from 1, *very*, to 4, *not at all*). Interitem correlations were high within each group type (ranging from .32 to .65, with all but one correlation greater than .40), and scale scores were calculated as the sum of item scores within a group type. Phenotypic correlations (from one individual in a given pair taken at random) between the three scales ranged from .31 to .38.

### 4.2.3 Analysis

Prior to conducting the analyses, we controlled for the effects of age and sex, and standardised residuals were used in subsequent analyses (McGue & Bouchard, 1984). A classical twin design was used. We used structural equation modelling to model the covariance of MZ twins in terms of additive genetic effects, shared-environment effects, and unique-environment effects. These models were estimated by full-information maximum-likelihood analysis using OpenMx (Boker et al., 2010a; Boker et al., 2010b).

### 4.3 Results

Descriptive statistics for each trait are presented in Table 4.1. Intra-class correlations indicated that MZ twins were significantly more similar to each other than were DZ twins for all three types of in-group favouritism, a pattern suggesting a genetic influence (see Figure 4.2). For ethnic in-group favouritism, MZ correlations were more than twice the DZ correlations, suggesting nonadditive genetic variance. However, because of the clear theoretical importance of the shared environment for all three types of in-group favouritism, we tested models incorporating additive genetic and shared- and unique-environment influences (the classical *ACE* model) for each type rather than modelling genetic dominance effects. The full results of the univariate modeling for each trait are presented in Table 4.2. In each case, additive genetic and unique-environmental influences were statistically significant. Shared-environment had significant effects on religious in-group favouritism ( $\Delta\chi^2(1) = 3.70, p = .05$ ), but these shared family effects were not significant for ethnic and race in-group favouritism, and could be dropped without a significant decrease in goodness-of-fit ( $\Delta\chi^2(1) = 0, p = 1.0$ ;  $\Delta\chi^2(1) = 0, p = 1.0$ , respectively).

Table 4.1 Descriptive statistics for religious, ethnic, and race favouritism across zygosity

|        | Mean       | MZm mean   | MZf mean   | DZm mean   | DZf mean   | DZos mean  |
|--------|------------|------------|------------|------------|------------|------------|
| Relig. | 2.51 (.90) | 2.69 (.91) | 2.40 (.90) | 2.56 (.91) | 2.51 (.83) | 2.47 (.93) |
| Ethn.  | 2.98 (.81) | 2.95 (.79) | 3.01 (.83) | 3.11 (.76) | 2.82 (.84) | 3.02 (.80) |
| Race   | 2.07 (.80) | 2.03 (.77) | 2.07 (.83) | 2.17 (.87) | 1.97 (.75) | 2.11 (.79) |

Note: Relig. = religious favouritism; Ethn. = ethnic favouritism; Race = race favouritism;

standard deviations are in parentheses; MZm = MZ males; MZf = MZ females; DZm = DZ

males; DZf = DZ females; DZos = DZ opposite sex

Table 4.2 Standardised univariate heritability estimates for religious, ethnic, and race in-group favouritism items with 95% Confidence Intervals.

|                       | A                  | C                  | E                  |
|-----------------------|--------------------|--------------------|--------------------|
| Religious Favouritism | .41<br>(.20 - .61) | .17<br>(.00 - .33) | .42<br>(.37 - .50) |
| Ethnic Favouritism    | .47<br>(.23 - .58) | .00<br>(.00 - .19) | .53<br>(.45 - .62) |
| Race Favouritism      | .39<br>(.18 - .48) | .00<br>(.00 - .16) | .61<br>(.54 - .71) |

Note: A = additive genetic effects; C = shared-environment effects; E = unique-environment effects

We next moved to our core tests: whether the CAM model, the essential model, or the mixed model provides a better fit to the data. The three theoretical models were compared with a standard baseline model - the Cholesky ACE decomposition incorporating all three favouritism traits (for fit statistics and comparison statistics for all models, see Table 4.3: Note that there was no significant difference between the phenotypic saturated model (estimating phenotypic means and variances, and covariances across twin order and zygosity) and the Cholesky;  $\Delta\chi^2(33) =$

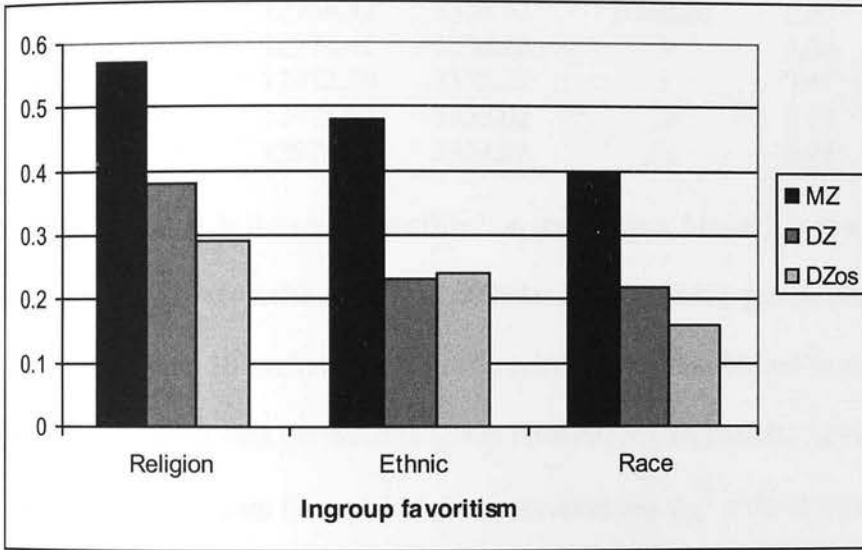
35.6,  $p = .35$ ). The prediction that a CAM factor alone provides an adequate explanation of favouritism (Model 1) was tested first. This model, which includes a common-pathway mechanism but no genetic pathways specific to any domain of in-group favouritism, fit significantly worse than the baseline model,  $\Delta\chi^2(6) = 38.89, p < .01$ . Thus, contrary to the CAM only theory, essentialist pathways are required to explain favouritism.

Next, we tested whether essentialist factors alone are sufficient to model in-group favouritism (Model 2). This model, lacking a CAM (common additive genetic, shared-, and unique-environment effects were constrained to zero), also fit significantly worse than the baseline model,  $\Delta\chi^2(6) = 845.68, p < .01$ . Thus, contrary to the essentialist-only theory, a common or context-sensitive system is required to explain favouritism. Finally, Model 3 (the mixed model) was tested. This model posited both a CAM system and essentialist factors, including correlated unique-environment pathways at the essentialist level. This model fit the data with no significant decrement from the fit of the baseline model,  $\Delta\chi^2(1) = 0.60, p = .44$ . This finding strongly supports the idea that both the CAM and essentialist genetic effects are required to explain variation in favouritism. We conducted chi-square comparisons as a rigorous and direct test of Model 3 against nested Models 1 and 2. These comparisons indicated that both Model 1,  $\Delta\chi^2(3) = 21.65, p < .01$ , and Model 2,  $\Delta\chi^2(3) = 222.49, p < .01$ , showed a significant loss of fit compared with Model 3, our preferred model. This indicated again that both the CAM and essentialist genetic effects are required to explain variation in favouritism. We then examined whether Model 3 could be further simplified without significant loss of fit. No genetic paths could be removed without significantly worsening fit. A marginal exception was the essentialist genetic path to religious favouritism. Dropping this path (Model 3a) did not cause a nominally significant decrease in fit,  $\Delta\chi^2(1) = 3.60, p = .058$ ; however, the model demonstrated



an inferior fit relative to Model 3 according to Akaike's information criterion (AIC; AIC increased to 3,338.42 from 3,336.82), and this path was therefore retained.

Figure 4.2 Intra-class correlations for three types of in-group favouritism (religious, ethnic, and racial) in monozygotic twins (MZ), dizygotic same-sex twins (DZ), and opposite-sex twins (DZos).



Exploring the role of environments on favouritism, we examined the significance of the shared- and unique-environment effects. It was possible to drop all shared-environment paths without significant loss of fit (Model 3b),  $\Delta\chi^2(4) = 3.47, p = .48$ . In a final step, we examined unique-environment influences. This step revealed that there were no significant effects from the common unique-environment influence on racial in-group favouritism, nor from the specific unique-environment influence on ethnic in-group favouritism: in Model 3c, the common unique-environment path was removed,  $\Delta\chi^2(1) = 2.73, p = .10$ , and in Model 3d, the specific unique-environment path was removed,  $\Delta\chi^2(1) = 0.04, p = .84$ . The final reduced model is shown in Figure 4.3.

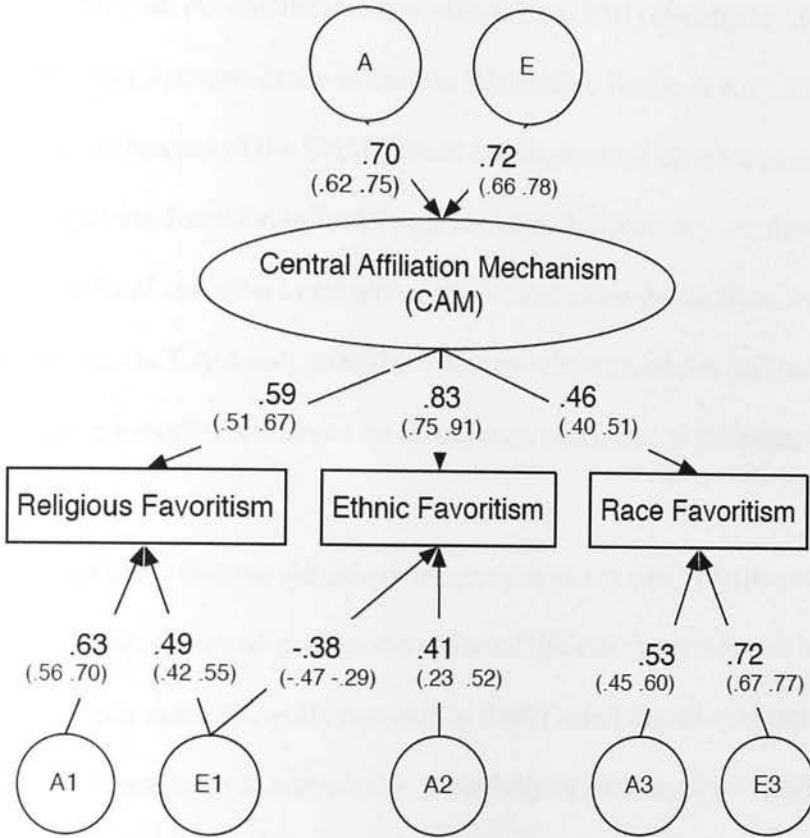


Table 4.3 Fit statistics and comparison statistics for all models.

| Model     | Parameters | Fit Statistics  |                | Nested Model Comparisons |                |             |            |
|-----------|------------|-----------------|----------------|--------------------------|----------------|-------------|------------|
|           |            | -2LL            | AIC            | Reference Model          | $\Delta\chi^2$ | $\Delta df$ | <i>p</i>   |
| Baseline  | 21         | 12968.22        | 3340.22        | -                        | -              | -           | -          |
| 1         | 15         | 13007.11        | 3365.11        | Baseline                 | 38.89          | 6           | < .01      |
| 2         | 15         | 13813.90        | 4171.90        | Baseline                 | 845.68         | 6           | < .01      |
| 3         | 20         | 12968.82        | 3336.82        | Baseline                 | 0.60           | 1           | .44        |
| 3a        | 19         | 12972.42        | 3338.42        | 3                        | 3.60           | 1           | .058       |
| 3b        | 16         | 12972.29        | 3332.27        | 3                        | 3.47           | 4           | .48        |
| 3c        | 15         | 12975.02        | 3333.02        | 3b                       | 2.73           | 1           | .10        |
| <b>3d</b> | <b>14</b>  | <b>12975.06</b> | <b>3331.06</b> | <b>3c</b>                | <b>0.04</b>    | <b>1</b>    | <b>.84</b> |

Note: Model 1 models the common affiliation mechanism, Model 2 is an essentialist model, and Model 3 is the mixed model. Model 3a excludes the essentialist genetic path to religious favouritism, Model 3b excludes all shared-environment paths, Model 3c excludes the common unique-environment path (to racial in-group favouritism), and Model 3d excludes the specific unique-environment path (to racial in-group favouritism).  $\Delta\chi^2$  is the change in  $-2 \log$  likelihood ( $-2LL$ ), and  $\Delta df$  is the change in the degrees of freedom, relative to the reference model. AIC = Akaike's information criterion.

Figure 4.3 Final model (Model 3d) of the genetic and environmental influences on in-group favouritism in three domains.



Note: All paths shown here are significant, and their coefficients are indicated. Variables with no connecting pathway were modelled as independent. The 95% confidence intervals are given in parentheses. A = genetic influences; E = unique environment influences.

#### 4.4 Discussion

This study is the first, to our knowledge, to provide genetic evidence that in-group favouritism, at least at the level of religion, ethnicity, and race, is underpinned by both a central affiliation mechanism (CAM) and essentialist favouritism systems, each with significant genetic and environmental components. These results are compatible with recent behavioural research

and game-theoretic modelling (Baumeister & Leary, 1995; Hammond & Axelrod, 2006) and suggest that human in-group favouritism is best understood in terms of a multicomponent architecture supporting both essentialist domains (Gil-White, 2001; Hirschfeld, 1996) and a flexible CAM supporting dynamic group affiliation (Cosmides, Tooby, & Kurzban, 2003). With regard to the relative influences of the CAM system and the essentialist systems on each of the favouritism traits, squaring the standardized factor loadings demonstrates that the CAM accounts for 35%, 69%, and 21% of variation in religious, ethnic, and racial favouritism, respectively. These data indicate that the CAM only partially mediates religious, ethnic, and racial favouritism, and that substantial influences on favouritism also occur at the essentialist-system level.

Our results indicated that the shared-environment does not exert significant influences on favouritism. Although our choice of final model reflected the most parsimonious interpretation of the data, our study was not sufficiently powered to detect small shared-environment effects. Further research is recommended to address this potentially important, albeit likely modest, source of variation in in-group favouritism. Conversely, although our final model contained an essentialist genetic influence on religious favouritism, removing this path only marginally worsened the model's fit to the data. Therefore, further research is recommended to clarify whether the genetic influences on religious in-group favouritism are wholly mediated through the CAM or act in tandem with it.

Perhaps the most interesting environmental effect was that elements of the unique-environment acting at the essentialist level exerted countervailing effects, such that elevated levels of religious favouritism were associated with lowered levels of ethnic favouritism. This may reflect the influence of religious teachings, which may increase ethnic tolerance, or the

possibility that religion became superordinate to coalitions based on ethnicity. Recent work supports the existence of these countervailing effects of religious belief. For example, Malka, Soto, Cohen, & Miller (2011) report that religious belief promotes both a culturally based conservative identity, in turn decreasing support for social welfare provision, but also promotes a prosocial value orientation, which in turn increases support for social welfare provision. Malka and Soto (2011) provide further evidence for such countervailing effects of religious belief, observing that religiosity has “*both a direct effect toward opposition to torture and an indirect effect—via conservative political alignment—toward support of torture*” (p. 1091).

What might be the psychological basis for the CAM? One possibility is that the CAM reflects right-wing authoritarianism (RWA; Altemeyer, 1981): RWA has been linked to both religious fundamentalism (Altemeyer & Hunsberger, 1992) and to ethnocentrism (Sibley & Duckitt, 2008), and contains heritable variance (McCourt, Bouchard, Lykken, Tellegen, & Keyes, 1999), suggesting that RWA is a plausible candidate explainer for the CAM. Future work is recommended to assess the important issue of whether common genetic variation underlies both generalised favouritism and authoritarianism.

Perhaps as an alternative to essentialist models, social dominance orientation (SDO; Pratto, Sidanius, Stallworth, & Malle, 1994) may account for specific genetic effects on either race and ethnic favouritism: SDO has been, independently of RWA, associated with ethnocentrism (Sibley & Duckitt, 2008), but is not typically found to relate to religious fundamentalism (Altemeyer, 1998; Van Hiel & Mervielde, 2002), suggesting that SDO is not likely to account for variation in the CAM, although is a plausible candidate for understanding the specific effects on race and ethnic favouritism. Future work addressing this issue is also recommended.

Although the three group types studied here tap commonly studied and relevant bases of in-group favouritism, future research could fruitfully be extended to additional domains — for instance, loyalty to military, political, and sports coalitions; employer and workplace affiliation; and detailed close-kin affiliations. Cross-cultural studies would also be useful to determine the extent to which our results generalize across societies. Such research could further understanding of the extent to which the reported common factor influences the full range of in-group favouritism behaviours and could reveal whether favouritism in other group domains reflects the specialized systems in our final model or additional specialized systems.

In conclusion, this study provides evidence that in-group favouritism possesses both a common affiliation mechanism and additional, specific affiliation mechanisms, each with a distinct genetic architecture and distinct responses to unique environments. These findings have significant implications for theories addressing the evolution of, and the mechanisms underpinning, human group behaviour.

## Chapter 5 – Genetic Architecture of Prosocial Obligations

### 5.1 Introduction

Prosocial behaviour is basic to successful social living (Staub, 1979), a contention supported by the centrality of prosocial attitudes and behaviour to the well-being of communities (Helliwell & Putnam, 2004; Keyes, 1998). Early work investigating the aetiology of prosociality argued that such behavior lacked stability both temporally and domain-wise (Gergen, Gergen, & Meter, 1972; Hartshorne & May, 1928; Piliavin, Dovidio, Gaertner, & Clark, 1981). While this situationist perspective dominated the field for some decades (Rushton, Chrisjohn, & Fekken, 1981), more recent research has demonstrated significant positive correlations between broad constellations of prosocial actions (Carlo & Randall, 2002; Eisenberg et al., 2002), supporting the existence of a stable prosocial personality. As noted by Dovidio, Piliavin, Schroeder, & Penner (2006): “[T]here is a convergence of findings...that lead us to conclude that...there is such a thing as a ‘prosocial personality’, and...differences in this personality attribute are associated with differences in prosocial actions that range from willingness to help a distressed individual, to heroic rescues of people whose lives were in danger, to willingness to serve as a volunteer” (p. 265).

A range of information supports the trait-like nature of prosociality. Factor analytic work by Carlo, Eisenberg, Troyer, Switzer, and Speer (1991) demonstrated two major factors underpinning prosociality; however, only one of these factors related to helping others when escape from a request to help was easy (i.e. ‘true’ prosociality; the second factor related to helping so as to alleviate ones own personal distress). Developmental studies have revealed that empathic responses and helping behaviours are seen in young children and even in infants

(Preston & de Waal, 2002; Warneken & Tomasello, 2006) are suggestive of an innate capacity for prosociality. Finally, behavioural genetic studies have shown heritable components for both empathy (Matthews, Batson, Horn, & Rosenman, 1981; Zahn-Waxler, Robinson, & Emde, 1992), and prosociality (Krueger, Hicks, & McGue, 2001; Rushton, 2004; Rushton, Fulker, Neale, Nias, & Eysenck, 1986; but see Krueger, Hicks, & McGue, 2001), with evidence for cross-culture generality in these effects (Hur & Rushton, 2007).

While these results strongly indicate the presence of a stable prosocial trait disposition with an underlying biology, existing genetically informative studies have been limited to what might be termed “inter-personal” or dyadic prosociality (e.g. “*I have helped carry a stranger’s belongings (books, parcels, etc.)*”; Rushton, 2004; Rushton et al., 1986). While inter-personal prosociality is certainly important, it is clear that many of the most important domains of prosociality, such as civic obligations, obligations in work (Rossi, 2004), and redistribution of wealth/welfare obligation (Gurven, 2004), have not previously been addressed in a genetically informative study. In particular, it is unclear whether these specific prosocial obligations are, firstly, individually heritable, and, secondly, are underpinned by a single, genetically-influenced, mental faculty (Knafo, Zahn-Waxler, Van Hulle, Robinson, & Rhee, 2008).

To address these issues, here, we report a twin study examining the genetic and environmental structure of self-reported prosocial behavior across three important social domains: the concern for the social welfare of others, civic dutifulness, and the level of commitment to employment/work. Based on previous work indicating significant phenotypic associations of prosocial behaviours across domains, we predicted that a common latent factor with significant genetic effects would affect behaviour on all three prosocial traits. These predictions were also driven by previous research indicating the existence of such genetic effects



on components of prosocial behavior (Rushton, 2004; Rushton et al., 1986), and because of the consistent evidence that humans are instinctively prepared to engage in large-scale cooperative endeavours (Boyd & Richerson, 2006), with this behaviour evident even in early childhood (Warneken & Tomasello, 2006), suggesting an innate predisposition for prosociality in humans.

## 5.2 Methods

### 5.2.1 Participants

Phenotypic data were available for 958 pairs of twins contacted by the MacArthur Foundation Survey of Midlife Development in the United States (Kendler, Thornton, Gilman, & Kessler, 2000; see Chapter 4 for more details of the sample and collection process). Of the monozygotic (MZ) pairs 167 were male (mean age = 44.64, SD = 11.32) and 194 were female (mean age = 43.69, SD = 12.20). Of the dizygotic (DZ) pairs 136 were male (mean age = 44.64, SD = 12.42), 210 were female (mean age = 45.78, SD = 12.61), and 251 were opposite-sex pairs (mean age = 45.86, SD = 11.73). The excess of females over males is comparable to previous twin research (Lykken, McGue, & Tellegen, 1987).

### 5.2.2 Prosocial Obligations Measures

Participants completed three scales measuring different forms of prosocial obligations: civic obligation (four items), work obligation (three items), and welfare obligation (three items) (Rossi, 2004), with a response scale from 0–10. An example item assessing civic obligation was: “How much obligation would you feel to testify in court about an accident you witnessed?”; for work obligation: “How much obligation would you feel to do more than most people would do on your kind of job?”; and for welfare obligation: “How much obligation would you feel to pay more

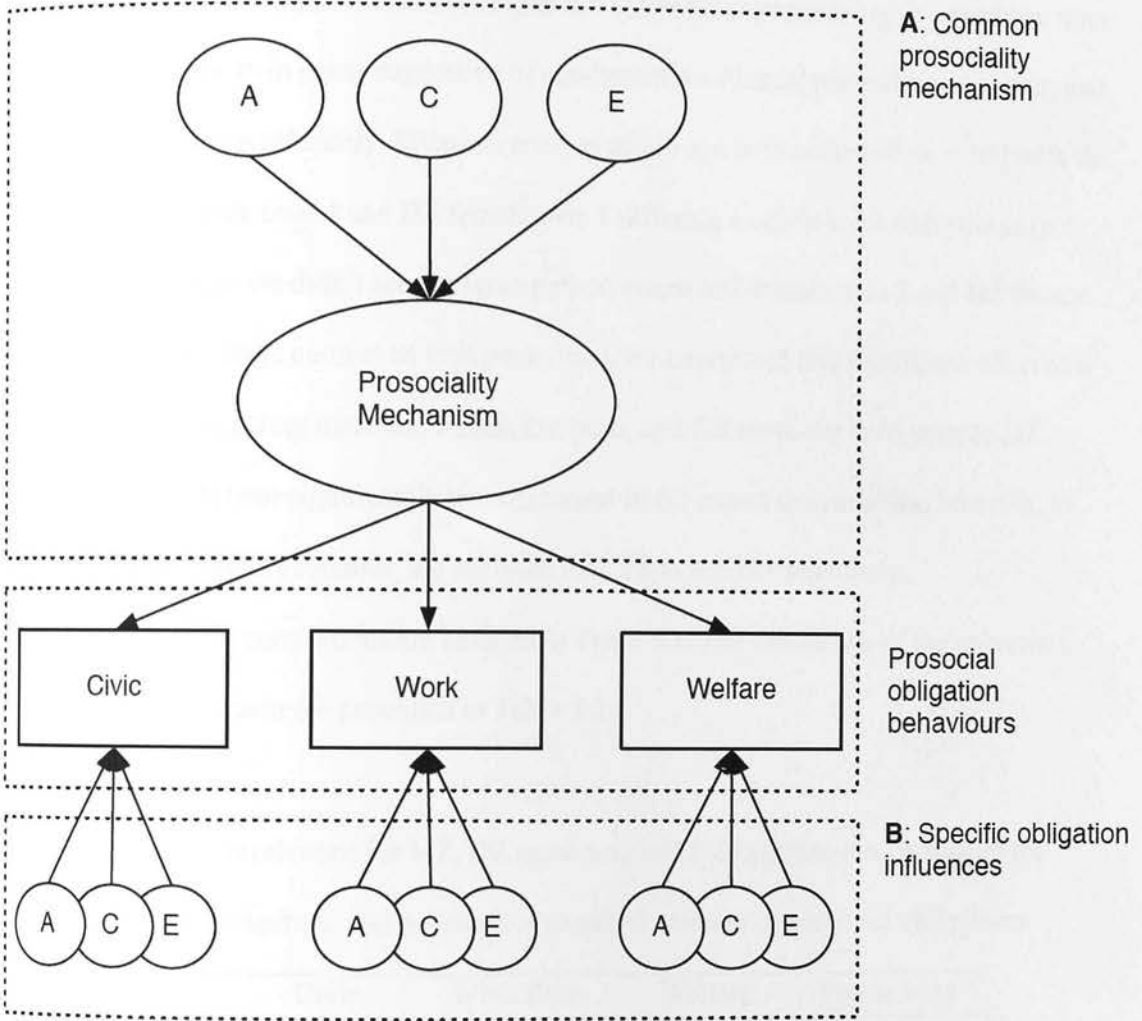
*for your health care so that everyone had access to health care?"* (also see Appendix B).

Cronbach's alpha (Cronbach, 1951) for the three prosocial domains was acceptable (Civic: 0.78; Work: 0.71; Welfare: 0.81). For the purpose of examining an omnibus univariate model, the three prosocial obligations scales were summed to form a composite prosocial obligations measure. Prior to analysis, the effects of age and sex were regressed out, and standardised residuals were used in subsequent analyses (McGue & Bouchard, 1984).

### 5.2.3 Analysis

All analyses utilised full-information maximum likelihood modelling, and structural equation modelling was conducted using OpenMx (Boker et al., 2010a; 2010b) and R (R Development Core Team, 2009). The modelling used to test our predictions is outlined graphically in Figure 5.1. The prediction of heritable and/or environment effects specific to each of the three prosociality measures is shown in the lower portion of the figure, where each obligation is accounted for by a combination of additive genetic (A), shared- (or familial) environment (C), and unique-environment (E) effects. The upper portion of Figure 5.1 shows the predicted latent mechanism for domain-general prosociality, labelled here as "Prosociality Mechanism". This functions as a common pathway affecting all obligation measures, and through which genetic and environmental influences must be mediated. If the fit of this common pathway model does not differ significantly from that of the saturated model, this would provide support for a model of prosocial obligations as involving a general psychological mechanism influencing each of the three measured prosocial domains.

Figure 5.1 Common pathway model for prosocial obligations.



Note: The three measured prosocial obligations are shown in rectangles. Part A shows the putative common or general prosocial obligations mechanism. Part B represents putative genetic and environment influences for distinct prosocial obligations systems. A = Additive genetic effects; C= common, or shared, environment effects; E = unique environment effects.

### 5.3 Results

For each of the obligation domains, same-sex DZ twins were more highly correlated than were opposite-sex DZ twin pairs, suggestive of sex-limitation. Phenotypic variances, means, and covariances were not significantly different across zygosity and twin-order (all  $p > .05$ ) with the exception of MZ female twin 1 and DZ female twin 1 differing on civic-work obligations ( $p < .05$ ); however, because we didn't see the same pattern across MZ female twin 2 and DZ female twin 2, as well as the large number of tests performed, we interpreted this significant effect as a sampling anomaly. Equating male and female DZ pairs, and DZ same-sex twin pairs to DZ opposite-sex pairs, did not significantly worsen model fit for any of the variables; however, to avoid biases in our model estimates, we analysed males and females separately.

Intra-class twin correlations are detailed in Table 5.1. The full results of the univariate modelling for each domain are presented in Table 5.2.

Table 5.1 Intra-class correlations for MZ, DZ same-sex, and DZ opposite-sex twin pairs for civic, work, welfare obligation, and an omnibus summed measure of prosocial obligations.

|                      | Civic | Work Ethic | Welfare | Prosociality |
|----------------------|-------|------------|---------|--------------|
| MZ male twin pairs   | .32   | .25        | .35     | .40          |
| MZ female twin       | .49   | .36        | .26     | .37          |
| DZ male twin pairs   | .24   | .13        | .11     | .30          |
| DZ female twin pairs | .19   | .20        | .30     | .27          |
| DZ opposite-sex      | .06   | -.01       | .05     | .06          |

For males across each obligation domain, including the general prosocial obligation scale, additive genetic and shared-environment effects were individually non-significant, although removing both paths simultaneously significantly worsened model fit indicating familial influences on each trait. For females, additive genetic and unique-environment effects

were significant for both civic and work obligation, with the third domain, welfare obligation, showing significant support only for unique-environmental influences (although dropping shared-environment effects reduced fit substantially,  $p = .06$ ). For the general prosocial obligation measure, familial effects were observed: additive genetic and shared-environment effects were individually non-significant, but could not be dropped simultaneously without worsening model fit.

Table 5.2 Standardised univariate heritability estimates for civic, work, and welfare obligation, and an omnibus summed measure of prosocial obligations (95% Confidence Intervals in brackets).

|                         | Males              |                    |                    | Females            |                    |                    |
|-------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
|                         | A                  | C                  | E                  | A                  | C                  | E                  |
| Civic                   | .14<br>(.00 - .44) | .17<br>(.00 - .39) | .69<br>(.56 - .83) | .50<br>(.30 - .60) | .00<br>(.00 - .15) | .50<br>(.40 - .62) |
| Work                    | .15<br>(.00 - .37) | .08<br>(.00 - .32) | .77<br>(.63 - .91) | .38<br>(.00 - .50) | .00<br>(.00 - .29) | .62<br>(.50 - .76) |
| Welfare                 | .34<br>(.00 - .46) | .00<br>(.00 - .34) | .66<br>(.54 - .81) | .00<br>(.00 - .36) | .28<br>(.00 - .37) | .72<br>(.60 - .82) |
| General<br>Prosociality | .23<br>(.00 - .48) | .13<br>(.00 - .41) | .64<br>(.52 - .79) | .32<br>(.00 - .50) | .06<br>(.00 - .33) | .62<br>(.50 - .77) |

We next tested our full common-and-specific model of prosocial obligations. The phenotypic correlations between the three obligations variables were moderate-to-high (.41 - .68). A confirmatory factor analysis indicated that neither a one-factor model nor a model with three un-correlated obligations factors fitted the data well (RMSEA = .15,  $\chi^2 = 1052.09$  ( $df = 44$ ,  $p < .01$ ), CFI = .71; RMSEA = .14,  $\chi^2 = 848.94$  ( $df = 44$ ,  $p < .01$ ), CFI = .77, respectively). By contrast, a hierarchical factor structure in which a super-ordinate "prosocial obligations" factor loaded on the three obligations domains fitted reasonably well (RMSEA = .07,  $\chi^2 = 206.90$  ( $df =$

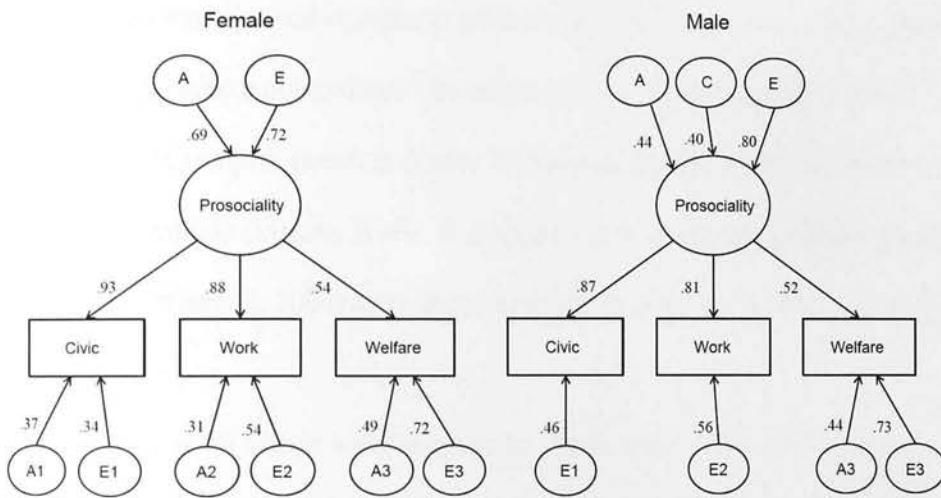
39,  $p < .01$ ), CFI = .96; see Appendix C for full details). This indicated that both a common obligations factor and distinct obligations were present in the data.

Having established the existence of a common prosocial obligations factor, we moved to biometric analyses. We compared the fit of the full common pathway model to the saturated model. The full common pathway model was a better fit to the data, when compared to the saturated model, for both males and females (AIC: 765.49 vs. 767.90, and 1295.93 vs. 1296.68, respectively). We next moved to tests of goodness of fit for nested common pathway models using the  $\chi^2$  test. For males, we could not drop all additive genetic and shared-environment effects simultaneously ( $\Delta\chi^2 = 34.78$  (8),  $p < .01$ ); however, these effects were individually non-significant ( $\Delta\chi^2 = 2.89$  (4),  $p = .58$ ;  $\Delta\chi^2 = 1.08$  (4),  $p = .90$ , respectively). As such, we retained both of these sources of influence for further analyses. Nested tests indicated that the specific genetic effects on civic and work obligation, and the shared-environment effects on civic, work, and welfare obligation were non-significant, and so were removed from the model ( $\Delta\chi^2 = 2.13$  (5),  $p = .83$ ). All other paths were significant and so we retained this reduced common-pathway model as our preferred final model for males (see Figure 5.2).

For females, the additive genetic effect on the common prosocial obligations factor was significant ( $\Delta\chi^2 = 8.55$  (1),  $p < .01$ ); however, the shared-environment effect to the common factor could be dropped without significantly worsening fit ( $\Delta\chi^2 = 0$  (1),  $p = 1$ ). At the domain-specific level, both additive genetic and shared-environment effects were non-significant ( $\Delta\chi^2 = 2.13$  (3),  $p = .55$ ;  $\Delta\chi^2 = 1.84$  (3),  $p = .61$ , respectively); however, these influences could not be dropped simultaneously without significantly worsening fit ( $\Delta\chi^2 = 57.62$  (6),  $p < .01$ ). Therefore, in line with the pattern of MZ-DZ intra-class correlations, we included genetic paths to civic and work obligation (reflecting the higher MZ to DZ correlations), and a shared-environment path to

welfare obligation (reflecting the similar MZ to DZ correlations). The final model for females is presented in Figure 5.2.

Figure 5.2 Final models of civic, work, and welfare prosocial obligations for males and females separately.



Note: Standardised path coefficients are shown, which when squared indicate the proportion of variance accounted for by that path. All paths are significant at the 5% level.

#### 5.4 Discussion

The data confirmed the significant role of genetic influences on prosocial obligations, supporting both common and specific mechanisms, and suggested a distinct pattern of effects between the sexes. For the common prosocial obligations mechanism, additive genetic factors accounted for 42% of the variance for females. In males, however, while familial effects on this common mechanism were apparent, the available power did not allow us to distinguish between additive genetic and shared-environment effects. These findings suggest that further work, perhaps with an extended twin design (Eaves, Last, Young, & Martin, 1978), will be required to



tease apart possible mechanisms for these effects. Potential influences include both assortative-mating for prosociality, non-additive genetic effects (Neale & Cardon, 1992), and, importantly gene-environment interaction (Neale & Cardon, 1992) between the sexes (see below).

At the domain-specific level, for males, welfare obligation showed a significant additive genetic component (with the other traits driven by unique-environment effects). For females, civic and work obligations showed significant additive genetic effects, with shared-environment influences underlying welfare obligations. The origin of these specific genetic influences on prosocial obligations is an open question. It may be that selection for stable division of work (Wahl, 2002), civil conflicts (Mitani, Watts, & Amsler, 2010), and welfare behaviours such as obligate food sharing (Gurven, 2004) have been important in shaping specific adaptations linked to in-group cooperation.

Unique-environment effects were often large. While these effects partly reflect measurement error, they also potentially reflect gene-environment interaction (Neale & Cardon, 1992). Given the likely differential family and social constraints placed on males and females enforcing compliance versus rewarding independence (Mischel & Shoda, 1995), it seems possible that genetic differences related to prosocial obligations may interact with these differentially experienced social environments. This view would be consistent with contingency-models of prosocial obligations supported by research noting decreases in prosocial contributions following social exclusion (Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007) and knowledge of prosociality levels in the group serving as a moderator of personal investment (Gurven, 2006). It is also possible that men are more prosocial when they have a conducive social environment (e.g. having attained status, are married, etc.) and are less helpful when they are still competing for social resources, perhaps reflecting the greater role of unique-

environments in males (compared to females). This suggestion is supported by recent work arguing that testosterone, a steroid hormone typically produced in greater quantities in males (Mazur & Booth, 1998), may not be associated with aggression per se (Eisenegger, Haushofer, & Fehr, 2011), but rather have social consequences (to the good or the bad) depending on the status of the individual in question (Eisenegger et al., 2011). Accordingly, future work is recommended to address the question of whether a hormone (e.g. testosterone)-by-situation effect on prosocial behaviour is present.

An important limitation of the present study concerns our lack of power to detect sex-limited effects, hence motivating our decision to model sexes separately. Accordingly, while we observed more modest heritable influences on the common prosocial obligations factor in males, we were unable to formally assess whether this quantitative difference in heritable influence is statistically significant. Additionally, we were unable to determine whether the genetic effects acting on prosocial obligations were qualitatively distinct between the sexes, although the near-zero correlations for DZ opposite-sex twin pairs on each of the prosocial obligations measures suggests gender-specific genetic factors may affect prosocial sentiment. Future work in a suitably powered sample is recommended to address this important issue.

In summary, the present data that indicate a common factor underlies prosocial obligations across three important social domains. The results also highlight important avenues for additional study in line with the contrasting observation of moderate-to-large additive genetic factors underlying this general prosocial obligations factor in females, with modest-to-moderate familial factors influencing general prosocial obligations in males. Further research is required to explore these possible gender differences and transmission modes, as well as the possible effects of contingency upon obligations.

## Chapter 6: Explaining the Genetic Influence on Religiosity: The Role of Community

### Integration and Existential Uncertainty

#### 6.1 Introduction

Worship and belief in the divine feature in all human societies recorded to date (Bulbulia, 2004; Swatos, 1998). While some accounts of these traits have relied entirely on cultural transmission (Batson, Schoenrade, & Ventis, 1993), genetically-informative studies have shown that religious belief is moderately heritable (D'Onofrio, Eaves, Murrelle, Maes, & Spilka, 1999), indicating a biological basis for religiosity. Research attempting to incorporate biological as well as cultural factors in explanations of religious faith suggests that belief may "recycle" more fundamental psychological and social processes (Boyer, 2003), such as needs for existential purpose and meaning in life (Kay, Gaucher, McGregor, & Nash, 2010), and for social needs such as community integration and binding (Graham & Haidt, 2010). Here we present a multivariate twin-study testing the extent to which non-theological variables relating to social and existential needs can account for heritable bases of religious belief.

The origins of religious belief have been of enduring interest to social and behavioural scientists (c.f. Dennett, 2006). Religious belief is commonly viewed as the product of environments designed to transmit and reinforce prevailing cultural values (Batson et al., 1993; Dudley & Dudley, 1986). In recent years, however, genetically-informative studies of religiosity have indicated that the strength of religious belief is heritable (Bouchard, McGue, Lykken, & Tellegen, 1999; D'Onofrio et al., 1999; Kendler et al., 2003). For example, Martin et al. (1986) reported significant genetic effects on attitudes such as the importance of observing the Sabbath and truthfulness of the Bible. And recently, Kendler and Myers (2009) observed significant genetic influences on frequency of church attendance. These observations give rise to the

important question of what kind of biological mechanism could underpin religious belief. Little is known of the mechanism(s) through which genetic factors exert their effects on religious belief; however, two broad accounts have been proposed that we term here: 1) the “reductionist” perspective, and 2) the “specificity” perspective on religious belief.

The reductionist perspective holds that religious belief is not unique but can be reduced to more fundamental psychological and/or social processes (Kay, Gaucher et al., 2010; Graham & Haidt, 2010). Two reductionist explanations of religion have been suggested to date. The first suggests that religious belief emerges as a source of existential certainty, generating a sense of agency and control, and thus acting to reduce feelings of anxiety (Kay, Shepherd, Blatz, Chua, & Galinsky, 2010). Supporting this idea, faith has been shown to increase when perceived instability is increased (Kay, Shepherd et al., 2010). Independent work supporting this conclusion has demonstrated that when (perceived) personal control is manipulated, belief in God is enhanced (Rutjens, van der Pligt, & van Harreveld, 2010). Interestingly, in the Rutjens and colleagues (2010) study, this increased belief in God was only observed in the absence of other belief frameworks that helped to create order in the world: in this instance, individuals primed to understand Darwinism as an orderly process with inevitable outcomes, did not show enhanced belief in God when personal control was threatened, although enhanced belief in Darwinism was observed for these individuals. For Kay, Gaucher et al. (2010), then, religious belief is seen as “recycling” this general existential certainty system, enhancing perceived personal control and providing an epistemic buffer from unpredictability and instability in this world.

The second major reductionist account of religion also deprecates the central role of what appears to define religion – religious belief – in favor of what Graham and Haidt (2010) call a

“relentlessly social” (p. 140) approach. In this view, the rituals and other surface structures of religion are to be explained in terms of foundational moral values that bind communities into cohesive units facilitating cooperation and well-being. Religion, they argue, reflects the “binding” foundations of in-group loyalty, authority/respect, and purity/sanctity, which serve to generate a moral community (Graham & Haidt, 2010).

This focus on social and community functions of religion has a long history in the literature. For instance, Durkheim (1915) argued that, “[t]he idea of society is the soul of religion” (p. 433). The social binding function of religion is also supported by research showing that high levels of community integration are a significant predictor of higher levels of religious belief (Cavendish, Welch, & Leege, 1998). Work on factors influencing church membership dropouts provides additional support for religious belief as a manifestation of social needs. For instance, Hartman (1976) asked former Methodist church members why they decided to leave with the most frequent response entailing “*their failure to feel . . . accepted, loved, or wanted*” by others in the congregation (p. 40). With these findings in mind, religious individuals may be predisposed towards group life in general rather than to religious belief strictly conceived.

In contrast to the two reductionist views of religious belief summarized above, the specificity perspective argues that worship of a higher power or Being reflects a source of motivation fundamentally distinct from any other human social and existential needs (Pargament, Magyar-Russell, & Murray-Swank, 2005). Examples of this mode of thought include Richards and Bergin (1997), who are explicit in stating that spirituality “*cannot be subsumed by other domains such as cognitions, emotions, social systems, and so on*” (p. 13). Under this perspective religiosity is an end in and of itself, rather than a means to an end, a position perhaps most clearly articulated by Johnson (1959) in suggesting that “[i]t is the ultimate Thou whom the

*religious person seeks most of all*" (p. 70). The implication of the specificity position for the genetic architecture of religiosity is that attempts to reduce heritable effects on religious belief to more general psychological and social processes will fail.

Two predictions can be derived from reductionist perspectives on religion. Firstly, if religiosity is explained by community integration (Graham & Haidt, 2010) then the genetic effects on religion should be accounted for by this variable. Secondly, if need for existential meaning underlies the heritable bases of religious belief, then again, this variable should account for the genetic effects on religiosity, with no religion-specific effects required to provide a well-fitting model. If both of these models provide partial accounts of religious belief, then their inclusion should lead to significant reductions in the specific heritable effects on religious belief. If specificity accounts are correct, neither of these variables, assessing non-theological concerns, should be able to account for the genetic variance in religious belief. Here we test these hypotheses in a large, nationally representative sample of identical, or monozygotic, and fraternal, or dizygotic, twins.

## 6.2 Method

### 6.2.1 Participants

Phenotypic data were available for 993 pairs of twins assessed for religiosity, community integration, and existential uncertainty contacted by the MacArthur Foundation Survey of Midlife Development in the United States (MIDUS; Brim, Ryff, & Kessler, 2004; see Chapter 4 for more details of the sample and collection process). Of the monozygotic (MZ) pairs, 178 were male (mean age = 44.47, SD = 11.53) and 192 were female (mean age = 43.56, SD = 12.28). Of the dizygotic (DZ) pairs, 143 were male (mean age = 44.25, SD = 12.35), 214 were female



(mean age = 45.90, SD = 12.53), and 266 were opposite-sex pairs (mean age = 45.77, SD = 11.85).

## 6.2.2 Measures

Religiosity was measured with the following items: “*How religious are you?*”; “*How important is religion in your life?*”; “*How important is it for you - or would it be if you had children now - to send your children for religious or spiritual services or instruction?*” (1: Not at all, to 4: Very). These items were highly correlated (.54 - .81, all  $p$  values < .01) and were thus summed into a composite religiosity score. Although additional indicators of religious belief/commitment were available, we selected only those items that did not make explicit reference to social manifestations of religiosity (e.g. attendance at a place of worship, identification with a religious group), or to items where religiosity was related to existential meaning (e.g. coping, divine support), so as to avoid confounding the test of our core hypothesis through content overlap.

Community integration was measured with the following three items: “*I don't feel I belong to anything I'd call a community*” (reverse-scored); “*I feel close to other people in my community*”; “*My community is a source of comfort*” (1: Disagree strongly, to 7: Agree strongly). These items were significantly correlated (.41 - .57, all  $p$  values < .01) and were thus summed into a composite score. Existential uncertainty was measured with the following two items: “*The world is too complex for me*”; “*I cannot make sense of what's going on in the world*” (1: Disagree strongly, to 7: Agree strongly). These items were significantly correlated (.44,  $p$  < .01) and were summed into a composite score.



### 6.2.3 Analysis

The classical twin design partitions observed variation into three latent components: additive genetic influences (A), shared-environmental influences (C; environmental influences fostering similarities within twin pairs), and unique-environmental influences (E). Genetic effects are inferred when monozygotic (MZ) twins are more similar than dizygotic (DZ) twins, whereas shared-environment effects are inferred when MZ twin correlations are less than twice that of the DZ twins. Unique-environment effects are inferred when MZ twins are correlated less than at unity for a given trait, and this variance component thus also contains measurement error. Prior to conducting the analyses, we controlled for the effects of age and sex, and standardised residuals were used in all subsequent analyses (McGue & Bouchard, 1984). The models were estimated by full-information maximum-likelihood analysis using OpenMx (Boker et al., 2010a; Boker et al., 2010b) and R (R Core Development Team, 2009).

The contrasting hypotheses that genetic variance in religiosity does or does not derive from the genetics of existential uncertainty and community integration were tested in a multivariate Cholesky decomposition (Neale & Cardon, 1992) of additive genetic, shared-environment, and unique-environment covariance between the measures (see Figure 6.1).

### 6.3 Results

Descriptive statistics are detailed in Table 6.1. MZ correlations were notably higher than for DZ pairs on all measures, implying the presence of genetic effects (see Table 6.2). The phenotypic correlations between community integration and existential uncertainty, and religiosity were .27 ( $p < .01$ ) and .01 ( $p = .68$ ), respectively. Assumption testing of means, variances, and phenotypic covariances across twin order and zygosity were all  $p > .05$ , with the

exception of MZ twin 1 and DZ twin 1 for community integration-existential uncertainty:  $p < .05$ ). Because of the large number of tests performed, this was interpreted as a sampling anomaly. Neither scalar nor general sex-limitation effects were significant (male and female DZ pairs, and same and opposite-sex groups could be equated without significant loss of model fit for any of the variables). Thus males and females were pooled for subsequent analyses.

Table 6.1 Descriptive statistics for community integration, existential uncertainty, and religiosity across zygosity

|        | Mean (SD)    | MZm mean (SD) | MZf mean (SD) | DZm mean (SD) | DZf mean (SD) | DZos mean (SD) |
|--------|--------------|---------------|---------------|---------------|---------------|----------------|
| Integ. | 14.48 (4.31) | 14.26 (4.46)  | 14.87 (4.22)  | 14.72 (3.93)  | 14.44 (4.35)  | 14.17 (4.48)   |
| Ex.    | 9.15 (3.22)  | 9.81 (3.10)   | 8.77 (3.28)   | 9.73 (3.17)   | 8.45 (3.24)   | 9.29 (3.12)    |
| Relig. | 5.71 (2.21)  | 6.20 (2.48)   | 5.34 (2.13)   | 5.90 (2.17)   | 5.14 (1.80)   | 6.06 (2.29)    |

Note: For community integration a high score equals high integration; for existential uncertainty a low score equals higher uncertainty; for religiosity a low score equals higher religiosity.

We next established the univariate heritability of each of our variables. Both community integration and existential uncertainty were best explained by models containing additive genetic and unique-environment effects (shared-environment effects could be removed without significantly worsening model fit:  $\Delta\chi^2 = 0$ ,  $p = 1$ ; and  $\Delta\chi^2 = 0$ ,  $p = 1$ , respectively): additive genetic and unique-environment effects explained 31% and 69% of the variance in community integration, and 36% and 64% of the variance in existential uncertainty. For religiosity, additive genetic, shared-environment, and unique-environment effects were all statistically significant, explaining 26%, 26%, and 48% of the variance, respectively. Full results of the univariate modeling are detailed in Table 6.2.

Table 6.2 Univariate modeling results and intra-class twin pair correlations for community integration, existential uncertainty, and religiosity.

|                         | A                | C                | E                | MZr | DZr | OSr |
|-------------------------|------------------|------------------|------------------|-----|-----|-----|
| Community integration   | .31<br>(.13-.41) | .00<br>(.00-.13) | .69<br>(.61-.80) | .37 | .18 | .12 |
| Existential Uncertainty | .36<br>(.11-.46) | .00<br>(.00-.19) | .64<br>(.56-.74) | .38 | .17 | .23 |
| Religiosity             | .26<br>(.05-.48) | .26<br>(.07-.43) | .48<br>(.41-.56) | .58 | .39 | .38 |

Note: A = additive genetic effects; C = shared-environment effects; E = unique-environment effects; MZr, DZr and OSr are the intra-class correlations for MZ, same-sex DZ, and opposite-sex DZ twin pairs, respectively (95% Confidence Intervals shown in brackets)

We next moved to a test of our core hypotheses. We built a multivariate model comprised of community integration, existential uncertainty, and religiosity. The specific genetic effects on religiosity in the full model were estimated at .1 indicating that community integration and existential uncertainty broadly accounted for the genetic variation in religiosity (note that in the univariate case, the equivalent parameter estimate for religiosity was .51). Moreover, this specific genetic effect for religiosity could be dropped without a significant loss of fit ( $\Delta\chi^2(1) = 0, p = 1$ ), indicating that genetic effects underlying community integration and existential uncertainty were sufficient to explain the heritable bases underpinning religiosity. Further tests examining whether religiosity could be reduced to just community integration or existential uncertainty in each case significantly worsened fit ( $\Delta\chi^2(1) = 6.09, p = .01$ ;  $\Delta\chi^2(1) = 4.33, p = .04$ , respectively) indicating that genetic bases underpinning religiosity could not be explained solely by community integration or existential uncertainty. Genetic correlations in the full (unreduced) model for community integration and existential uncertainty were as follows: community integration-religiosity  $r = .67$ ; existential uncertainty-religiosity  $r = .33$ , again

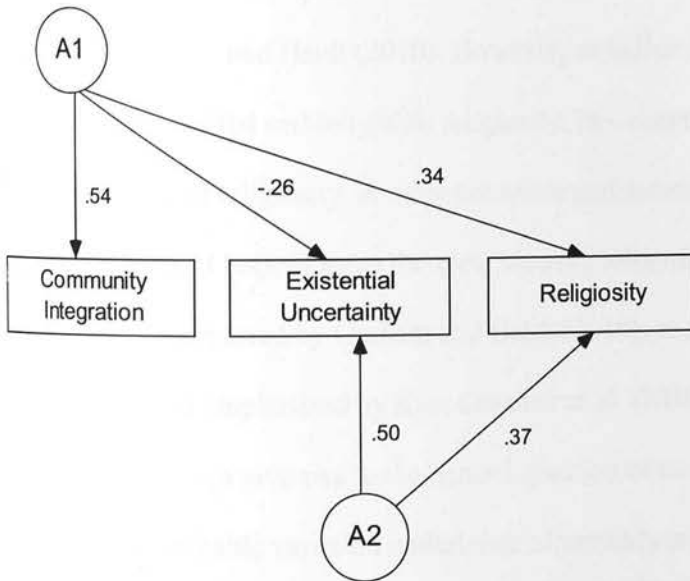
supporting strong genetic links from community integration and existential uncertainty to religiosity. The final model is detailed in Figure 6.1 and Table 6.3.

Table 6.3 Final model of shared- and unique-environment effects (standardised path coefficients) for community integration, existential uncertainty, and religiosity.

|                         | C1   | C2  | C3  | E1   | E2  | E3  |
|-------------------------|------|-----|-----|------|-----|-----|
| Community Integration   | -.07 |     |     | .84  |     |     |
| Existential Uncertainty | .18  | .00 |     | -.16 | .79 |     |
| Religiosity             | .51  | .00 | .00 | .02  | .04 | .69 |

Note: C = shared-environment effects; E = unique-environment effects

Figure 6.1 Final model of additive genetic effects on community integration, existential uncertainty, and religiosity.



Note: Circles represent latent additive genetic variables. Path values are standardised path coefficients (squaring the path loading indicates the proportion of variance accounted for in the measured variable by the latent factor).

## 6.4 Discussion

Compatible with previous work in this field (e.g. Bouchard et al., 1999; D'Onofrio et al., 1999) religiosity was moderately heritable. Existential uncertainty and community integration were also under partial genetic control, with approximately a third of the variance in each case accounted for by heritable factors. Most importantly, and in line with the reductionist hypotheses, the genetic effects on religiosity were fully accounted for by genetic effects on existential uncertainty and community integration.

Community integration showed a strong relationship to religiosity, with a genetic correlation of .67. By contrast, existential uncertainty and religiosity showed a more moderate genetic correlation of .33 (although this may reflect the possible lower reliability of this construct as compared to community integration). This indicates that at least for this component of religious belief, social needs appear to be the predominant motivating concern, supporting the theorising of Graham and Haidt (2010). However, as indicated by the significant genetic correlation of existential certainty with religiosity, this community-binding model was not a sufficient account of religiosity. A more complete understanding of religiosity, then, would integrate elements of both of these theories, viewing religion as both a tool for the formation of communities, as suggested by Graham and Haidt (2010), and also as a facility for meeting existential needs as emphasized by Kay, Gaucher et al. (2010).

These findings give rise to the natural question of whether genetic effects on religiosity, here reduced to heritable variation underlying community and existential needs, can be further reduced to more “fundamental” traits. A number of constructs are plausible candidates. Of the five factors of personality (Costa & McCrae, 1992), extraversion and agreeableness are characterised as traits concerned with gregarious, social, and cooperative behaviour (Costa &

McCrae, 1992). As such, these traits may account for some of the heritable variance underlying community integration, and in turn religious beliefs. Furthermore, neuroticism is characterised by anxiety and fearfulness (Gray & McNaughton, 2003), and so is plausibly linked to (low) existential certainty. Additionally, general cognitive ability, with existing (negative) associations to religious belief (e.g. Bertsch & Pesta, 2009; Lewis, Ritchie, & Bates, under review), may also relate to existential certainty by increasing understanding and comprehension of complex events, thus decreasing uncertainty directly. Both neuroticism and general cognitive ability, then, are candidates for future work seeking to further decompose the genetic effects underlying both existential uncertainty and religiosity.

Speculatively, the current findings indicate that religion *per-sé* may not be the sole organisation or system able to fill the niche created by human needs for community and existential meaning. The succession, displacement, and evolution of religions can be viewed in this light as the shaping of religious systems by their adherents to maximise the extent to which their needs are met. It might be predicted, then, that under certain conditions even a secular apparatus, should it be able to meet the community and existential needs of people, may be attributed the same importance in people's lives as religion often occupies (Kay, Shepherd et al., 2010). Graham and Haidt (2010), however, suggest this "exchangeable goods" notion of religion may fail to acknowledge the tight fit between religious belief and human psychology: *"Is there anything special or necessary about religion? If we can see the wonders of group cohesion in maypole dances or college football games, then why can't we get rid of Gods and religions and swap in secular practices? In our view, religious practices and rituals co-evolved with religiously inclined minds, so that they now fit together extremely well...Modern cultural creativity can generate endless practices that trigger or exploit many of the same mental*



*systems...But, because of our biological and cultural-evolutionary history, it's hard to come up with anything that "fits" or satisfies as many people as does religion. God is the original maypole, and groups that do maypole dances well have outcompeted those that don't, for many thousands of years"* (p. 147). The extent to which religion is an exchangeable good thus remains to be seen.

A limitation of the present study is that the sample is nearly-exclusively comprised of individuals reporting affiliations with Christian religious denominations (> 95%). Future research should address whether these findings generalise to additional religions, such as Islam and Judaism, but also non-Abrahamic religions such as Buddhism, Hinduism, and Taoism, as well as across cultures (Sasaki & Kim, 2010). It is also important to acknowledge that religious belief is a multidimensional construct (Hill & Hood, 1999; Kendler et al., 2003). As such, while the strength and importance of religious belief in one's life is a central and widely recognised component of religious belief, other aspects of religious life warrant study. Doctrinal literalism and spirituality, for instance, are worthy targets of future research. In particular, the extent to which community and existential foundations can (or cannot) be extended to the doctrinal and spiritual characteristics of religion will be of interest for further studies.

In summary, our results indicate that the genetic influences underlying existential uncertainty and community integration completely explain the genetic effects underlying a measure of religious belief reflecting the strength and importance of religion in one's life. Additional familial influences were observed for religiosity, in line with previous work, although these effects were non-significant for both existential uncertainty and community integration. These findings shed light on the role of religion as a system for meeting basic social and existential needs, and for the additional role of cultural transmission in shaping the strength of



religious beliefs. Future work should seek to generalise these findings to other religions, such as Judaism and Islam, and cultures, as well as to examine the reducibility of additional aspects of religious belief, such as doctrinal literalism and spirituality.

## Chapter 7 - General Discussion

The aim of this thesis was to make a substantive contribution to knowledge concerning the origins of social and political attitudes. In this chapter I first briefly summarise the core findings of the thesis. I then discuss the broader implications of the work reported here for theory. Finally, I outline work that might be conducted to extend the findings of the current thesis and thus to shed further light on the origins of social and political attitudes.

### 7.1 Summary of Findings

The work reported here utilised two perspectives which have largely been untapped in prior work on the origins of social and political origins: personality system theory (McCrae & Costa, 1999) and behavioural genetics (Falconer & MacKay, 1996). Several important results were noted. Firstly, in Chapter 3, a personality system model of political conservatism was tested in two large samples (447 UK undergraduates and 476 mature US adults; published as Lewis & Bates, 2011a). Basic traits of personality were observed to exert significant effects upon political conservatism; however, these influences were largely exerted via an intermediary layer of characteristic adaptations, in this case the moral values of individualizing and binding (Graham, Haidt, & Nosek, 2009). These findings help to clarify why previous work in the literature has often failed to find the personality-conservatism association in the absence of this intermediary layer. Put simply, behaviours such as voting conservative are multi-faceted in their nature: political attitudes are determined by multiple moral attitudes, with each proximal moral factor in turn possessing multiple overlapping or distinct personality underpinnings. Focus on the third level of behaviour (here on conservative political attitudes), without acknowledging these

intermediary values masks the significant role personality plays in generating political attitudes and can thus hide these sources of influence.

Secondly, across three study-sets (Chapters 4-6), the genetic architecture of several social attitudes was examined utilising a large, representative US sample of adult twin pairs (MIDUS: Midlife in the United States; Brim et al., 1995-1996). In Chapter 4 we asked, firstly, whether three forms of in-group favouritism (religious, ethnic, and racial) contain significant genetic underpinnings, and secondly, whether heritable effects on race favouritism could be accounted for by broad favouritism genes, or whether specific genetic effects were required to understand this aspect of favouritism. The findings indicated that a common genetic factor facilitates generalised favouritism, which we term the Common Affiliation Mechanism (CAM), with evidence for additional genetic effects specific to each form of group favouritism. These findings (published as Lewis & Bates, 2010) suggest that (at least) at the genetic level, race (as well as ethnic and religious) favouritism is multiply determined.

In Chapter 5, we examined whether prosocial obligations across the domains of welfare, work, and civic obligation share a common genetic basis, or reflect specific heritable components (published as Lewis & Bates, 2011b). This study was important as mixed results concerning the heritability of prosociality had been reported in the literature (e.g. Krueger, Hicks, & McGue, 2001; Rushton, 2004), as well as an absence in work addressing the genetic architecture of broader prosocial domains (such as those noted above). In females, results indicated the existence of a common and substantially heritable factor underlying each of these prosocial obligations. In males, a prosocial factor was also observed; modest-to-moderate familial effects (genetic and shared-environment effects were indistinguishable) influenced this general mechanism. At the domain-specific level, modest genetic effects were observed in

females for civic and work obligations, with shared-environment effects influencing welfare obligations. In males, genetic influences were observed for welfare obligation, with unique-environments affecting work and civic duty. These findings confirm previous work indicating that prosocial obligations contain a heritable basis, but that additional genetic factors influence specific components of prosociality, such as obligations in work and toward civic duty. The data also suggest that sex-limited effects may be present that future work is recommended to further explore.

Finally, in Chapter 6, we presented work examining the genetic architecture of religious belief (Lewis & Bates, under review). Although genetic factors have been known to influence strength of religious belief for some time (e.g. Waller, Kojetin, Bouchard, Lykken, & Tellegen, 1990), the psychological mechanism(s) through which this biological influence is manifest were poorly understood prior to this work. Two non-theological constructs – 1) need for community integration and 2) need for existential certainty – were hypothesised to account for the genetic effects on religiosity, in line with recent (and more classic) work in the literature (Durkheim, 1915; Kay, Gaucher et al., 2010; Graham & Haidt, 2010). The results supported these hypotheses, with genetic influences on these traits of community integration and existential certainty wholly accounting for the heritable basis of religiosity. This finding suggests that religion “re-uses” systems involved in meeting both social and existential needs.

## 7.2 Implications for Theory

### 7.2.1 Social and Political Attitudes are Heritable

Although behavioural geneticists are used to observing heritable effects on psychological traits (e.g. Turkheimer, 2000), firm knowledge as to whether this genetic influence extends to

social and political attitudes was largely absent until recently (Alford, Funk, & Hibbing, 2005), and still underexplored several years later. Thus, the observation of substantial genetic effects on in-group favouritism, and modest-to-moderate effects on prosocial obligations and religious belief, particularly in light of wide-spread scepticism of whether genetic influences extend to such attitudes (Charney, 2008a), represents an important collection of insights for the attitudes literature. The implications of this observation for understanding attitude formation are potentially profound: attitude origins can no longer be considered solely in light of environmental factors as has often been assumed to be the case (e.g. De Houwer, Thomas, & Baeyens, 2001; Watson, 1924/1931). Instead, systematic work must begin to establish a neurobiological explanation capable of reflecting the observed genetic effects. Possible avenues of exploration in this domain are detailed below (see Section 7.3).

### 7.2.2 Complex Phenotypic and Genetic Architectures

As noted in detail in Chapter 1, both quantitative and molecular genetic work into the biological bases of social and political attitudes has been a topic of growing interest (e.g. Alford et al., 2005). However, in line with findings from Chapter 3 utilising personality system theory, if political conservatism can be “built” (more or less) equivalently via different routes e.g. through high extraversion and low openness or through high conscientiousness and low agreeableness, then molecular studies will struggle or even fail to discover loci underlying the conservatism phenotype on account of its content complexity (e.g. van der Sluis, Verhage, Posthuma, & Dolan, 2010). Genetically informative work detailed in Chapters 4-6 further extend this point to a framework including other social attitude constructs: for each of the attitudes we examined, we found significant support for at least two distinct genetic influences.

Furthermore, personality system theory postulates that all biological factors underlying psychological traits are manifest at the first layer, the so-called “basic tendencies” of personality. While this assertion is ultimately an empirical question that has yet to be well-tested, and likely underestimates the scope of basic tendencies of relevance to attitude origins (e.g. general cognitive ability; Deary, Batty, & Gale, 2008), it supports a gene-discovery strategy for social and political attitudes that focuses on basic personality traits, on account of their (putative) higher heritable bases, as well as the fact that characteristic adaptations will reflect environmental effects from which basic personality traits are argued to be largely inoculated (McCrae & Costa, 1999). Important work in this domain lies ahead.

### 7.2.3 The Role of the Shared-Environment

A frequent observation from studies in the behavioural genetics literature is that shared-environment effects on psychological traits are zero or near-zero (Bouchard, 2004). For several of the social attitudes reported in the current thesis, shared-environment presented non-negligible influences. Religious belief was seen to be moderately affected by shared-environment, in line with some previous work (D’Onofrio, Eaves, Murrelle, Maes, & Spilka, 1999), and components of prosocial obligations were also, in part, under this influence. Although further work is required to establish the robustness of these findings, remaining mindful of these somewhat unusual findings until further studies in this domain have been reported would likely be wise.

### 7.2.4 Personality Exerts Significant Influences on Social and Political Attitudes

Although the title of this sub-section would perhaps not surprise many (e.g. Sniderman, 1975), in fact, the conclusion that personality is a significant influence on political conservatism



is less well-supported in the literature than is commonly imagined, and has in fact been argued to be not the case (e.g. Alford & Hibbing, 2007). Importantly, the finding reported in this thesis that personality affects politics via intermediary moral values clarifies mixed results, and paves the way for more sophisticated models of political attitudes; models formulated so as to take account of multiple levels of analysis. This mode of thought has begun to appear in the literature in recent years (e.g. Duckitt & Sibley, 2010b), although considerable work still remains to fully explicate a system model of political attitudes that is fully able to account for the origins of political attitudes (see Section 7.3.1 for further discussion of some of the issues that remain).

### 7.3 Future Possibilities

Genetically informative work reported in previous chapters has identified significant heritable components for a range of social attitudes. This set of observations gives rise to questions concerning the nature of these biological factors: what functions and structures in the brain generate attitudes? And while personality system theory provides important insights into the aetiology of political conservatism, what avenues for further advances can this framework provide? In the coming sections I briefly address avenues of research that the current findings open up for exploration.

#### 7.3.1 Personality System Model of Social and Political Attitudes: Extensions

The outlines of a personality system model were first proposed as recently as the very late 1990s (e.g. McCrae & Costa, 1999). Work in Chapter 3 illustrated the usefulness of framing political attitudes within this type of model, but also the need to expand it, and to more clearly specify what occurs in each level. Most immediately, this model highlights the indirect routes

through which personality may exert influences on politics; namely, via moral values constructs of binding and individualizing. However, despite this theoretical contribution to the political psychology literature, a number of important issues need to be resolved before this model can form an adequate account of the origins of social and political attitudes. McCrae and Costa (2006), originators of this framework, duly acknowledge these current limitations in personality system theory: *“There is as yet nothing like an adequate taxonomy of processes, and creating such a taxonomy should become a priority for personality theorists”* (p. 164).

Firstly, it is currently unclear how constructs outside the domain of the five-factor model (i.e. factors and facets) should be integrated into the personality system model. For example, (higher) general cognitive ability has been associated with liberal attitudes (Deary, Batty, & Gale, 2008) and with lower levels of religious belief (Bertsch & Pesta, 2009), especially fundamentalism (Lewis, Ritchie, & Bates, under review; Nyborg, 2009). Moreover, evolutionary psychologists argue that humans possess a large array of psychological adaptations, of which at least some will relate to political attitudes and actions e.g. psychological processes adapted to coalition affiliation (Kurzban, Tooby, & Cosmides, 2001) and evaluating the adequacy with which others are treating you (Sell, Tooby, & Cosmides, 2009). Theory in the respective literatures of intelligence and evolutionary psychology indicates that these constructs should be viewed as operating at the primary layer (i.e. as basic tendencies). It is not clear, however, what representation these variables may have at the second level, where interactions with the environment occur, and where interactions between, say, intelligence and feelings of anger might occur in influencing constrained or unconstrained behavior. For example, how might coalitional adaptations relate to personality traits, some of which themselves are characterised as traits reflecting affiliation and gregariousness (e.g. extraversion)? Attempts to understand how the

individual differences approach to personality could be integrated with an adaptationist perspective are rare in the literature but such a task will be important for generating a full model of social and political attitude origins.

Secondly, while our intermediary layer of characteristic adaptations incorporated two robust predictors of political attitudes – Haidt’s moral values constructs of binding and individualizing (Graham, Haidt, & Nosek, 2009) – it is currently unclear whether additional predictive validity could be achieved by incorporating further constructs such as social dominance orientation (SDO) and right-wing authoritarianism (RWA), each with strong links to political conservatism themselves (e.g. Sibley & Duckitt, 2008). McFarland (2010) has made a noteworthy initial contribution to this issue, demonstrating that both empathy (the empathic concern and perspective taking subscales of Davis's (1983) Interpersonal Reactivity Index) and principled moral reasoning (using the revised five-item Defining Issues Test; Rest, Narvaez, Thoma, & Bebeau, 1999), predict levels of prejudice over and above effects of SDO and RWA; however, future work is recommended to include Haidt’s moral values alongside further predictors of social and political attitudes (e.g. political conservatism) to establish the full extent of the intermediary layer of characteristic adaptations.

Thirdly, the issue of which environmental factors moderate effects of personality on the intermediary layer of values, and on one’s political attitudes, is currently underexplored. Personality system theory, while recognising the importance of environment effects, does not explicitly address the specific environmental factors or processes that shape attitudes; however, several plausible candidate environmental modulators of attitudes and behaviour have been identified in the literature and are presented here in brief: 1) Social exclusion: experimental manipulations increasing exclusion have been shown to decrease prosocial behaviour (Twenge,

Baumeister, DeWall, Ciarocco, & Bartels, 2007); 2) Status: increases in perceived social status have been linked to decreases in prosocial behaviour (Piff, Kraus, Côté, Cheng, & Keltner, 2010); moreover, individuals with higher absolute social standing engage in greater moral hypocrisy (Lammers, Stapel, & Galinsky, 2010); 3) Threat: a number of studies (both longitudinal and experimental) have shown situational threat increases conservative and/or authoritarian attitudes (Bonanno and Jost, 2006; Cohrs, Kielmann, Maes, & Moschner, 2005; Duckitt and Fisher, 2003; Willer, 2004). 4) Political expertise/sophistication: work has demonstrated that attitudes are more coherently structured/logically consistent as a function of political sophistication (e.g. Converse, 2000; Jennings, 1992).

Finally, as Bloom (2010) notes, although in recent years values have more frequently become understood as the output of “gut instincts” (Haidt, 2007), values can clearly change over time. This suggests that effort needs to be expended to find the mechanisms of this change: *“Emotional responses alone cannot explain one of the most interesting aspects of human nature: that morals evolve... What is missing, I believe, is an understanding of the role of deliberate persuasion.”* (Bloom, 2010, p. 490). Considerable work has been conducted in the attitude change/persuasion domain (e.g. the elaboration likelihood model; Petty & Cacioppo, 1986); however, integrating these persuasion models into a broader framework such as the personality system model has not (to my knowledge) been attempted and would represent a valuable step forward.

### 7.3.2 Neural Bases of Social and Political Attitudes

Work in this thesis observing substantial genetic effects on several social attitudes constructs gives rise to the important question of how these biological influences might be

instantiated in neural terms. Although work of this kind is largely in its infancy, some encouraging results have been reported in recent years, representing both neuroanatomical and functional imaging association with social and political attitudes.

Amodio, Jost, Master, and Yee (2007) report an association between political conservatism and conflict-related activity during a Go/No-Go task (measured with event-related potentials) originating in the anterior cingulate cortex (ACC). The authors interpret this finding as evidence that liberals possess “*greater neurocognitive sensitivity to cues for altering a habitual response pattern*” (p. 1246). Inzlicht, McGregor, Hirsh, and Nash (2009) support this association between conservatism/traditionalism and ACC function, finding that greater religious belief was associated with decreased activity in the ACC following error in a Stroop task. In this paper, however, the authors suggest that rather than ACC activity influencing subsequent traditional attitudes (as suggested by Amodio et al., 2007), decreased ACC activity reflects the fact that “*religious conviction buffers against anxiety by providing meaning systems*” (p. 390), although they accept that establishing direction of causation requires further experimentation.

Beyond links to ACC, amygdala activity has been noted to be significantly increased when individuals view faces of out-group vs. in-group individuals. Hart et al. (2000) showed that both Black and White individuals showed a stronger amygdala response to other-race faces, and Van Bavel, Packer, & Cunningham (2008) demonstrated that this effect extends to learned out-group members irrespective of race. Neuroanatomical work provides partial support for functional imaging findings linking political conservatism to ACC and amygdala. For instance, Kanai, Feilden, Firth, and Rees (2011) recently reported that increased gray matter volume in the anterior cingulate cortex and decreased volume of the right amygdala predicts political liberalism (measured with a single item) in young adults.



Empathy (conceptually linked to the moral values of harm and fairness) has been associated with activation in the right ventral medial prefrontal cortex (Shamay-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003). Observing pain in others also activates anterior cingulate cortex (bilaterally), right middle frontal gyrus, and left superior frontal gyrus (Morrison, Lloyd, di Pellegrino, & Roberts, 2004). Unfair treatment of (liked) others is associated with activity in anterior cingulate cortex and insula (Singer et al., 2006). In neuroanatomical terms, empathy has been associated with volume of the right temporal pole, right fusiform gyrus, and right caudate/subcallosal gyrus (Rankin et al., 2006), and left inferior frontal gyrus (Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). DeYoung et al. (2010) related agreeableness (with links to individualizing and empathy) to smaller volumes in the posterior left superior temporal sulcus, and larger volumes in posterior cingulate, fusiform gyrus (with suggestive evidence, although non-significant after correction for multiple testing, for higher volumes predicting agreeableness in middle temporal gyrus, and lower volumes predicting agreeableness in precentral gyrus, precuneus, and middle frontal gyrus). Finally, Moll et al. (2011) noted that degeneration (following frontotemporal dementia) of the frontopolar and ventromedial frontal areas was associated with decreases in prosocial behaviour, which the authors suggest “*could be attributed to a generalized emotional blunting*” (p. 1735). However, as Kanai and Rees (2011) note, it is not yet clear how these structural correlates relate to underlying mechanisms of social behaviour.

What mechanism(s) might account for these links between certain brain regions and social and political attitudes? In the case of amygdala and prejudice attitudes, one possibility is the role of the amygdala in fear-conditioning (LeDoux, 2003). Recent behavioural work has indicated that implicit and explicit race prejudice is predicted by negative-affect conditionability (Livingston & Drwecki, 2007; Olsson, Ebert, Banaji, & Phelps, 2005), supporting this

“amygdala-conditioning-prejudice” account. Amygdala activation has also been associated with disgust sensitivity (Harris & Fiske, 2004), which is, in turn, linked with prejudice (e.g. Hodson & Costello, 2007), perhaps as a form of psychological prophylaxis (Schaller & Duncan, 2007). This disgust association may reflect a unique route to prejudice or reflect broader aversive-conditioning links: future work should explore these possibilities, particularly in a genetically-informative design to establish how these factors might mediate heritable effects on favouritism. This approach has already been successful as exemplified by work demonstrating significant genetic links between brain volume and general cognitive ability (e.g. Posthuma et al., 2002), and once robust candidate regions for social and political traits have been identified from phenotypic work, powerful insights into the biological bases of attitudes stand to be made from placing the CTD within a social neuroscience framework.

It is currently unclear how links between ACC (among other regions), and political conservatism should be interpreted. As demonstrated in Chapter 3, conservatism is multiply determined and so these associations may reflect values concerning fairness and equality (e.g. individualizing), group norms and authoritarianism (e.g. binding), or other constructs. As noted above, ACC is activated both when (liked) others are mistreated (Singer et al., 2006), perhaps reflecting individualizing, as well as when response-patterns require updating, with decreased ability to do so putatively representing a “conservative” capacity (Amodio et al., 2007).

Research seeking to establish the precise set of social and political attitudes associated with the volume and functional activation of a given region will allow more specific hypotheses to be tested concerning underlying mechanisms.



### 7.3.3 Hormonal Bases of Social and Political Attitudes

Complementing work elucidating the neural bases of social and political attitudes, several neurotransmitter and hormone systems have been implicated in behaviour of relevance to such traits. Below, I briefly discuss a core sub-set of these candidates (testosterone and oxytocin) and close by suggesting further work in this domain, in line with work reported in this thesis, which might further illuminate biological bases of social and political attitudes.

The experimental administration of testosterone (T) decreases recognition of fear and anger (van Honk & Schutter, 2007), reduces empathic behaviour (Hermans et al 2006), particularly as a function of 2D:4D digit ratio (a somatic marker of foetal androgen exposure; van Honk et al., 2011), and erodes social trust (Bos et al., 2010). Higher T also relates to desire for social dominance (especially after defeat), but only with accompanying low cortisol (Mehta & Josephs, 2010). However, Eisenegger et al. (2010) note that higher T predicts benevolent behaviour in ultimatum games. This raises the possibility that T may manifest its effect in a contingent manner, perhaps as a function of social status or position (van Honk, Terburg, Bos, & 2011). Finally, T has been associated with enhanced in-group connectedness (Edwards et al., 2006), suggesting a role for T in generating intergroup bias; again, however, this effect may be contingent on circumstance such that high T individuals who are threatened may become desire affiliation with in-group members whereas when threat is low may proffer benefits to out-group individuals as a means of enhancing dominance.

Oxytocin (OXT) has similarly pronounced social behavioural effects. Intra-nasal administration of OXT enhances trust (Kosfeld et al., 2005) and increases socio-cognitive abilities (e.g. emotion recognition; Domes et al., 2007). OXT facilitates parochial altruism, with administration of OXT increasing in-group favouritism (De Dreu et al., 2010; 2011), although

not out-group derogation. Finally, OXT decreases aversive responses to fear-conditioned stimuli (Petrovic, Kalisch, Singer, & Dolan, 2008), and, at the neural level, appears to exert this effect via down-regulating amygdala activation (Petrovic et al., 2008). These data, however, lead to the (apparently) paradoxical situation that OXT administration reduces amygdala activation, a region with associations to out-group enmity (Hart et al., 2000), yet does not enhance out-group love (although *does* enhance in-group love) at a behavioural level.

The links between both T and OXT, and multiple social behaviours, including (dis)trust, social dominance, and parochial altruism, indicate that better understandings of the functional bases of these hormones, both at the behavioural and neural level, may reveal foundational biological insights to social and political attitudes. Research has begun to address such questions with studies reporting associations between basal T and fundamentalist religious attitudes among teenage boys in Gaza living under the Second Intifada (Victoroff et al., 2010), and between basal T and utilitarian moral decision-making (Carney & Mason, 2010). And as noted above, De Dreu et al. (2010; 2011) have demonstrated that OXT is associated with ethnocentrism. Nonetheless, many important questions remained unanswered, notably issues of the role of hormone-by-context interactions (e.g. van Honk et al., 2011). For example, does T enhance out-group derogation, especially when out-group threat is salient/experimentally raised? And does OXT attenuate this threat effect? In line with evidence suggesting that T reduces recognition of socially corrective signals (fear and anger in others) and enhances dominance seeking, does T predict (lower) levels of compromise in social exchanges? And if so, is this effect moderated by status? Conversely, does OXT facilitate compromise in social exchange? How do we reconcile research indicating OXT facilitates ethnocentrism, yet increases trust: Does OXT increase attachment behaviours to group members but also facilitates newcomers to the in-group (if not

necessarily raising warmth for those who are in the out-group)? Moving to functional imaging, OXT decreases aversive responses to fear-conditioned stimuli via amygdala down-regulation; however, is this effect also present when out-group stimuli are used? And does OXT administration reduce/extinguish in-group/out-group differences in empathy for pain experienced in others?

Clearly, many questions remain to be answered with regards to the role of hormones on attitudes; however, early work suggests the field of social endocrinology will be fundamental in generating insights into individual differences underlying social and political attitudes.

#### 7.4 Summary

In summary, across four study-sets, several core results stand out. Firstly, basic personality traits significantly influence political conservatism, although these effects are often complex and indirect. Secondly, in-group favouritism contains several underlying genetic components: specifically, we observed a common favouritism genetic factor influencing preferences to religious, ethnic, and racial in-groups, as well as specific genetic effects to each of these domains of favouritism. Thirdly, prosocial obligations across the domains of work, civic, and welfare were shown to be underpinned by a common heritable factor, but with suggestions of sex-limited effects: genetic effects explained a larger proportion of variation in this common factor prosociality than for males. Additional specific genetic effects were observed for these prosocial domains (on civic and work for females; on welfare for males). Finally, an examination of the genetic architecture of religious belief, seeking to explain the underlying psychological bases through which biological influences are manifest revealed that heritable effects on need for community and existential certainty fully accounted for the genetic bases of religiosity. In

closing, the collection of studies presented in the current thesis contributes to the literature by supporting and extending previous work indicating social attitudes possess significant genetic bases, as well as to demonstrate that social attitudes are multiply determined, both at the genetic and the phenotypic level.

## Appendices

### Appendix A - Favouritism Measures

Scale from 1-4 (1 = Very closely; 2 = Somewhat closely; 3 = Not very closely; 4 = Not at all closely)

#### **Religious Favouritism**

- i. How closely do you identify with being a member of your religious group?
- ii. How much do you prefer to be with other people who are the same religion as you?
- iii. How important do you think it is for people of your religion to marry other people who are the same religion?

#### **Ethnic Favouritism**

- i. How closely do you identify with other people who are of the same ethnic descent as yourself?
- ii. How much do you prefer to be with other people who are of this same ethnic group?
- iii. How important do you think it is for people who are from this ethnic group to marry other people who are also from this ethnic group?

#### **Race Favouritism**

- i. How closely do you identify with being a member of your racial group?
- ii. How much do you prefer to be with other people who are the same race as yourself?
- iii. How important do you think it is for people who are in your racial group to marry other people who are the same race?

## Appendix B - Prosocial Obligations Measures

*Please rate how much obligation you would feel in the following hypothetical situations; Scale from 1-10 (1 = no obligation at all; 10 = a very great obligation)*

### **Civic obligations**

- i. To serve on a jury if called.
- ii. To keep fully informed about national news and public issues.
- iii. To testify in court about an accident you witnessed.
- iv. To vote in local and national elections.

### **Work obligations**

- i. To do more than most people would do on your kind of job.
- ii. To work hard even if you didn't like or respect your employer or supervisor.
- iii. To cancel plans to visit friends if you were asked, but not required, to work overtime.

### **Welfare obligations**

- i. To pay more for your health care so that everyone had access to health care.
- ii. To volunteer time or money to social causes you support.
- iii. To collect contributions for heart or cancer research if asked to do so.
- iv. To vote for a law that would help others worse off than you but would increase your taxes.



### Appendix C - Factor structure of Prosocial Obligations

Confirmatory factor analyses were performed on three models using one twin from each pair (randomly assigned;  $n = 1005$ ) to satisfy the assumption of independence: Model 1. A one-factor model, with a latent “prosocial obligations” factor loading directly on each of the obligations items; Model 2. A model with three un-correlated obligations factors (civic, work, and welfare), each loading on their respective items; Model 3. A hierarchical factor model in which a super-ordinate “prosocial obligations” factor loaded on the three obligations domains (civic, work, and welfare), which in turn loaded on their respective items.

Both Model 1 and Model 2 fitted the data poorly. By contrast, Model 3 fitted the data reasonably well, and minor modifications to Model 3 (the inclusion of two residual co-variances) produced a well-fitting model (Model 3a). Path diagrams are shown in Figures A1-A4. Fit statistics are detailed in Table A1.

Table A1 Fit statistics for confirmatory factor analyses on prosocial obligations measures.

|          | $\chi^2$ | df | CFI  | RMSEA |
|----------|----------|----|------|-------|
| Model 1  | 1052.09  | 44 | .710 | .151  |
| Model 2  | 848.94   | 44 | .768 | .135  |
| Model 3  | 305.64   | 41 | .924 | .080  |
| Model 3a | 206.90   | 39 | .955 | .065  |

Figure A1 Path diagram of Model 1: A one-factor model, with a latent 'prosocial obligations' factor loading directly on each of the obligations items.

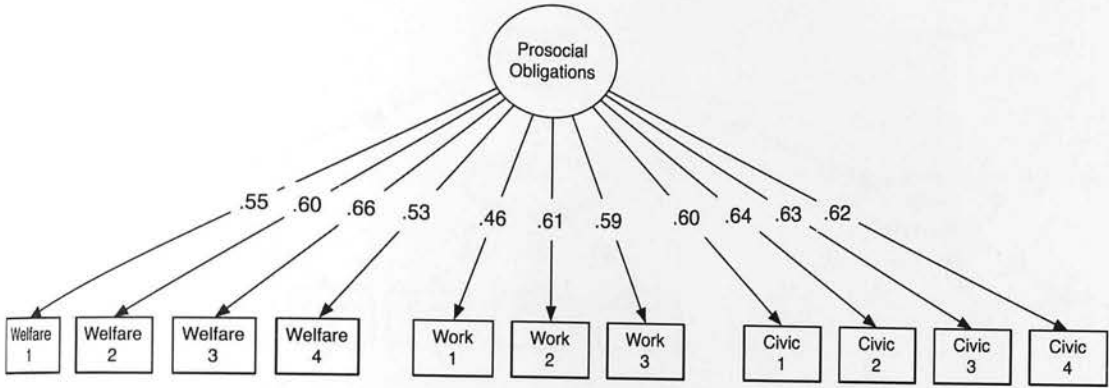


Figure A2 Path diagram of Model 2: A model with three un-correlated obligations factors (civic, work, and welfare), each loading on their respective items.

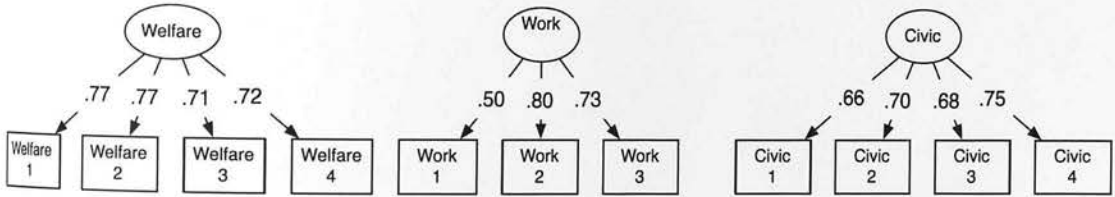


Figure A3 Path diagram of Model 3: A hierarchical factor model with a super-ordinate 'prosocial obligations' factor loading on the three obligations domains (civic, work, and welfare).

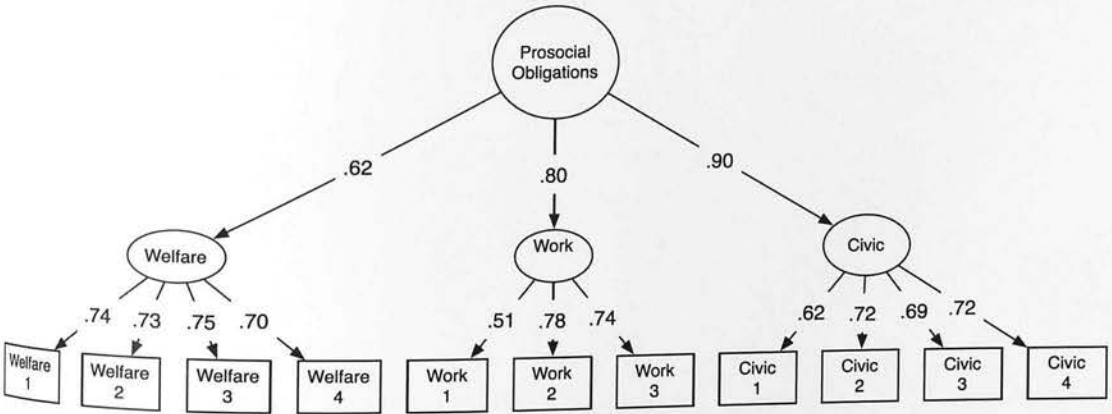
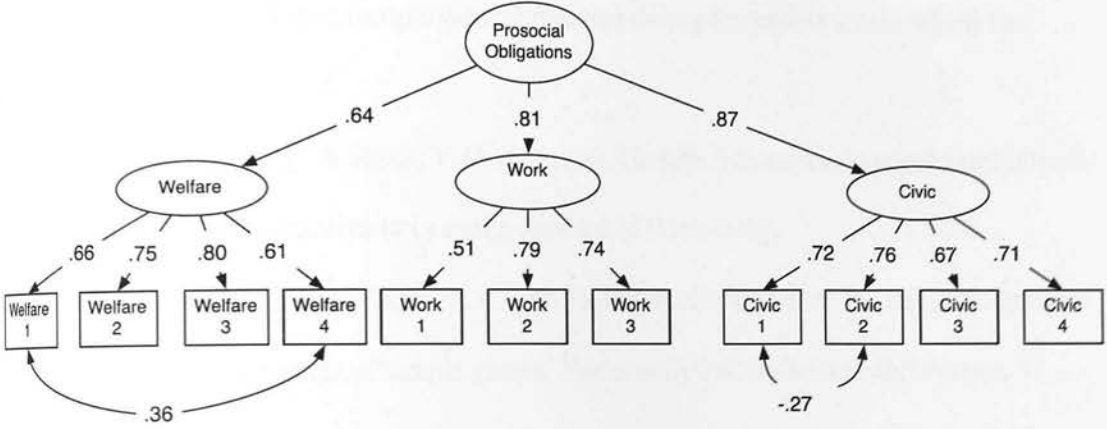


Figure A4 Path diagram of Model 3a: As in Model 3, with the addition of two residual covariances.



## Appendix D - List of Publications and Submitted Manuscripts

The following articles and manuscripts were completed during the period within which this thesis was undertaken:

Archontaki, D., Lewis, G. J., & Bates, T. C. (in press). Genetic influences on psychological well-being: A nationally representative twin study. *Journal of Personality*.

Brocklebank, S., Lewis, G. J., & Bates, T. C. (2011). Personality accounts for stable preferences and expectations across a range of simple games. *Personality and Individual Differences*, 51, 881-886.

Lewis, G. J., & Bates, T.C. (under review). Understanding the genetic bases of religious belief: The role of community integration and existential uncertainty.

Lewis, G. J., & Bates, T. C. (2010). Genetic evidence for multiple biological mechanisms underlying ingroup favoritism. *Psychological Science*, 21, 1623-1628.

Lewis, G. J., & Bates, T. C. (2011a). From left to right: How the personality system allows basic traits to influence politics via characteristic moral adaptations. *British Journal of Psychology*, 102, 546-558.

Lewis, G. J., & Bates, T. C. (2011b). A common heritable factor influences prosocial obligations across multiple domains. *Biology Letters*, 7, 567-570.

Lewis, G. J., Ritchie, S. J., & Bates, T.C. (2011). The relationship between intelligence and multiple domains of religious belief: Evidence from a large adult US sample. *Intelligence*, 39, 468-472.

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