ARTICLE

The long reach of the gene

Gary J. Lewis and **Timothy C. Bates** discuss genetic influence on politics, prejudice and religiosity

One does not have to look very hard to observe that people differ greatly in their social and political attitudes. Views on religion, gun control, free markets, and political parties can divide rooms. But from where do these differences in opinion emerge? And what do genes and biology have to do with this apparently most social of questions?

This essay describes a growing body of work suggesting that our biological makeup influences our social and political attitudes and explores the methods that underpin such claims. The authors argue that the conclusions from this work are increasingly clear: understanding political divides will require biological as well as social explanations.

questions

How much of your politics is influenced by your DNA?

How do genes 'build' social and political attitudes?

What brain mechanisms mediate this pathway from DNA to voting booth?

resources

Ebstein, R.P., Israel, S., Chew, S.H. et al. (2010). Genetics of human social behavior. *Neuron, 65*, 831–844.
www.nchpeg.org/bssr

I often think it's comical;
How 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!
(from Gilbert and Sullivan's *Iolanthe)*

It will come as no news that people differ, often strikingly, in their views on how society should be run. Whereas some value ethnic diversity, others believe non-indigenous individuals should be repatriated to their land of origin, as demonstrated in the views of the anti-immigration British National Party. And while some feel religion ought to play no role in government, others strongly advocate God's law as national law, such as those who support a strict interpretation of Sharia. While these facts are clear to all, the origins of these individual differences in social attitudes remain ill understood, despite having been of enduring interest to psychologists, sociologists, and political scientists. This is unfortunate as one only need bring to mind the shocking terrorist attacks of 7/7 and 9/11 to recognise that attitudes and values can have very real consequences for human lives.

While work in this area has almost exclusively focused on environmental determinants of social and political sentiment, recent evidence strongly implicates a role for genetic factors. In this article we introduce this behaviour genetic approach for understanding aetiologies of social attitudes: one that has been gaining momentum in recent years. We highlight some core as well as recent results in the literature, examine some of the challenges currently facing the field, and investigate possible future paths of research. Before tackling these issues, however, we start with a brief introduction to behaviour genetic methods.

What can twins tell us about the origins of social attitudes?

Although behaviour genetics has come to embody a variety of approaches, perhaps most central to the discipline has been the use of twin and family designs to tease apart the relative genetic and environmental influences underpinning individual differences for a given trait (e.g. height, personality, social attitudes: Plomin et al., 2009). In the classical twin design, researchers utilise a remarkable natural experiment afforded by the fact that human twins come as one of two types. Identical, or monozygotic (MZ), twins arise from a single fertilised egg splitting into two only a few divisions after fertilisation. This process leads to the formation of two blastulas, which share their entire nuclear DNA. In contrast, fraternal, or dizygotic (DZ) twins, like regular siblings, share approximately half of their variable genetic matter. This important difference between the two types of twins provides researchers with a powerful signal concerning the influence of genes and environments for any trait of interest: Given the roughly equal environments experienced between the MZ and DZ twins, if MZ twins reared in the same family are more similar to each other than are DZ twins reared in the same family, this increased similarity is argued to stem from the greater genetic similarity of the MZ twins as compared to the DZ twins. And larger differences between MZ and DZ twin pairs indicate larger genetic, or heritable, effects.

This elegant design, then, has the advantage of separating environmental and genetic effects that are confounded in non-

references

Alford, J.R., Funk, C.L. & Hibbing, J.R. (2005). Are political orientations genetically transmitted? *American Political Science Review, 99*, 153–167.
Amodio, D.M. & Frith, C.D. (2006). Meeting of minds: The medial frontal cortex and social cognition. *Nature Reviews Neuroscience, 7*, 268–277.
Amodio, D.M., Jost, J.T., Master, S.L. & Yee, C.M. (2007). Neurocognitive correlates of liberalism and conservatism. *Nature Neuroscience, 10*, 1246–1247.
Benjamin, D.J., Cesarini, D., van der Loos, M.J.H.M. et al. (2012). The genetic architecture of economic and political preferences. *Proceedings of the National Academy of Sciences of the United States of America*. Published online before print 7 May 2012, doi: 10.1073/pnas.1120666109
Bettelheim, B. (1967). *The empty fortress*. Chicago, IL: Free Press.
Chabris, C.F., Hebert, B.M., Benjamin, D.J. et al. (2012). Most reported genetic associations with general intelligence are probably false positives. *Psychological Science*. doi: 10.1177/0956797611435528
Charney, E. (2008). Genes and ideologies. *Perspectives on Politics, 6*, 299–319.
Cloninger, C.R., Svrakic, D.M. & Przybeck, T.R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50*, 975–990.
Dawes, C.T. & Fowler, J.H. (2009). Partisanship, voting, and the dopamine D2 receptor gene. *Journal of Politics, 71*, 1157–1171.
Deary, I.J., Yang, J., Davies, G. et al. (2012). Genetic contributions to stability and change in intelligence from childhood to old age. *Nature*.

genetic designs. The evolution of theories in the field of autism provides a strong example of the importance of this approach. Autism was once believed by some to arise through a lack of maternal warmth; the so-called 'refrigerator mother' hypothesis (Bettelheim, 1967). What makes this inference vulnerable to confounding is the fact that mothers not only provide environments for their infants, but also transmit genetic factors. As such, while maternal coldness may be *correlated* with autistic traits in the offspring, the aetiology of this association cannot be understood without a design that can successfully distinguish genetic and environmental influences. Application of the twin method revolutionised both research in autism and clinical approaches to the disorder by providing evidence for genetic influences (Folstein & Rutter, 1977).

Assumptions of the twin design

The inferences borne from twin studies depend on assumptions about the mechanisms of inheritance, and questions have been raised concerning the validity of these underlying assumptions (Plomin et al., 2009). For example, the equal environment assumption states that MZ twins are not subject to more similar functional environmental influences than are DZ twins. Indeed, if greater similarities between MZ twins as compared to DZ twins could arise because of more similar environmental experiences, then the inference that genetic factors are involved would no longer be logically justified.

Are differences in social and political attitudes rooted in genetics?

A number of responses to this claim are relevant. Firstly, while it is uncontroversial that MZ twins experience more similar environments than DZ twins in some regards – for instance, MZs are often dressed more similarly (Plomin et al., 2009) – the critical issue concerns whether these more similar treatments cause changes in the measures of interest to the researcher; in this instance, social and political attitudes. The assumption can thus be tested, and it is routine for twin researchers to collect data on treatment of twins, and examine whether or not differences in twins' equal treatment affects their similarity of the trait of interest. In the case of prejudice, political orientation, and religiosity, evidence to date suggests this is not the case (e.g. Martin et al., 1986). It is also hard to understand why parents would (consciously or unconsciously) desire for their identical offspring to be more similar on such social attitudes, but for parents of fraternal twins to be less desirous of such concordance among their offspring. Equally, it is hard to understand how parents could translate such desires into effect, and why particular treatments, such as sharing a style or item of clothing could be effective at changing such beliefs.

Secondly, compelling advances in molecular genetic technologies (the marvellous ability to cheaply measure millions of DNA markers across the genome) have led to breakthroughs in methods estimating heritability, but which avoid the assumptions of the twin design. For example, recent work takes advantage of the fact that siblings, while approximately 50 per cent alike on their variable genetic matter, vary around this average 50 per cent sharing due to chance in individual cases. Some siblings may share as little as 45 per cent of their variable alleles, whereas others may share as much as 55 per cent. This deviation around the average 50 per cent allows researchers to directly assess whether sharing more DNA leads to sharing more similar behaviour. In the case of height, this method has been found to converge on the same heritability estimate as findings from the classical twin design suggesting the assumptions are valid in this case (Visscher et al., 2006). Recently, a conceptually related method, but using gene sharing in unrelated individuals, has confirmed that genetic factors are of substantial importance in the aetiology of general cognitive ability/intelligence (Deary et al., 2012).

In short, twin studies, while by no means perfect, can offer valuable insights into the origins of psychological traits. With this in mind we now turn to some of the core findings behaviour genetics has brought to the study of social and political attitudes.

Genetic insights into social and political attitudes

The earliest genetically informative study of socio-political attitudes was conducted by Eaves and Eysenck (1974), who found that self-reported radicalism (vs. conservatism) and tough-mindedness (vs. tender-mindedness) were both substantially influenced by heritable factors. However, these heterodox findings were not widely cited in the literature (despite being published in *Nature*). This appears to have been due in large part to extended criticisms of genetic explanations of social behaviour and attitudes: biological explanations at this time were simply not in vogue (Segerstråle, 2000).

Some 12 years later a second such article appeared (Martin et al., 1986), replicating the findings of Eaves and Eysenck (1974), and extending the scope of heritable influences on social and political attitudes to include a broader

Published online ahead of print version: doi:10.1038/nature10781

D'Onofrio, B.M., Eaves, L.J., Murrelle, L. et al. (1999). Understanding biological and social influences on religious affiliation, attitudes, and behaviors. *Journal of Personality, 67*, 953–984.

Duckitt, J. & Sibley, C.G. (2010). Personality, ideology, prejudice, and politics: A dual process motivational model. *Journal of Personality, 78*, 1861–1894.

Eaves, L.J. & Eysenck, H.J. (1974). Genetics and the development of social attitudes. *Nature, 249*, 288–289.

Folstein, S. & Rutter, M. (1977). Infantile autism: A genetic study of 21 twin pairs. *Journal of Child Psychology and Psychiatry, 18*, 297–321.

Fowler, J.H., Baker, L.A. & Dawes, C.T. (2008). Genetic variation in political participation. *American Political Science Review, 102*, 233–248.

Fowler, J.H. & Dawes, C.T. (2008). Two genes predict voter turnout. *Journal of Politics, 70*, 579–594.

Hatemi, P., Funk, C.L., Medland, S.E. et al. (2009) Genetic and environmental transmission of political attitudes over a life time. *Journal of Politics, 71*, 1141–1156.

Inzlicht, M., McGregor, I., Hirsh, J.B. & Nash, K. (2009). Neural markers of religious conviction. *Psychological Science, 20*, 385–392.

Kanai, R., Feilden, T., Firth, C. & Rees, G. (2011). Political orientations are correlated with brain structure in young adults. *Current Biology, 21*, 677-680.

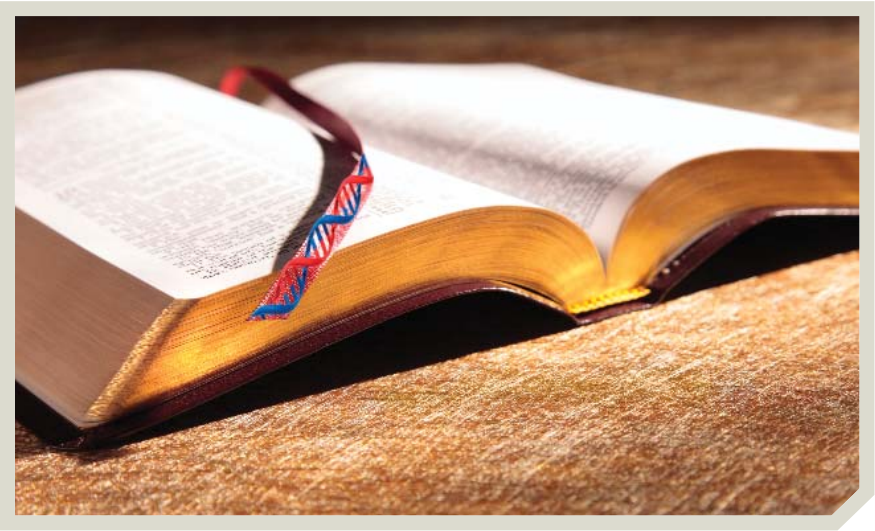
Kurzban, R., Tooby, J. & Cosmides, L. (2001). Can race be erased?

range of social and political issues, including gay rights, the death penalty and abortion. These findings too, however, largely failed to enter mainstream consideration of these results until being revisited in 2005 by political scientist John Alford and colleagues, who presented re-analyses of these data to a wide and influential social and political science audience.

Subsequently, a growing stream of findings has emerged into the literature, replicating and extending these initial findings of genetic influence on social and political attitudes. For instance, Hatemi et al. (2009) found that genetic effects on political attitudes emerge strongly only after children have typically left the family home, with MZ twins converging and DZ twins diverging in similarity around young adulthood (> 20 years of age). And Fowler et al. (2008) observed that the decision to vote at all (voter turnout) is substantially heritable; indeed, more so than party-choice or political attitudes.

Religion

Perhaps the most surprising result to emerge from genetic research into social and political attitudes has been the finding of heritable effects underlying religious beliefs. In an early study, Martin et al. (1986) examined religious attitudes such as observance of the Sabbath, authority of the Church, and truthfulness of the Bible. They found not only significant shared-environment influences (environmental influences that make children in the same family more similar to one another), but also significant genetic effects. Waller et al. (1990) subsequently confirmed these findings showing that religious attitudes and interests contained significant genetic influences. Provocative even 20 years later (e.g. Charney, 2008), these authors concluded that it was now time to 'discard the *a priori* assumption that individual differences in religious and other social attitudes are solely influenced by environmental factors' (p.141).



Religious attitudes and interests contained significant genetic influences

Recently, we ourselves examined the heritable basis of religiosity (Lewis & Bates, 2012b). We again found that religiosity was heritable, but perhaps more interesting was the observation that these heritable influences on religiosity were completely accounted for by genetic influences on traits with no intrinsic religious component; namely, basic sentiment concerning community integration and existential certainty.

In-group favouritism

Unlike politics and religion, the genetic basis of in-group favouritism and prejudice had not been studied at all until recently. Work from our own group demonstrated that in-group favouritism also contains a substantial heritable component (Lewis & Bates, 2010). In this study, we examined the claim that race favouritism (i.e. preferences for members of one's own racial group) is simply one manifestation of a more general 'us vs. them' coalitional mechanism. This claim is based on reasoning that limited exposure to other racial groups over evolutionary time necessarily must have limited any ability of natural selection to shape the human mind towards specific race preferences (Kurzban et al., 2001). Our study found support for a common, and strongly heritable, favouritism 'system' – reflecting in-group bias in the realm of religion, ethnicity and race. Interestingly, however, we also found evidence for specific sets of genetic factors for each of these forms of favouritism: in other words, even when one accounts for the common favouritism system, additional genetic factors appear to influence race favouritism.

The overarching sentiments emerging from these genetic studies of attitudes are twofold. Firstly, genetic influences are evident on a range of social and political traits and behaviours, an observation that sits in contrast to common assumptions in social sciences, although one that should not be ignored if we are to fully unravel the origins of social attitudes. Secondly, genetic architectures of social traits are likely to be both complex and multifaceted, as evidenced, for example,

Coalitional computation and social categorization. *Proceedings of the National Academy of Sciences of the United States of America, 98*, 15387–15392.

Lango Allen, H., Estrada, K., Lettre, G. et al. (2010). Hundreds of variants clustered in genomic loci and biological pathways affect human height. *Nature, 467*, 832–838.

Lesch, K-P., Bengel, D., Heils, A. et al. (1996). Association of anxiety-related traits with a polymorphism in the serotonin transporter gene regulatory region. *Science, 274*, 1527–1531.

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. (2012a). *Common heritable effects underpin concerns for norm-maintenance and in-group favoritism.* Manuscript submitted for publication.

Lewis, G.J. & Bates, T.C. (2012b). *Genetic influences on religiosity are explained by heritable effects on community integration and existential uncertainty.* Manuscript submitted for publication.

Lewis, G.J., Kanai, R., Bates, T.C. & Rees, G. (2012). Moral values are associated with individual differences in regional brain volume. *Journal of Cognitive Neuroscience*. doi:10.1162/jocn_a_00239

Martin, N.G., Eaves, L.J., Heath, A.C. et al. (1986). Transmission of social attitudes. *Proceedings of the National Academy of Sciences of the United States of America, 83*, 4364–4368.

McCrae, R.R. (1996). Social

by the multiple heritable influences underlying in-group favouritism (Lewis & Bates, 2010).

Unmasking genes: Potential for molecular studies?

While twin studies provide clues as to the presence of genetic influences, they of course cannot identify specific alleles that are at work. So, if social and political sentiment contains an underlying heritable basis, what is the likelihood of finding actual DNA markers that influence such attitudes? At the time of writing, only a modest number of molecular genetic studies of social and political attitudes have been reported. Of these early studies, one has linked two alleles (in genes coding for monoamine oxidase and serotonin) to voting participation (Fowler & Dawes, 2008), while a dopamine receptor gene has been associated with variation in partisan attachment (Dawes & Fowler, 2009). Additionally, a recent study addressing gene–environment interaction reported that the number of friends in adolescence was significantly associated with liberal political attitudes, but only for those who possessed the 7R variant of the dopamine receptor D4 gene (DRD4: Settle et al., 2010): The authors argued that individuals high in sensation-seeking – behaviour commonly linked with the dopaminergic system (Cloninger et al., 1993) – are more likely to have desires for novel and unusual experiences, which, to some extent, maps onto a liberal view of the world (McCrae, 1996). Moreover, of such individuals, those who possess a wider social network are suggested to be more likely to develop more liberal attitudes as a function of being exposed to broader socio-political discourses, thus generating the observed interaction.

While these early results are encouraging and certainly provide promise for future research programmes, it is also worth noting that molecular approaches in parallel disciplines – such as psychiatry (Wray & Visscher, 2010), personality (Munafò & Flint, 2011), and cognition (Chabris et al. 2012) – have struggled to reliably identify specific alleles giving rise to individual differences in measured traits. For instance, early work on personality genetics was published amid much fanfare with the belief that the biology of such traits was soon to be within our grasp (e.g. Lesch et al., 1996). Two decades on and the lessons learned seem to be that, while genetic influences do underpin most traits researchers typically investigate, these effects almost certainly arise as the sum action of a very large number of genetic variants. Each of these can exert only a very modest effect (perhaps accounting for variance in the realm of just 0.1 or even 0.01 per cent of variance in a measured trait (Munafò & Flint, 2011). The findings reported above linking specific genetic variants to politics have not (to our knowledge) been replicated in independent samples, and so question marks remain concerning these particular results. Positive and highly repeatable results from studies with tens of thousands of subjects in psychiatry and biology (e.g. Lango Allen et al., 2010) suggest that the genetic bases of social and political attitudes will require similar investments, with such projects now under way (e.g. Benjamin et al., 2012).

What mechanisms mediate the pathway?

Even if molecular markers cannot be easily located, knowledge that genetic factors are at work in shaping social attitudes gives rise to a key question: Through what neurobiological systems do these genetic effects manifest their influence? 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 associations with social and political attitudes. Amodio et al. (2007) reported an association between political conservatism and conflict-related activity during a Go/No-Go task using event-related potentials. The Go/No-go task requires participants to make a response ('go'), or to withhold a response ('no-go'), to specific stimuli, with go trials typically occurring with higher frequency than the irregular no-go trials, which are believed to engage conflicting monitoring systems. Interestingly, the neural activity reported in this study originated in, or near, the anterior cingulate cortex (ACC), a region with known links to conflict monitoring. The authors interpreted this finding as evidence that liberals possess 'greater neurocognitive sensitivity to cues for altering a habitual response pattern' (p.1246). More recently, Inzlicht et al. (2009) supported this association between conservatism/traditionalism and ACC function, finding that greater religious belief – which itself is commonly linked with conservatism – was associated with decreased activity in the ACC following errors 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 noted that establishing direction of causation requires further experimentation.

Neuroanatomical work provides partial support for functional imaging findings linking political conservatism to the ACC and amygdala. For instance, Kanai et al. (2011) recently reported that increased grey matter volume in the ACC and decreased volume of the right amygdala predicts political liberalism in young adults. This association between liberalism and the ACC supports the work noted above forging links between politics and conflict monitoring/response. And the finding that liberals have less grey matter in the amygdala – a region with links to disgust processing and fear conditioning – also converges with behavioural work showing that conservatives tend to be more disgust sensitive and responsive to threat (Oxley et al., 2008). Following on

consequences of experiential openness. *Psychological Bulletin, 120*, 323–337.

Munafò, M.R. & Flint, J. (2011). Dissecting the genetic architecture of human personality. *Trends in Cognitive Science, 15*, 395–400.

Oxley, D.R., Smith, K.B., Alford, J.R. et al. (2008). Political attitudes vary with physiological traits. *Science, 321*, 1667–1670.

Plomin, R., Defries, J.C., McClearn, G.E. & McGuffin, P. (2009). *Behavioral genetics* (5th edn). New York: Worth.

Segerstråle, U. (2000). *Defenders of the truth: The sociobiology debate*. Oxford: Oxford University Press.

Settle, J.E., Dawes, C.T., Christakis, N.A. & Fowler, J.H. (2010). Friendships moderate an association between a dopamine gene variant and political ideology. *Journal of Politics, 72*, 1189–1198.

Toga, A.W. & Thompson, P.M. (2005). Genetics of brain structure and intelligence. *Annual Review of Neuroscience, 28*, 1–23.

Visscher, P.M., Medland, S.E., Ferreira, M.A.R. et al. (2006). Assumption-free estimation of heritability from genome-wide identity-by-descent sharing between full siblings. *PLoS Genetics, 2*, e41.

Waller, N.G., Kojetin, B.A., Bouchard, T.J., Jr. et al. (1990). Genetic and environmental influences on religious interests, attitudes, and values. *Psychological Science, 1*, 138–142.

Wray, N.R. & Visscher, P.M. (2010). Narrowing the boundaries of the genetic architecture of schizophrenia. *Schizophrenia Bulletin, 36*, 14–23.

from this work, Lewis and colleagues (2012) found that moral concerns with (1) limiting harm to others and maximising fairness, and (2) authority deference, group loyalty, and purity/sanctity were associated with grey matter volume in dorsomedial prefrontal cortex and subcallosal gyrus, respectively. While subcallosal gyrus had not been implicated in social attitudes previously, dorsomedial prefrontal cortex is a major hub facilitating social cognition and mentalising (Amodio & Frith, 2006), thus supporting links between this region and concerns over others well-being.

Taken together, these findings begin to lay the foundations for detailed understandings of how genetic factors modulate neurobiology, and in turn generate individual differences in social attitudes. What is not yet understood, however, is whether these brain regions are linked to social attitudes via genetic pathways or environmentally influenced pathways. We are only at the very beginning of the quest to answer such questions; however, social psychological work combining the powerful methods of genetics with cognitive neuroscience techniques (e.g. Toga & Thompson, 2005) may lead to powerful insights into the biological mechanisms that underpin social attitudes.

Genetic factors influencing prejudice were substantially overlapping with measures of traditionalism and right-wing authoritarianism

Mutability of genetic effects

One of the perennial concerns levelled at work purporting to find a genetic basis to traits of central interest to human existence, as social and political attitudes clearly are, is that they suggest determinism and immutable effects. While this criticism is itself often rather ideologically predictable (i.e. criticisms seem directed more frequently when the findings appear to conflict with values), it is certainly true that such immutability, at least in the case of social attitudes, seems to be quite the opposite of what we see around us much of the time: as Winston Churchill noted, 'If you're not a liberal at twenty you have no heart, if you're not a conservative at forty you have no brain', alluding to the notion that context plays an important role in the expression of political attitudes.

Leaving aside the political wrangling, what is clear here is that political affiliations do change, and sometimes markedly. How can genetic studies account for such observations? One answer to this question is that genetic influences on social and political attitudes are unlikely to reflect mechanisms designed to output focal behaviours such as joining specific political parties (e.g. Labour or Conservative), or believing in a specific divine figure: indeed, twin studies show that while strength of religious belief is heritable, the actual denomination one ascribes to is almost entirely attributable to environmental influences (D'Onofrio et al., 1999). Rather, it is more probable that these underlying genetic influences serve to shape somewhat less focal social behaviours, such as general concerns for norm adherence. In support of this notion, interesting recent work by Duckitt and Sibley (2010) suggests prejudice, at least in part, may reflect increased concerns over violations of social norms: out-groups who are perceived as breaking local norms are typically most disliked. We recently tested this hypothesis using a twin sample and found that genetic factors influencing prejudice were substantially overlapping with measures of traditionalism and right-wing authoritarianism (Lewis & Bates, 2012a), both of which are measures reflecting concerns for norm maintenance. It is plausible, then, that mean levels of prejudice are moderated by environmental factors – such as realistic challenges to social norms – but that individual responses to these challenges reflect underlying heritable sensitivities to norm violations.

Final words

We hope this brief journey through the emerging and exciting work applying behaviour genetic methods to the study of social and political attitudes will leave the reader thinking about three key pieces of information.

Firstly, individual differences in social attitudes, in part, appear to contain an underlying genetic basis (in keeping with what is known for a range of other psychological traits). Therefore, any attempt to foster understandings of the socio-political mind will be impoverished without the involvement of a genetically informed approach to such explorations.

Secondly, while genomic technologies have advanced enormously in recent years, we are still a long way from understanding the precise genetic markers that give rise to these heritable individual differences. In fact, it is possible that we may never possess sufficient sample sizes to reliably map the location of these genetic influences, and that the effects we do uncover may be of (extremely) modest size.

Thirdly, while the evidence for genetic influences underlying social attitudes is growing, it is still far from clear what the psychological mechanisms are which mediate these genetic effects on social traits such as political conservatism, religiosity and prejudice; however, this literature is developing rapidly at the time of writing and substantial insights may not be far away.

In summary, we are looking at a bright new approach to social and political psychology, albeit one with many challenges ahead. We are excited to see how the field matures in years to come and what insights into the origins of social attitudes will be gleaned from future research. The new approach challenges existing theories, but creates a revolutionary moment for researchers to provide mechanisms explaining human social behaviour at a deeper level than previously explored.

Gary J. Lewis
is at the Division of Psychology, University of Stirling
glewis1@gmail.com

Timothy C. Bates
is at the Department of Psychology, University of Edinburgh